



**WARREN COUNTY  
CAREER  
CENTER**

## Warren County Career Center

3525 OH-48  
Lebanon, OH 45036

SEPTEMBER 15, 2026  
LPA PROJECT NUMBER: 263306.00

Prepared by:



**LEVIN PORTER  
ARCHITECTS**

3011 NEWMARK DRIVE  
MIAMISBURG, OHIO 45342

Levin Porter Associates Inc. dba Levin Porter Architects

CONSTRUCTION DOCUMENTS

PROJECT MANUAL &  
SPECIFICATIONS

For

## Warren County Career Center Medical Academy Addition

Project Address:

3525 OH-48  
Lebanon, Ohio 45036

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**SECTION 000110**  
**TABLE OF CONTENTS**

**PROCUREMENT AND CONTRACTING REQUIREMENTS**

1.01 DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- A. 001113 - Advertisement for Bids
- B. 002113 - Instructions to Bidders
- C. 004100 - Bid Form
- D. 004500 – Contractor’s Personal Property Tax Affidavit
- E. 004513 – Contractor’s Qualifications Form
- F. 006113 – Bond Form
- G. 006500 – Project Forms
- H. 007200 - General Conditions

**SPECIFICATIONS**

2.01 DIVISION 01 -- GENERAL REQUIREMENTS

- A. 013000 - Administrative Requirements
- B. 013119 – Agreement and Waiver for Use of BIM Files (BCL)
- C. 013216 - Construction Progress Schedule
- D. 014000 - Quality Requirements
- E. 014100 - Regulatory Requirements
- F. 014216 - Definitions
- G. 014219 - Reference Standards
- H. 014533 - Code-Required Special Inspections
- I. 015000 - Temporary Facilities and Controls
- J. 016000 - Product Requirements
- K. 017000 - Execution and Closeout Requirements
- L. 017800 - Closeout Submittals
- M. 017900 - Demonstration and Training

2.02 DIVISION 02 -- EXISTING CONDITIONS

020342 - Removal and Salvage of Period Construction Materials

- A. 024100 – Demolition

2.03 DIVISION 03 -- CONCRETE

- A. 032000 - Concrete Reinforcing
- B. 033000 - Cast-in-Place Concrete
- C. 033005 - Moisture Vapor Reducing Admixture for Cast-in-Place Concrete - ISE Logik
- D. 033511 - Concrete Floor Finishes

2.04 DIVISION 04 -- MASONRY

- A. 040100 - Maintenance of Masonry
- B. 040511 - Masonry Mortaring and Grouting
- C. 042000 - Unit Masonry
- D. 042613 - Masonry Veneer
- E. 047200 - Cast Stone Masonry

2.05 DIVISION 05 -- METALS

- A. 055133 - Metal Ladders
- B. 055213 - Pipe and Tube Railings

2.06 DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

- A. 061000 - Rough Carpentry
- B. 061600 - Sheathing - USG
- C. 062000 - Finish Carpentry
- D. 064100 - Architectural Wood Casework

2.07 DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

- A. 070150.19 - Preparation for Re-Roofing
- B. 071113 - Bituminous Dampproofing
- C. 071400 - Fluid-Applied Waterproofing
- D. 071900 - Water Repellents
- E. 072100 - Thermal Insulation
- F. 072123 - Loose-Fill Insulation
- G. 072500 - Weather Barriers
- H. 072600 - Vapor Retarders
- I. 072700 - Air Barriers
- J. 074213 - Metal Wall Panels
- K. 075400 - Thermoplastic Membrane Roofing
- L. 076200 - Sheet Metal Flashing and Trim
- M. 077100 - Roof Specialties
- N. 077200 - Roof Accessories
- O. 078100 - Applied Fire Protection
- P. 078400 - Firestopping
- Q. 079200 - Joint Sealants
- R. 079513 - Expansion Joint Cover Assemblies

2.08 DIVISION 08 -- OPENINGS

- A. 080671 - Door Hardware Schedule
- B. 081113 - Hollow Metal Doors and Frames
- C. 081116 - Aluminum Doors and Frames

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- D. 081416 - Flush Wood Doors
- E. 083100 - Access Doors and Panels
- F. 084313 - Aluminum-Framed Storefronts
- G. 085113 - Aluminum Windows
- H. 087100 – Door Hardware and Schedule
- I. 088000 - Glazing
- J. 088300 – Mirrors

## 2.09 DIVISION 09 -- FINISHES

- A. 090561 - Common Work Results for Flooring Preparation
- B. 092116 - Gypsum Board Assemblies
- C. 092216 - Non-Structural Metal Framing
- D. 092400 - Cement Plastering
- E. 095100 - Acoustical Ceilings
- F. 099113 - Exterior Painting
- G. 099123 - Interior Painting
- H. 099300 - Staining and Transparent Finishing
- I. 099600 - High-Performance Coatings

## 2.10 DIVISION 10 -- SPECIALTIES

- A. 101100 - Visual Display Units
- B. 102123 - Cubicle Curtains and Track
- C. 102600 - Wall and Door Protection
- D. 102800 - Toilet, Bath, and Laundry Accessories
- E. 104400 - Fire Protection Specialties
- F. 105617 - Wall Mounted Standards and Shelving

## 2.11 DIVISION 11 -- EQUIPMENT

- A. Not Used

## 2.12 DIVISION 12 -- FURNISHINGS

- A. 122400 - Window Shades
- B. 123200 - Manufactured Wood Casework
- C. 123600 - Countertops

## 2.13 DIVISION 13 – SPECIAL CONSTRUCTION

- A. Not Used

2.14 DIVISION 14 -- CONVEYING EQUIPMENT

- A. Not Used

2.15 DIVISION 21 -- FIRE SUPPRESSION

- A. 210001 – Basic Fire Suppression Requirements
- B. 210002 – Fire Suppression Work in Existing Buildings
- C. 210004 – Firestopping for Fire Suppression Systems
- D. 21 0519 – Meters and Gauges
- E. 210529 – Pipe Hangers and Supports
- F. 210553 – Identification for Fire Suppression Systems
- G. 211313 – Wet-Pipe Sprinkler Systems

2.16 DIVISION 22 -- PLUMBING

- A. 220001 – Basic Plumbing Requirements
- B. 220002 – Plumbing Work in Existing Buildings
- C. 220004 – Firestopping for Plumbing Systems
- D. 220005 – Excavation, Backfill and Surface Restoration
- E. 220519 – Meters and Gauges
- F. 220523 – General Duty Valves
- G. 220529 – Pipe Hangers, Supports, and Penetrations
- H. 220530 – Equipment bases and Supports
- I. 220553 – Identification for Plumbing Systems
- J. 220719 – Pipe Insulation
- K. 220800 – Plumbing Commissioning
- L. 221116 – Domestic Water Piping
- M. 221119 – Domestic Water Piping Specialties
- N. 221123 – Domestic water Pumps
- O. 221316 – Sanitary Waste and Vent Piping
- P. 221319 – Sanitary Waste Piping Specialties
- Q. 221416 – Interior Storm Piping
- R. 221423 – Storm Drainage Piping Specialties
- S. 221613 – Natural Gas House Piping
- T. 223436 – Gas Fired Storage Water Heaters
- U. 224200 – Plumbing Fixtures

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

- A. 230001 – Basic HVAC Requirements
- B. 230006 – Agreement and Waiver for Use of Electronic Files
- C. 230513 – Electrical Requirements for HVAC Equipment
- D. 230530 – Equipment Bases and Supports

- E. 230548 – Vibration Control
- F. 230553 – Identification for HVAC Systems
- G. 230593 – Testing, Adjusting and Balancing
- H. 230713 – Duct Insulation
- I. 230913 – Instruments and Control Devices
- J. 230914 – Control Wiring and Cabling
- K. 230923 – Direct Digital Control System
- L. 233113 – Ductwork
- M. 233300 – Air Duct Accessories
- N. 233400 – Fans
- O. 233600 – Air Terminal Units
- P. 233713 – Diffusers, Registers, Grilles, and Louvers
- Q. 237413 – Packaged, Outdoor, Air Handling Units

## 2.18 DIVISION 25 -- INTEGRATED AUTOMATION

- A. Not Used

## 2.19 DIVISION 26 -- ELECTRICAL

- A. 260001 – Basic Electrical Requirements
- B. 260004 – Firestopping for Electrical Systems
- C. 260005 – Excavation, Backfill and Surface Restoration
- D. 260519 – Low-Voltage Electrical Power Conductors and Cables
- E. 260526 – Grounding and Bonding for Electrical Systems
- F. 260529 - Hangers and Supports for Electrical Systems
- G. 260533 – Raceway and Boxes for Electrical Systems
- H. 260543 – Underground Ducts and Raceways for Electrical Systems
- I. 260553 – Identification for Electrical Systems
- J. 260563 – Specific Wiring Applications
- K. 260923 – Lighting Control Devices
- L. 262213 – Low-Voltage Distribution Transformers
- M. 262416 – Panelboards
- N. 262726 – Wiring Devices
- O. 262813 – Fuses
- P. 262816 – Enclosed Switches and Circuit Breakers
- Q. 264313 – Surge Protective Devices (SPD) for Low-Voltage Electrical Power Circuits
- R. 265113 – Interior Lighting Fixtures
- S. 265600 – Exterior Area Lighting
- T. 266103 – Fire Detection and Alarm System

2.20 DIVISION 27 -- COMMUNICATIONS

- A. 270500 – Common Work Results for Communications
- B. 270525 – Firestopping
- C. 270526 – Grounding and Bonding for Communications Systems
- D. 270528 – Pathways for Communications Systems
- E. 270553 – Identification for Communications Systems
- F. 271100 – Communications Equipment Room Fittings
- G. 271300 - Communications Backbone Cabling
- H. 271500 – Communications Horizontal Cabling
- I. 272100 – Data Communications Network Equipment
- J. 272133 – Data Communications Wireless Access Points
- K. 274119 – Audio-Visual Systems and Equipment
- L. 275123 – IP Central Sound / Master Clock System
- M. 275127 – Classroom Sound Reinforcement Systems
- N. 275313 – Clock Systems

2.21 DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

- A. 280513 – Conductors and Cables for Electronic Safety and Security
- B. 281300 – Access Control System
- C. 281600 – Intrusion Detection System
- D. 282300 – Video Surveillance
- E. 284800 – Emergency Responder Communication Enhancement System (ERCES)

2.22 DIVISION 31 -- EARTHWORK

- A. 311000 – Site Clearing
- B. 312000 – Earth Moving
- C. 321216 – Asphalt Paving
- D. 321313 - Concrete
- E. 323113 – Chain Link Fences and Gates
- F. 331100 – Water Distribution
- G. 333100 – Sanitary Sewers
- H. 334100 – Storm Drainage

2.23 DIVISION 32 -- EXTERIOR IMPROVEMENTS

- A. Not Used



|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

2.24 DIVISION 33 -- UTILITIES

A. Not Used

2.25 DIVISION 34 -- TRANSPORTATION

A. Not Used

2.26 DIVISION 40 -- PROCESS INTEGRATION

A. Not Used

2.27 DIVISION 46 -- WATER AND WASTEWATER EQUIPMENT

A. Not Used

**SECTION 001113**  
**ADVERTISEMENT FOR BIDS**  
**INVITATION TO BID**

WARREN COUNTY CAREER CENTER  
MEDICAL ACADEMY ADDITION  
3525 OH-48  
Lebanon, Ohio 45036

Separate sealed bids for furnishing all labor, materials, and equipment necessary for the construction of the new Medical Academy Addition as specified, will be received by the Office of the Treasurer, Warren County Career Center on **October 5 at 2:00 P.M. (local time)** and will be opened and read aloud at that time at the above address.

Bids may be mailed or delivered in person to the Treasurer, Katrina Hillard, Warren County Career Center Admin Office, 3529 North State Route 48, Lebanon, Ohio 45036. Bids received after 2:00 P.M. (local time) will be returned unopened. No bids received through FAX or electronic transmission will be accepted.

Qualified Bidders may obtain digital sets of bidding documents after September 15, 2026 by contacting Mike Huff at [mhuff@levin-porter.com](mailto:mhuff@levin-porter.com). Documents will be distributed via electronic pdf file only (no fee).

A pre-bid conference will be held on September 21, 2026 at 3:00 P.M. at the Warren County Career Center in the Media Center, 3525 North Ste Route 48. The pre-bid conference is not mandatory but highly encouraged.

A bid security in the form of a Bid Bond in accordance with Chapter 153.54 of the Ohio Revised Code in the amount of 100 percent of the total bid shall accompany each bid, or a certified check, cashier's check, or letter of credit pursuant to Chapter 1305 of the Ohio Revised Code in the amount of 10 percent of the total bid shall accompany each bid.

The successful bidder(s) will be required to furnish a satisfactory performance bond for one hundred (100%) of the contract price.

No bidder may withdraw his bid within 60 days after the actual date of the bid opening.

The Board of Education reserves the right to reject each and every bid, and to waive informalities and errors in bidding to the extent permitted by law. This includes the right to extend the date and time for receipts of bids.

BOARD OF EDUCATION  
Warren County Career Center

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

By: Katrina Hillard, Treasurer

**END OF SECTION**

**SECTION 002113**  
**INSTRUCTIONS TO BIDDERS**

|    |                                                                                                |                                     |
|----|------------------------------------------------------------------------------------------------|-------------------------------------|
| A. | BIDDER'S PLEDGE AND AGREEMENT .....                                                            | 1                                   |
| B. | EXAMINATION OF CONTRACT DOCUMENTS AND SITE CONDITIONS AND RELIANCE<br>UPON TECHNICAL DATA..... | 1                                   |
| C. | PROJECT .....                                                                                  | 2                                   |
| D. | WORK .....                                                                                     | 2                                   |
| E. | ESTIMATE OF COST .....                                                                         | <b>Error! Bookmark not defined.</b> |
| F. | CONTRACT DOCUMENTS AND PRE-BID MEETING .....                                                   | 2                                   |
| G. | PREPARATION OF BIDS .....                                                                      | 3                                   |
| H. | METHOD OF AWARD .....                                                                          | 5                                   |
| I. | EXECUTION OF CONTRACT .....                                                                    | 8                                   |
| J. | SUBSTITUTIONS/NON-SPECIFIED PRODUCTS.....                                                      | 8                                   |
| K. | ALTERNATES.....                                                                                | 9                                   |
| L. | UNIT PRICES .....                                                                              | 9                                   |
| M. | ADDENDA.....                                                                                   | 9                                   |
| N. | INTERPRETATION.....                                                                            | 10                                  |
| O. | STATE SALES AND USE TAXES .....                                                                | 11                                  |
| P. | DATE FOR SUBSTANTIAL COMPLETION/ DATE FOR FINAL COMPLETION /LIQUIDATED<br>DAMAGES .....        | 11                                  |
| Q. | OWNER'S RIGHT TO WAIVE DEFECTS AND IRREGULARITIES.....                                         | 11                                  |
| R. | MODIFICATION/WITHDRAWAL OF BIDS.....                                                           | 11                                  |
| S. | COMPLIANCE WITH APPLICABLE LAWS.....                                                           | 12                                  |
| T. | FINDINGS FOR RECOVERY .....                                                                    | 12                                  |

**A. BIDDER'S PLEDGE AND AGREEMENT**

1. **Each Bidder acknowledges that this is a public project involving public funds and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. Each Bidder by submitting a bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Design Professional, (b) it will use its best efforts to cooperate with the Owner and the Design Professional and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Design Professional, and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.**

**B. EXAMINATION OF CONTRACT DOCUMENTS AND SITE CONDITIONS AND RELIANCE UPON TECHNICAL DATA**

1. Each Bidder shall have a competent person carefully and diligently review each part of the Contract Documents, including the Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors, or omissions in the Contract Documents for which it has not notified the Design Professional in writing at least ten (10) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors, or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment, or materials of the better quality or greater quantity of Work and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any Change Order, additional compensation, or additional time on account of such conditions for any conflicts, inconsistencies, errors, or omissions that would have been discovered by such careful and diligent review, unless it has given prior written notice to the Design Professional.
2. Each Bidder shall have a competent person carefully and diligently inspect and examine the entire site and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, including location, condition, and layout of the site and the location of utilities, and carefully correlate the results of the inspection with the requirements of the Contract Documents. The Bidder's bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of such conditions.
3. The Bidder may rely upon the general accuracy of any technical data identified in the Owner-Contractor Agreement (e.g., any soils exploration reports, soil boring logs, site survey, or abatement reports) in preparing its bid, but such technical data are not part of the Contract Documents. Except for the limited reliance described in the preceding sentence, Bidder may not, if awarded a contract for the Work, rely upon or make any Claim against the Owner or Design Professional, or any of their agents or employees, with respect to any of the following:
  - (a) the completeness of such reports and drawings for Bidder's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by the successful Bidder and safety precautions and programs incident thereto; or

- (b) any interpretation by the successful Bidder of or conclusion drawn from any technical data or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by the Bidder to estimate locations or quantities of subsurface strata are independent factual assumptions, which Owner does not warrant.
- 4. Each Bidder will be deemed to have actual knowledge of all information provided or discussed at the pre-bid meeting.

#### **C. PROJECT**

1. The Project is the Warren County Career Center - Medical Academy Addition ("the Project"). The Project and Work for the Project consists of 19,395 square foot addition to the existing Warren County Career Center, in accordance with the Drawings and Specifications prepared by the Design Professional.
2. The Design Professional for the Project is:

Levin Porter Associates, Inc.  
3011 Newmark Drive  
Miamisburg, Ohio 45342  
Design Professional Representative: Mark Wiseman, AIA, LEED AP  
Email: mwiseman@levin-porter.com

#### **D. WORK**

1. Only one contract will be issued by the Owner for constructing the Project, the General Contract, which will cover all scopes of work necessary to construct the Project.
2. The Contractor awarded the General Contract (General Contractor) will be responsible for the performance and coordination of any and all subcontractors and suppliers either directly or indirectly contracted with the General Contractor.
3. Owner may provide Bidders access to the Project site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations and Owner's policies relative to excavation and utility locates. **Outside of the pre-bid conference**, Bidders may visit the site by contacting Joel King, Superintendent, at joel.king@mywccc.org to set an appointment.

#### **E. ESTIMATE OF COST**

1. The total estimated construction cost for the base bid is \$7,250,000

#### **F. CONTRACT DOCUMENTS AND PRE-BID MEETING**

1. The Contract Documents consist of the Contract Documents listed in Section 1 of the Owner-Contractor Agreement.
2. Electronic copies of the Contract Documents will be available by request, from the office of the Architect, Mark Wiseman, at mwiseman@levin-porter.com.
3. Bidders shall use complete sets of Contract Documents in preparing bids. Neither the Owner nor the Design Professional assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

4. The Owner or the Design Professional, in making the Contract Documents available on the above terms, does so only for the purpose of obtaining bids on the Work and does not confer a license or grant for any other use.
5. A pre-bid conference will be held on **September 21<sup>st</sup> 2026 at 10:00 am** at the Warren County Career Center, **Room xxx**, 3525 North State Route 48, Lebanon, Ohio 45036.

Attendance is highly recommended. The Owner shall not be held liable if a bidder is unable to attend due to technical or other issues or obstructions.

#### **G. PREPARATION OF BIDS**

1. All bids must be submitted on the "Bid Form" furnished with the Contract Documents.
2. All blank spaces shall be filled in, in ink or typewritten, in words and figures, and in figures only where no space is provided for words, and signed by the Bidder. The wording on the Bid Form shall be used without change, alteration, or addition. Any change in the wording or omission of specified accompanying documents may cause the bid to be rejected. If there is an inconsistency or conflict in the bid amount, the lowest amount shall control, whether expressed in numbers or words.
3. Bidders shall note receipt of Addenda on the Bid Form. If the Bidder fails to acknowledge receipt of each Addendum, the Bid shall be deemed non-responsive, unless the Bid amount clearly and unambiguously reflects receipt of the Addendum or the Addendum involves only a matter of form and does not materially affect the price, quantity or quality of the Work to be performed.
4. Each Bidder shall submit **2 originals** of its bid to the Owner. The Bid Form shall be signed with the name typed or printed below the signature. A Bid shall not be submitted by facsimile transmission or any other electronic means. A Bidder that is a corporation shall sign its bid with the legal name of the corporation followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.
5. Bids shall be enclosed in a sealed opaque envelope with the Bidder's name, plainly marked on the outside **"WARREN COUNTY CAREER CENTER MEDICAL ACADEMY ADDITION PROJECT BID,"** and addressed as follows:

**Warren County Career Center  
ATTN: Joel King, Superintendent  
3525 State Route 48  
Lebanon, Ohio 45036**

Bids must be received at the location designated above before

**2:00 P.M., local time October 5TH, 2026.**

**Hand deliveries to this location are preferred. Respondents are responsible for confirming current operating hours.**

**A public bid opening** will take place at the Warren County Career Center, **Room xxx**, 3525 State Route 48, Lebanon, Ohio 45036 immediately following the bid submission deadline.

The Owner shall not be held liable if a bidder is unable to attend due to technical or other issues or obstructions.

6. **The completed Bid Form shall be accompanied by the following completed documents:**  
**Bid Guaranty and if applicable, Contract Bond (See Paragraph G.8 below.)**  
**Contractor's Qualification Statement (See Paragraph H.4 below.)**

7. The Bidder shall take the following precautions in preparing its bid:

- a. Sign the bid and check to ensure all blank spaces have been filled in with requested information and that the specified accompanying documents (listed in Paragraph G.6 above) have been included in a sealed opaque envelope addressed as described in item Paragraph G.5 above.
- b. When the Bid Form provides for quoting either an addition or deduction for an Alternate item, indicate whether the sum named is an addition or deduction. If it is not indicated, it will be conclusively presumed that the amount is a deduction.
- c. When the Bid Form provides for quoting a unit price, the Bidder should quote the unit price as set forth in the Contract Documents and as described in Paragraph L.1 below.
- d. When applicable, make sure that the Bid Guaranty is properly executed and signed by:
  - 1) The Bidder
  - 2) The Surety or Sureties
- e. Make sure that the amount of the Bid Guaranty (if the Bid Guaranty is in the form of a certified check, letter of credit, or cashier's check) is for a specific sum in an amount as instructed in Paragraph G.8.a below. If the Bid Guaranty is in the form of the Bid Guaranty and Contract Bond, the amount may be left blank; if an amount is inserted, it must equal the total of the base bid plus the amount of all add alternates included in the bid. If inserted, then the failure to state an amount equal to the total of the base bid and all add alternates shall make the bid non-responsive if the Owner selects alternates not included in the amount.
- f. Make sure that the appropriate bid package and scope of work is inserted in the correct space on the Bid Guaranty and Contract Bond Form. Failure to include work covered by the bid submitted may make the bid non-responsive.

8. Bonds and Guarantees

- a. **Bid Guaranty:** Bidder shall furnish a Bid Guaranty, in the form prescribed in Sections 153.54, 153.57, and 153.571 of the Ohio Revised Code, in the form of either: (1) a bond for the full amount of the Base Bid plus the amount of all Add Alternates included in the Bidder's bid, in the form of the Bid Guaranty and Contract Bond included in the Contract Documents; or (2) a certified check, cashier's check, or irrevocable letter of credit in a form satisfactory to the Owner in an amount equal to 10% of the bid. Bid amount shall be the total of all sums bid, including all add alternatives, but excluding all deduct alternatives. NOTE: AIA or EJCDC Bid Bond forms are not acceptable.
- b. **Contract Bond:** The successful Bidder, who, as a Bid Guaranty, submits a certified check, cashier's check, or irrevocable letter of credit in an amount equal to 10% of the bid, shall furnish a Contract Bond in the form Contract Bond included in the Contract Documents in an amount equal to 100% of the Contract Sum. NOTE: AIA or EJCDC Bond forms are not acceptable.
- c. The bond must be issued by a surety company authorized by the Ohio Department of Insurance to transact business in the State of Ohio and acceptable to the Owner. The bond must be issued by a surety capable of demonstrating a record of competent underwriting, efficient management, adequate reserves, and sound investments. These criteria will be deemed to be met if the surety currently has an A.M. Best Company Policyholders Rating of "A-" or better and has or exceeds the Best Financial Size Category of Class VI. Other sureties may be acceptable to the Owner, in its sole discretion



- d. All bonds shall be signed by an authorized agent of an acceptable surety and by the Bidder.
- e. Surety bonds shall be supported by credentials showing the Power of Attorney of the agent, a certificate showing the legal right of the Surety Company to do business in the State of Ohio, and a financial statement of the Surety.
- f. The Bid Guaranty, as applicable, shall be in the name of or payable to the order of the Owner.
- g. The name and address of the Surety and the name and address of the Surety's Agent should be typed or printed on each bond.

#### H. METHOD OF AWARD

1. **All bids shall remain open for acceptance for sixty (60) days** following the day of the bid opening, but the Owner may, in its sole discretion, release any bid and return the Bid Guaranty prior to that date. The Bid Guaranty shall be subject to forfeiture, as provided in the Ohio Revised Code, if a bid is withdrawn during the period when bids are being held.
2. The Owner reserves the right to reject any, part of any, or all bids and to waive any informalities and irregularities. The Bidder expressly acknowledges this right of the Owner to reject any or all bids or to reject any incomplete or irregular bid. Bidders must furnish all information requested on or accompanying the Bid Form. Any false representations or failure to provide information may result in disqualification of the bid.
3. Determination of the Lowest Responsible Bid. Subject to the right of the Owner to reject any or all bids, the Owner will award the Contract for the Work to the bidder submitting the lowest responsible bid that is responsive to the bidding requirements, taking into consideration accepted alternates. In evaluating bids, the Owner may consider the qualifications of the Bidders, whether or not the bids comply with the prescribed requirements, and alternates and unit prices, if requested, on the Bid Form. The Owner may also consider the qualifications and experience of subcontractors and suppliers. The Owner may conduct such investigations as are deemed necessary to establish the qualifications and financial ability of the Bidder and its subcontractors and suppliers. The factors the Owner may consider in determining which bid is the lowest responsible include the factors set forth below. The Owner, in its discretion, may consider and give such weight to these criteria as it deems appropriate.
  - a. The Bidder's work history. The Bidder should have a record of consistent customer satisfaction and of consistent completion of projects, including projects that are comparable to or larger and more complex than the Owner's Project, on time and in accordance with the applicable Contract Documents, and based upon the Bidder's claims history. If the Bidder's management operates or has operated another construction company, the Owner may consider the work history of that company in determining whether the Bidder submitted the lowest responsible bid.

The Owner will consider the Bidder's prior experience on other projects of similar scope and/or complexity including prior projects with the Owner and/or Design Professional, including the Bidder's demonstrated ability to complete its work on these projects in accordance with the Contract Documents and on time, and will also consider its ability to work with the Owner and Design Professional as a willing, cooperative, and successful team member. Bringing overstated claims, an excessive number of claims, acting uncooperatively, and filing lawsuits against project owners and/or their design professionals on prior projects of similar scope and/or complexity will be deemed evidence of a Bidder's inability to work with the Owner and Design Professional as a willing, cooperative, and successful team member.

The Bidder authorizes the Owner and its representatives to contact the owners and design professionals (and construction managers, if applicable) on projects on which the Bidder has worked and authorizes and requests such owners and design professionals (and construction managers) to provide the Owner with a candid evaluation of the Bidder's

performance. By submitting its bid, the Bidder agrees that if it or any person, directly or indirectly, on its behalf or for its benefit brings an action against any of such owners or design professionals (or construction managers) or the employees of any of them as a result of or related to such candid evaluation, the Bidder will indemnify and hold harmless such owners, design professionals (and construction managers) and the employees of any of them from any claims, whether or not proven, that are part of or are related to such action and from all legal fees and expenses incurred by any of them arising out of or related to such legal action. This obligation is expressly intended for the benefit of such owners, design professionals (and construction managers), and the employees of each of them.

- b. The Bidder's financial ability to complete the Contract successfully and on time without resort to its Surety.
  - c. The Bidder's prior experience with similar work on comparable or more complex projects.
  - d. The Bidder's prior history for the successful and timely completion of projects, including the Bidder's history of filing claims and having claims filed against it.
  - e. The Bidder's equipment and facilities.
  - f. The adequacy, in numbers and experience, of the Bidder's work force to complete the Contract successfully and on time.
  - g. The Bidder's compliance with federal, state, and local laws, rules, and regulations, including but not limited to the Occupational Safety and Health Act and Ohio ethics laws.
  - h. The Bidder's participation in a drug-free workplace program acceptable to the Owner, and the Bidder's record for both resolved and unresolved findings of the Auditor of State for recovery as defined in Section 9.24 of the Ohio Revised Code.
  - i. The Owner's prior experience with the Bidder's surety.
  - j. The Bidder's interest in the Project as evidenced by its attendance at any pre-bid meetings or conferences for bidders.
  - k. Depending upon the type of the work, other essential factors, as the Owner may determine and as are included in the Specifications.
  - l. The number of years the Bidder has been actively engaged as a contractor in the construction industry.
  - m. Financial responsibility demonstrated by the Bidder and whether Bidder possesses adequate resources and availability of credit, the means and ability to procure insurance and acceptable performance bonds required for the Project and whether any claims have been made against performance bonds secured by the bidder on other construction projects.
  - n. The foregoing information with respect to each of the Subcontractors and Suppliers that the Bidder intends to use on the Project.
4. **Qualifications Statement.** Each Bidder will submit with its bid a completed Contractor Qualifications Statement, which is included with the Contract Documents, and thereafter provide the Design Professional promptly with such additional information as the Design Professional may request regarding the Bidder's qualifications. A Bidder shall submit any requested additional information within 24 hours of the date on the request.
5. The failure to submit requested information on a timely basis may result in the determination that the Bidder has not submitted the lowest responsible bid.
6. By submitting its bid, the Bidder agrees that the Owner's determination of which bidder is the lowest responsible bidder shall be final and conclusive, and that if the Bidder or any person on its behalf challenges such determination in any legal proceeding, whether or not proven, the Bidder will indemnify and hold the Owner and its employees and agents harmless from any claims included or related to such legal proceeding, whether or not proven, and from legal fees and expenses incurred by the Owner, its employees, or agents that arise out of or are related to such challenge.

**7. After bid opening, within 24 hours of a request made by the Owner or Design Professional, the apparent low Bidder and any other Bidder so requested must submit the following:**

- a. SUBCONTRACTORS:** For all subcontracts with an estimated value of at least \$20,000, a list of all Subcontractors that the Bidder will use to construct the Project, as well as an indication of whether or not the Bidder has ever worked with a proposed Subcontractor before, including the following information for the three most recent projects on which the Bidder and each Subcontractor have worked together:

- Project Owner
- Project Name
- Subcontract Scope
- Subcontract Value
- Owner's contact name and phone number.

If Bidder and a proposed Subcontractor have not worked together on at least three projects in the five years, Bidder must submit the information set forth above for the three most recent similar projects to the Project that a proposed Subcontractor has worked on.

The above Subcontractor information, as well as the information pertaining to each proposed Subcontractor, shall be used in the Owner's determination of the lowest responsible bid.

Once a Bidder identifies its proposed Subcontractors as set forth herein, and Owner makes no objections, the list shall not be changed unless written approval of the change is authorized by the Owner and Design Professional.

- b. FINANCING:** The following additional financial information is not a public record under Ohio Revised Code Section 149.43 and will be kept confidential, except under proper order of a court, per Ohio Revised Code Section 9.312(A).

i. Provide a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

- Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);
- Net Fixed Assets;
- Other Assets;
- Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes); and
- Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

ii. Provide the name and address of firm preparing attached financial statement, and date thereof.

iii. If the attached financial statement is not for the identical organization named in the completed Contractor's Qualification Statement submitted with the bid, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidary).

8. Affidavit as to Personal Property Taxes. Each successful Bidder shall submit, prior to the time of the entry into the Contract, an affidavit in the form required by Section 5719.042, Ohio Revised Code, regarding the status of the Bidder's personal property taxes. A copy of the affidavit form is included with the Contract Documents.
9. No Bidder may withdraw its bid within **sixty (60)** days after the date bids are opened. The Owner reserves the right to waive any formalities or irregularities or to reject any or all bids.
10. The Owner reserves the right to disqualify bids, before or after opening, upon evidence of collusion with intent to defraud or other illegal practices on the part of the Bidder.
11. Award of Contract. The award of the Contract, when required, will only be made pursuant to a duly adopted resolution of the Owner.

#### **I. EXECUTION OF CONTRACT**

1. Within the time designated by the Owner or Design Professional after award of the Contract, the successful Bidder shall execute and deliver to the Owner or Design Professional the required number of copies of the Owner-Contractor Agreement, in the form included in the Contract Documents, and all accompanying documents requested, including, but not limited to, a Contract Bond (if applicable), insurance certificates, and a valid Workers' Compensation Certificate. The successful Bidder shall have no property interest or rights under the Owner-Contractor Agreement until the Agreement is executed by the Owner.

#### **J. SUBSTITUTIONS/NON-SPECIFIED PRODUCTS**

1. Certain brands of material or apparatus are specified. Each bid will be based on these brands, which may be referred to in the Contract Documents as Standards. The use of another brand (referred to as a substitution or proposed equal in the Contract Documents, when a bidder or the contractor seeks to have a different brand of material or apparatus than that specified approved by the Owner for use in the Project) may be requested as provided herein.
2. The products specified in the Contract Documents establish a standard of required function, dimension, appearance, and quality.
3. Bidders wishing to obtain approval to bid non-specified products shall submit written requests to the Design Professional a minimum of ten (10) calendar days before the bid date and hour. To facilitate the submission of requests, a Pre-Bid Substitution Form is included in the Contract Documents. The Bidder shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution, including the name of the proposed manufacturer and/or product and a complete description of the proposed product including the manufacturer's name and model number or system proposed, drawings, product literature, performance and test data, color selections or limitations, and any other information necessary for evaluation. Include a statement including any changes in other materials, equipment, or other work that would be required if the proposed product is incorporated in the materials, equipment, or other work that would be required if the proposed product is incorporated in the work. The burden of proof of the merit of the proposed product is on the proposer. The Design Professional's decision on approval of a proposed product will be final.

The following will be cause for rejection of a proposed substitution:

- a. Requests submitted by subcontractors, material suppliers, and individuals other than Bidders;

- b. Requests submitted without adequate documentation;
  - c. Requests received after the specified cut-off date.
4. When the Design Professional approves a product submission before receipt of bids, the approval will be included in an Addendum, and Bidders may include the pricing of this product in their bid. Bidders shall not rely on approvals made in any other manner.
  5. In proposing a non-specified product or a substitution, the Bidder represents and warrants that each proposed product will not result in any changes to the Project, including changes to the Work of other contractors, or any decrease in the performance of any equipment or systems to be installed in the Project and agrees to pay any additional costs incurred by the Owner and the Owner's consultants as a result of a non-specified or substitute product that is accepted.
  6. Following the award of the Contract, there shall be no substitutions for specified products, except pursuant to a Change Order. The Owner in its sole discretion may decline to consider a substitution for a Change Order.

#### **K. ALTERNATES**

1. The Owner may request bids on alternates. If the Owner requests bids on alternates, the Bidder should include the cost of the alternates requested on its Bid Form.
2. At the time of awarding the Contract, the Owner will select or reject alternates as it determines is in its best interest. A Bidder's failure to include on its Bid Form the cost of an alternate selected by the Owner and applicable to the Bidder's work shall render the bid non-responsive and be grounds for the rejection of the bid. Otherwise, the failure to include the cost of an alternate will not be deemed material.
3. The Bidder acknowledges that although there is an estimate for the cost of the Project, the market conditions may and frequently do result in the estimate being different from the sum of the bids received, either higher or lower. The Bidder understands that the Owner may include alternates, which may include deduct alternates as well as add alternates, to give it flexibility to build the Project with the funds available. The Bidder further understands and acknowledges that use of add and deduct alternates is a long held customary practice in the construction industry in the State of Ohio. The Bidder also acknowledges that the Owner will not make a decision about the alternates on which to base the award of contracts until the bids are received, and the Owner can compare its available funds with the base bids and the cost or savings from selecting different alternates. The Bidder understands that the award to the Bidder submitting the lowest responsible bid will be based on the lowest base bid plus selected alternates, and may result in an award to a Bidder other than the Bidder that submitted the lowest base bid.
4. If, during the progress of the Work, the Owner desires to reinstate any alternate not included in the Contract, the Owner reserves the right to reinstate the alternate at the price bid by the Contractor provided that such action is taken in sufficient time so as not to delay the progress of the work or cause the Contractor additional expense.

#### **L. UNIT PRICES**

1. Where unit prices are requested in the Bid Form the Bidder should quote a unit price. Unless otherwise expressly provided in the Contract Documents, such unit prices shall include all labor, materials, and services necessary for the timely and proper installation of the item for which the unit prices are requested. The unit prices quoted in the bid shall be the basis for any Change Orders entered into under the Owner-Contractor Agreement, unless the Design Professional determines that the use of such unit prices will cause substantial inequity to either the Contractor or the Owner.

#### **M. ADDENDA**

1. The Owner reserves the right to issue Addenda changing, altering, or supplementing the Contract Documents prior to the time set for receiving bids. The Design Professional will issue the Addenda to clarify bidders' questions and/or to change, alter, or supplement the Contract Documents.
2. Any explanation, interpretation, correction, or modification of the Contract Documents will be issued in writing in the form of an Addendum, which shall be the only means considered binding; explanations, interpretations, etc., made by any other means shall NOT be legally binding. All Addenda shall become a part of the Contract Documents.
3. Bidders shall submit written questions to **Mark Wiseman, AIA, LEED AP, at mwiseman@levin-porter.com by 12:00 p.m. Noon, September 28th, 2026** to allow sufficient time for the Design Professional to respond. All Addenda will be issued, except as hereafter provided, and e-mailed or otherwise furnished to persons who have obtained Contract Documents for the Project, at least seventy-two (72) hours prior to the published time for the opening of bids, excluding Saturdays, Sundays, and legal holidays. If any Addendum is issued within such seventy-two (72) hour period, then the time for opening of bids shall be extended one (1) week with no further advertising of bids required.
4. Copies of each Addendum will be sent only to the Bidders to whom Contract Documents have been issued and to Plan Rooms where copies of the Contract Documents are maintained. Receipt of Addenda shall be indicated by Bidders in the space provided on the Bid Form. Bidders are responsible for acquiring issued Addenda in time to incorporate them into their bid. Bidders should contact the Design Professional prior to the bid opening to verify the number of Addenda issued.
5. Each Bidder shall carefully read and review the Contract Documents and immediately bring to the attention of the Design Professional any error, omission, inconsistency, or ambiguity therein.
6. If a Bidder fails to indicate receipt of all Addenda through the last Addendum issued by the Design Professional on its Bid Form, the bid of such Bidder will be deemed to be responsive only if:
  - a. The bid received clearly indicates that the Bidder received the Addendum, such as where the Addendum added another item to be bid upon and the Bidder submitted a bid on that item; or
  - b. The Addendum involves only a matter of form or is one which has either no effect or has merely a trivial or negligible effect on price, quantity, quality, or delivery of the item bid upon.

#### N. INTERPRETATION

1. If a Bidder contemplating submitting a bid for the proposed Project is in doubt as to the true meaning of any part of the Contract Documents, it may submit a written request for an interpretation thereof to **Mark Wiseman, AIA, LEED AP, at mwiseman@levin-porter.com by the deadline for questions per paragraph L.3 above**. Any interpretation of the proposed documents will be made by Addendum only, duly signed by the Design Professional, and a copy of such Addendum will be mailed or delivered to each Bidder receiving a set of Contract Documents and each plan room where the Contract Documents are maintained. The Owner will not be responsible for any other explanation or interpretation of the proposed documents.
2. In interpreting the Contract Documents, words describing materials that have a well-known technical or trade meaning, unless otherwise specifically defined in the Contract Documents, shall be construed in accordance with the well-known meaning recognized by the trade.
3. Bidders are responsible for notifying the Owner and the Design Professional in a timely manner of any ambiguities, inconsistencies, errors, or omissions in the Contract Documents. The Bidder shall not, at any time after the execution of the Contract, be compensated for a claim alleging insufficient data, incomplete Contract Documents, or incorrectly assumed conditions

regarding the nature or character of the Work, if no request was made by the Bidder prior to the bid opening.

**O. STATE SALES AND USE TAXES**

1. The Owner is a political subdivision of the State of Ohio and is exempt from taxation under the Ohio Sales Tax and Use Tax Laws. Building materials that the successful Bidder purchases for incorporation into the Project will be exempt from state sales and use taxes if the successful Bidder provides a properly completed Ohio Department of Taxation Construction Contract Exemption Certificate to the vendors or suppliers when the materials are acquired. The Owner will execute properly completed certificates on request.

**P. DATE FOR SUBSTANTIAL COMPLETION/ DATE FOR FINAL COMPLETION /LIQUIDATED DAMAGES**

1. The Date for Substantial Completion (aka Contract Time), Date for Final Completion, and Liquidated Damages shall be as defined and set forth in the Owner-Contractor Agreement. **By submitting its Bid, each Bidder agrees that the period for performing its Work is reasonable.**

**Q. OWNER'S RIGHT TO WAIVE DEFECTS AND IRREGULARITIES**

1. The Owner reserves the right to waive any and all irregularities provided that the defects and irregularities do not affect the amount of the bid in any material respect or otherwise give the Bidder a competitive advantage.

**R. MODIFICATION/WITHDRAWAL OF BIDS**

1. Modification. A Bidder may modify its bid by written communication to the Owner addressed to the Owner's Representative at any time prior to the scheduled closing time for receipt of bids, provided such written communication is received by Owner's Representative prior to the bid deadline. The written communication shall not reveal the bid price, but should provide the addition or subtraction or other modification so that the final prices or terms will not be known until the sealed bid is opened. If the Bidder's written instructions with the change in bid reveal the bid amount in any way prior to the bid opening, the bid may be rejected as non-responsive.
2. Withdrawal Prior to Bid Deadline. A Bidder may withdraw its bid at any time for any reason prior to the bid deadline for the opening of bids. The request to withdraw shall be made in writing to and received by the Owner prior to the time of the bid opening.
3. Withdrawal after Bid Deadline.
  - a. All bids shall remain valid and open for acceptance for a period of at least 60 days after the bid opening; provided, however, that a Bidder may withdraw its bid from consideration after the bid deadline when all of the following apply:
    - (1) the price bid was substantially lower than the other bids;
    - (2) the reason for the bid being substantially lower was a clerical mistake, rather than a mistake in judgment, and was due to an unintentional and substantial error in arithmetic or an unintentional omission of a substantial quantity of work, labor, or material;
    - (3) the bid was submitted in good faith; and
    - (4) the Bidder provides written notice to the Owner, to the attention of the Owner's Representative, within two (2) business days after the bid opening for which the right to withdraw is claimed.
  - b. No bid may be withdrawn under this provision if the result would be the awarding of the contract on another bid for the bid package from which the Bidder is withdrawing its bid to the same Bidder.

- c. If a bid is withdrawn under this provision, the Owner may award the Contract to another Bidder determined by the Owner to be the lowest responsible bidder or the Owner may reject all bids and advertise for other bids. In the event the Owner advertises for other bids, the withdrawing Bidder shall pay the costs incurred in connection with the rebidding by the Owner, including the cost of printing new Contract Documents, required advertising, and printing and mailing notices to prospective bidders, if the Owner finds that such costs would not have been incurred but for such withdrawal.

#### **S. COMPLIANCE WITH APPLICABLE LAWS**

1. By submitting a bid for Work on the Project, the Bidder acknowledges that it is in compliance with applicable federal, state, and local laws and regulations, including, but not limited to, the following:
  - a. Equal Employment Opportunity/Nondiscrimination. The Bidder agrees that if it is awarded a contract that in the hiring of employees for performance of work under the contract or any subcontract, neither it nor any subcontractor, or any person acting on its behalf or its subcontractor's behalf, by reason of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color, shall discriminate against any citizen of the state in the employment of labor or workers who are qualified and available to perform work to which the employment relates. The Bidder further agrees that neither it nor any subcontractor or any person on its behalf or on behalf of any subcontractor, in any manner, shall discriminate against or intimidate any employees hired for the performance of the work under the contract on account of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color.
  - b. Ethics Laws. The Bidder represents that it is familiar with all applicable ethics law requirements, including without limitation Sections 102.04 and 3517.13 of the Ohio Revised Code, and certifies that it is in compliance with such requirements.

#### **T. FINDINGS FOR RECOVERY**

1. By submitting its bid, each Bidder certifies for reliance of the Owner that it has no unresolved finding for recovery against it issued by the Auditor of the State of Ohio on or after January 1, 2001, except as permitted by Section 9.24 (F) of the Ohio Revised Code.

### **END OF SECTION**



## **SECTION 1A (000011)**

### **SUPPLEMENTARY GENERAL CONDITIONS**

1. SCOPE

Except as modified by other parts of the Contract Documents, The original provisions of "General Conditions of the Contract for Construction," AIA Document A201, 2017 Edition, shall remain in full effect. The following Supplementary General Conditions shall be considered as additions or modifications to the original provisions.

2. DOCUMENTS REQUIRED PRIOR TO SIGNING OF CONTRACT

Immediately upon the award of, and prior to the signing of the contract, the successful Bidder shall furnish to the Architect:

- A. If Contractor's Proposal is secured by a means other than a Bid Guarantee and Contract Bond, a Bond meeting the requirements of Ohio Revised Code Chapter 153. Said Bond shall:
  - 1. Be written for an amount not less than 100% of the Contract Amount.
  - 2. Be accompanied by a Power of Attorney of the Agent of the Company signing the same, showing that said agent is authorized to execute a bond in a sum sufficient to cover the amount of the bond.
  - 3. Be accompanied by a certificate signed by the Superintendent of Division of Insurance, State of Ohio, showing that said company is authorized to do business in Ohio.
- B. A signed and notarized copy of a "Delinquent Personal Property Tax Statement" for the Contractor per the requirements of Ohio Revised Code Section 5719.042.
- C. Certificates of Insurance Coverage for all insurance coverage required of the Contractor by the Contract Documents.
- D. Workman's Compensation Certificates.
- E. Complete list of Subcontractors and material and equipment suppliers with a complete listing of all segments of the Work each Subcontractor and material and equipment supplier shall be used for.
- F. The full name, address and phone number, including residential phone number, of the Job Superintendent for Contractor and major Subcontractor, who will be in charge during the entire duration of the project.
- G. Schedules of Values (Division of Contract). The schedule of values cost breakdowns shall follow the Construction Specification Institute (CSI) division of work/sequence. In addition to the CSI cost breakdown listing, the following additional cost breakdowns are required:

- Bond & Insurance
- Site Mobilization
- General Conditions
- Scheduling and Coordination of work
- Field Supervision
- Punchlist

### Project Closeout Items

All costs shall indicate the labor and material cost associated with each items noted on the cost breakdown.

- H. Time-progress schedule of the Work. The General Trades Contractor shall develop and maintain the overall project schedule for the work. Each Prime Contractor shall submit a submittal schedule to the Prime Contractor for review.

### 3. CONTRACT DOCUMENTS

- A. Contract documents as indicated in Paragraph 1.1.1 of the General Conditions, shall be modified to include the following documents:

1. Drawing sheets
2. General Conditions (AIA Document A201-2017)
3. Supplementary General Conditions.
4. Additional Conditions
5. General Requirements (Division 1).
6. Owner/Contractor Agreement (AIA A101-2017)
7. Bid Guaranty and Contract Bond
8. Specifications
9. Addenda, as issued prior to the receipt of Bids.

- B. Drawings and Specifications

1. The successful contractor(s) will be furnished PDF files of the drawings and specifications which will include all bid addendum and code review items.
2. Contractor shall keep one (1) complete clean copy of all drawings and specifications for the work, in good shape, available to everyone engaged on the job, see Paragraph 3.11 of the AIA Document A201-2017. In addition one (1) complete copy of all Drawings and Specifications shall be maintained to record all changes made during the execution of the Work.
3. The Drawings are divided by category and the Specifications are divided into Divisions and Section for the purpose of providing order to the many elements of the work. The Contractor is responsible for a complete familiarity of all of the Contract Documents and the complete understanding of the Scope of responsibility of the Contractor's work. The Contractor is also responsible to establish the Scope of any subcontractor's work; the division of the Construction Documents is not intended to establish such divisions of responsibility.
4. Unless specifically indicated otherwise, all elements of the Work shall produce a complete installation. Contractor is responsible to provide the materials, labor and services necessary to produce a complete installation regardless of the inclusion of all necessary components of the installation in the Contract Documents.
5. In event of inconsistencies within or between the Contract Documents, the Contractor shall provide the better quality or greater quantity of Work, and shall comply with the more strict requirement.
6. Contractor shall be responsible to field verify all existing conditions. Any deviations found between the existing conditions and the Contract Documents, including dimensions, that affect the Work in any way shall be brought to the attention of the

Architect immediately. 3.2.3 of the General Conditions (AIA Document A201-2017) is modified such that the Contractor shall be responsible for any corrective Work required as a result of failure to obtain guidance from the Architect for such deviations between existing conditions and the Contract Documents.

7. The Contractor shall only forward a "Request for Information" to the Architect for elements of the Work where there is reason to believe there are errors, inconsistencies or omissions in the Contract Documents or there is reason to believe that there are deviations between existing conditions and requirements of Work represented in the Contract Documents. Requests for consideration of a substitute product or consideration of a product as an "equal" shall not be submitted as a Request for Information; such request shall be submitted under the conditions prescribed in the Specifications for Submittals. See Specification Section 1B-Additional Conditions for requirements associated with "Request for Information".

#### 4. INSURANCE

- A. The Contractor shall furnish and maintain insurance as follows, in accordance with Article 11 of the AIA General Conditions, except as modified herein.
- B. All policies shall be subject to the approval of the Owner.
- C. The Owner shall be listed as co-insured on all policies.
- D. The form and adequacy of Protective Liability Insurance shall be written, unless otherwise provided with minimum limits of \$2,000,000 for injury to one (1) person and \$2,000,000 limit for total injury in any one occurrence and the minimum for property damage in policies shall be \$2,000,000 in each case. Vehicles operated in connection with the project shall be included in the coverage. Coverage shall be written on the Comprehensive Form.
- E. The Contractor shall furnish and maintain a Builder's All Risk Policy in the amount of the Contract.
- F. Certificate of all required insurance shall be filed with the Architect prior to signing the Contract.

#### 5. PERMITS

- A. Building and zoning permits required for construction shall be obtained and paid for by the Owner. The Owner will submit drawings and specifications to the governing authorities.
- B. Any other permits required will be obtained and paid for by the Contractor.
- C. All permits shall remain in full force for the period necessary to complete work under this Contract.

#### 6. NOTICE OF COMMENCEMENT

- A. Pursuant to Section 1311.252, Ohio Revised Code, the Owner shall prepare a Notice of Commencement in affidavit form identifying the name and address of the Owner, the Project number, the name, address and trade of all Contractors, the date of execution of the Contracts, and the name and address of the Surety for each Contract, in addition to the name and address of the Owner's representative upon whom a Claim Affidavit may be served.

- B. The Notice of Commencement shall be made available upon request. The unavailability of a Notice of Commencement or incorrect information in the Notice of Commencement does not adversely affect the right of claimants, pursuant to Section 1311.252 (C), Ohio Revised Code.

7. JOB CONDITIONS

- A. The commencement of work by any Contractor or Subcontractor shall indicate his acceptance of all surfaces that his work will adjoin or cover, and of all job conditions. Each Contractor and Subcontractor shall be responsible for the satisfactory installations of his own work, regardless of contributory causes, once he has accepted job conditions. Any necessary corrections to said surfaces shall be reported immediately to the Architect prior to commencement of said work.

8. CONTRACTOR'S SUPERINTENDENT

- A. Contractor shall keep the same competent superintendent and any necessary assistants, on the work during its progress. All shall be satisfactory to the Architect.
- B. Superintendent shall have previous experience in this type of work and shall maintain progress schedule and be authorized to make field decisions in the absence of the Contractor. He shall not be required to perform work not related to administering, expediting or coordinating the work under this Contract.
- C. The Contractor shall attend to every part of the work personally, or through his competent foremen, who shall be constantly on the work, shall lay it out and give all necessary lines, levels, patterns and dimensions according to the accompanying drawings and these Specifications, and shall verify that Drawings and Specifications are observed by all Subcontractors and employees.
- D. The Contractor shall inspect all materials when delivered and see that it is properly stored and protected from damage until used and must keep himself familiar with the working drawings, scale and full size details and Specifications concerning all parts of the work at all times, and must report to the Architect for correction of apparent errors, either in the drawings or specifications, as soon as discovered.

9. MATERIALS AND WORKMANSHIP

- A. The Architect or authorized representatives shall have the right to reject work and materials not in accordance with the true intent and meaning of the Drawings and Specifications.
- B. Contractor shall accept responsibility for any changes or deviations from the Drawings and Specifications made without authorization from the Architect.

10. MANUFACTURER'S DIRECTION

- A. All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned, adjusted and conditioned as directed by the manufacturer, unless herein specified to the contrary.

11. REVISIONS AND EXTRAS

- A. Contractor will accept orders for extra work or make changes in this Contract as per provisions of the General Conditions.

- B. If satisfactory resolution is not reached in Item "A" above, then all extra work or changes in the work shall be paid for on the basis of 10% in addition to the actual cost of labor as submitted by the Contractor and 10% on materials in accordance with suppliers' invoices. Contractor mark-up on sub-contractors is limited to 10%.

## 12. RELEASE OF LIENS

- A. Lien laws of the State of Ohio shall govern all work and materials.
- B. Contractor shall furnish the Owner with each estimate for payment and before final payment is made, a full Release of Lien signed by all Subcontractors and Material-men associated in any way with the work.
- C. If any Subcontractor refuses to furnish a release or receipt in full, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against any lien.
- D. If any lien remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all the monies that the latter may have been compelled to pay in discharging such lien including all costs and a reasonable Attorney's fee.

## 13. PAYMENT TO CONTRACTOR

- A. Payment to the Contractor will be made in accordance with the General Conditions.
- B. At the end of each calendar month, the Contractor shall prepare and present to the Architect an estimate of work completed and materials which have been delivered on the site or secured for the job and stored during such month or subsequent to making of the last preceding estimate. Estimate forms will be AIA Documents G702 and G702A, Application and Certificate for Payment.
- C. Until all work is completed, the Owner shall make partial payments to the Contractor based on estimates prepared by the Contractor and approved by the Architect. These partial payments shall be governed by the following:
  - 1. Partial payments to the Contractor for labor performed shall be made at the rate of ninety-two percent of the approved estimates until the work of the Contract has achieved fifty percent completion. All payments for labor performed after the work of the Contractor has achieved fifty percent completion shall be paid based on one hundred percent of the approved estimates.
  - 2. Partial payments to the Contractor for materials shall be made at the rate of ninety-two percent of the approved estimates for materials delivered to the job site but not incorporated into the work. Once the materials are incorporated into the work, they shall be paid at one hundred percent of the approved percentage completion. All payments for materials delivered after the work of the Contractor has achieved fifty percent completion shall be paid based on one hundred percent of the approved estimates.
  - 3. The balance of labor estimates retained by Owner in 1, above, shall not be paid to the Contractor until the work of the Contractor meets the condition of Final Completion.
  - 4. The balance of material estimates retained by Owner in 2, above, shall not be paid until all materials required by the Work have been properly installed by the Contractor.

- D. All materials and work covered by partial payments made shall thereupon become the sole property of the Owner, but this provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and Work upon which payments have been made or the restoration of any damaged Work, or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract.
- E. Monthly estimates shall be proportioned to the Division of Contract. (Schedule of Values) prepared by the Contractor and approved by the Owner. Such monthly estimates shall be adjusted proportionately by item to agree with the total amount of the Contract
- F. Partial payments made as the work progresses shall in no way be construed as acceptance of any portion of the completed work embraced in the Contract.

#### 14. DEFINITIONS

- A. "Provide" - means furnish, fabricate, complete, deliver, install and erect, including labor, materials, equipment, apparatus, appurtenances extra expenses necessary to complete in place, ready for operation and/or use under the terms of the Contract Documents.
- B. "As Shown" - "As Indicated" - "As Detailed" - "As Noted" or words of similar import refer to Contract Drawings accompanying Specifications.
- C. "As Directed" - "As Ordered" - "As Designated" - "As Required" or words of similar import refer to the Architect's instruction.
- D. "Approved" - "Acceptable" - "Satisfactory" - or words of similar import refer to approved by, acceptable, or satisfactory to the Architect based on the best professional judgment of the Architect upon his review of conditions, data, and other information made available to him, but does not relieve the Contractor from his obligations and responsibilities as delineated in the Contract Documents.

#### 15. ASSIGNMENT

- A. Assignment of this Contract or any part thereof, or any funds to be received thereunder, by the Contractor will be subject to the approval of the Owner. Such assignment shall contain a clause to the effect that it is agreed the funds to be paid the assignee under this assignment, are subject to the prior lien for services rendered or materials supplied for the performance of the work called for in said Contract in favor of all persons, firms and corporation, rendering such services or supplying such materials.

#### 16. GUARANTEE

- A. For a period of one (1) year from the date of Substantial Completion by the Owner, all Contractors unconditionally shall warrant all material, equipment, design and workmanship to be free from inherent defects, and warrants against any malfunction caused thereby. Contractor shall at his own expense, cause all defects discovered during period to be removed, repaired and/or replaced to the complete satisfaction of the Owner.
- B. The Owner shall notify the Contractor in writing stating such defects and repairs to be made and the Contractor agrees to remedy such defects and make such repairs as directed by the Owner and to start the work not more than five (5) days from date of said notification. If the Contractor fails to make such repairs within five (5) days of said notification. Owner may cause said repairs to be made and charge said expenses to the Contractor.
- C. This guarantee shall not serve to reduce any otherwise longer guarantees and warranty periods under which any units or components are regularly sold, or which require longer guarantees under the Specifications.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- D. Contractor shall be responsible for making corrections of any Work found to be not in conformance with the Contract Documents regardless of when discovery of such non-conformance is discovered.

#### 17. CODE COMPLIANCE

- A. The Contractor shall give all requisite notices to the proper authorities, obtain all official inspections, permits (except for permits specifically specified as the responsibility of the Owner) and licenses made necessary by the work and shall comply with all laws, ordinances, rules and regulations pertaining thereto.

#### 18. WAGES

- A. Per the Ohio Revised Code, as a project for a Public School District, Prevailing Wages need not be paid.
- B. Contractor, when requested by the School District, shall be required to fill out a Prevailing Wage Exemption Survey Contractor Estimate Form.

#### 19. OHIO SALES TAX EXEMPTION:

- A. As a public body, the Owner has a sales tax exemption status, and Work performed for this Project is exempt of such tax. Owner shall furnish Contractor proper sales tax exemption certification for use by the Contractor to avoid the need to make sales tax payments for materials, services and equipment related to the Work.

END OF SECTION

## **SECTION 1B (000012)**

### **ADDITIONAL CONDITIONS**

1. GENERAL

The following shall supplement the General and Supplementary Conditions of the Contract.

2. LAYOUT AND SURVEY

- A. The Contractor shall, from bench marks available at the site, verify all lines, levels and dimensions as shown on the Drawings, and shall report promptly any errors or inconsistencies to the Architect before commencing work. The Contractor shall be responsible for the proper location and level of all work.

3. MEASUREMENTS

- A. Before ordering any materials or doing any work, the Contractor shall verify all measurements at the site of the work and shall be responsible for the corrections of the same. Any discrepancies which may be found shall be promptly reported to the Architect for consideration before proceeding with the work.

4. ELECTRONIC FILES OF THE CONSTRUCTION DOCUMENTS

- A. The Architect, at his sole discretion and without obligation, can make graphics portions of the contract documents available for use by the Contractor in electronic format upon request and completion of a Waiver Agreement and review fees payable to the Architect.
- B. Electronic files shall be provided only after bids have been received for the project and contracts have been signed with the contractors.
- C. The electronic file formats provided by the Architect to the Contractor shall be as follows:
- CADD Drawing Files: AutoCAD 2018  
Word Processing Files: Microsoft Word 2023  
Spreadsheet Files: Microsoft Excel 2023
- D. The Waiver Agreement provided by the Architect must be signed by the contractor making the request for the electronic files indicating the following conditions for the release of the electronic files.
1. The Contractor requesting these drawings solely for the purpose of coordinating and expediting the contractor's work on this specific project and for no other purpose.
  2. The files on these diskettes are not Contract Drawings; they are work product tools used to produce the Contract Drawings. As such, they may contain information that may or may not be consistent with the Contract Drawings.
  3. Ownership of the information to be provided to you as herein set forth is and shall remain the sole and exclusive property of the Architect.
  4. The Architect makes no representation or warranty, expressed or implied, as to the quality or content of the information of these files.



5. CONTRACTOR ACCESS TO THE SITE

- A. All construction activity including storage of materials and employee parking, access to construction site, etc., shall be limited to the area of construction outline in the Site Logistics Plan(s).
- B. Contractor shall verify with the Owner the location of, and area available for the storage of material and tools, and the placement of the construction office and temporary storage. The Contractor shall clean up and restore such area, surfaced or unsurfaced, to their original conditions upon completion of the work.

6. CUTTING AND PATCHING

- A. Contractor shall provide openings, penetrations including cutting and patching as required to complete their installation by craftsmen skilled in that type of work:
- B. Cutting, when necessary shall be done with such tools and methods to prevent unnecessary damage to surrounding areas or equipment. No cutting shall be done which will in any way reduce the structural strength of the building. Should such cutting be necessary, consult the Architect and do not proceed with such operation unless the Architect's approval is given.
- C. Wherever existing walls, floors, ceilings, beams, etc., are cut, exposed cut surfaces must be neatly finished by patching, filling, etc., as required to the satisfaction of the Architect, or covered with Architect approved finish materials, such as metal and wood trim, adequately fastened and aligned.

7. PROTECTION OF EXISTING FACILITIES

- A. Extreme care shall be taken to properly protect all existing items to remain.
- B. Properly protect all components and surfaces of the existing structures.
- C. All existing items and surfaces damage during the work are to be repaired/replaced as required to equal or better condition than previously existed.

8. ASBESTOS CONTAINING BUILDING MATERIALS:

- A. The Owner shall make the Contractor aware of all suspect and confirmed asbestos containing building materials present at the project site as have been identified per the requirements of the Asbestos Hazard Emergency Response Act.
- B. Contractor shall be responsible to inform each of his employees and subcontractors of the location of asbestos containing building materials and require his subcontractors to do the same.
- C. Any Work associated with existing roofs may involve cutting or removal of asbestos containing roof felts and/or flashing membrane. Contractor shall use only craftsmen meeting governing agency requirements for training to perform such Work. In addition all Work of this nature shall conform with prevailing regulations.

9. COMPLETION DATES

- A. The required dates of Substantial Completion and Final Completion are identified in Specification Section 01 01 00 – Summary of Work.

## 10. LIQUIDATED DAMAGES

- A. If Contractor fails to achieve Substantial Completion and Final Completion by the required dates, the Contractor shall be assessed liquidated damages.
- B. The Architect, based on his best professional judgment, shall determine the liability the contractor shall incur, if any, for liquidated damages based on the performance and/or failure to perform by Contractor.
- C. The maximum daily amount Contractor shall be held liable for liquidated damages shall be determined based on the Contract Amount of the Contractor as follows:

| <u>Contract Amount</u>           | <u>Dollars per day</u> |
|----------------------------------|------------------------|
| \$1.00 - \$50,000.00             | \$150.00               |
| \$50,001.00 - \$150,000.00       | \$250.00               |
| \$150,001.00 - \$500,000.00      | \$500.00               |
| \$500,001.00 - \$2,000,000.00    | \$1,000.00             |
| \$2,000,001.00 - \$5,000,000.00  | \$2,000.00             |
| \$5,000,001.00 - \$10,000,000.00 | \$2,500.00             |
| \$10,000,001.00 and more         | \$3,000.00             |

- D. Contractor liability to the Owner for Liquidated Damages shall entitle the Owner to retain from the amount owed the Contractor and/or recover from the Contractor Liquidated Damages, and not as penalty, amounts as set forth above for each and every calendar day thereafter until the condition causing the Liquidated Damages has been corrected. The Contractor acknowledges by submitting its bid and entering into a contract with Owner, that such amounts of Liquidated Damages represent a reasonable estimate of the actual damages that the Owner would incur if the work is not substantially and finally completed by the foregoing dates. These Liquidated Damages are damages for loss of use of the project. The Owner's right to recover Liquidated Damages shall not substitute for any other right of recovery for additional costs incurred should the Contractor fail to complete the Contract according to the Contract Documents.

## 11. REQUESTS FOR INFORMATION (RFI's)

- A. In the event that the contractor or subcontractor, at any tier, determines that some portion of the drawings, specifications, or other contract documents requires clarification or interpretation by the Construction Manager, the contractor shall submit a **Request for Information** in writing to the Architect. Requests for Information may only be submitted by the contractor and shall only be submitted on the Request for Information form provided by the Architect. The contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Architect. In the Request for Information, the contractor shall set forth an interpretation or understanding of the requirements along with reasons why such an understanding was reached.
- B. The Architect acknowledge that it is a complex project. Based upon the Architect's past experiences with projects of similar complexity, the Architect anticipate that there will probably be some Requests for Information on this project.
- C. The Architect will review all Requests for Information to determine whether they are Request for Information within the meaning of the term. If the Architect determines that the document is not a Request for Information, it will be returned to the contractor, un-reviewed as to content, for re-submittal on the proper form and in the proper manner.
- D. Responses to Requests for Information shall be issued within two (2) working days of receipt of the request from the contractor unless the Architect determine that a longer time is

necessary to provide an adequate response. If a longer time is necessary by the Architect, the Architect will, within two (2) working days of receipt of the request, notify the contractor of the anticipated response time. If the contractor submits a Request for Information on an activity with two (2) working days or less of float on the current project schedule, the contractor shall not be entitled to any time extension due to the time it takes the Architect to respond to the request provided that the Architect responds within the two (2) working days set forth above.

- E. Responses from the Architect will not change any requirement of the contract documents. In the event the contractor believes that a response to a Request for Information will cause a change to the requirements of the contract documents, the contractor shall immediately give written notice to the Architect stating that the contractor considers the response to be a Change Order. Failure to give such written notice immediately shall waive the contractor's right to seek additional time or cost under the appropriate articles of the General Conditions.
- F. Copy of the RFI Form will be distributed at the Pre-Construction Meeting.

END OF SECTION

**SECTION 004100**  
**BID FORM**

**1.01 BID SUBMITTED BY:**

\_\_\_\_\_  
(Contractor)

Date bid submitted: \_\_\_\_\_

**1.02 DELIVER TO:**

**Warren County Career Center  
ATTN: Joel King, Superintendent  
3525 North State Route 48  
Lebanon, Ohio 45036**

- 1.03** Having carefully reviewed the Instructions to Bidders, Drawings, Specifications and other Contract Documents for the Project titled **Medical Academy Addition** including having also received, read, and taken into account the following Addenda:

Addendum No.

Dated

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

and likewise having inspected the site and the conditions affecting and governing the Project, the undersigned hereby proposes to furnish all materials and to perform all labor, as specified and described in the said Specifications and/or as shown on the said Drawings for all Work necessary to complete the Project on a timely basis and in accordance with the Contract Documents regardless of whether expressly provided for in such Specifications and Drawings.

- 1.04** Before completing the Bid Form, the undersigned represents that it has carefully reviewed the Request for Bids, Instructions to Bidders, this Bid Form, Form of Bid Guaranty and Contract Bond, Contractor's Affidavit (O.R.C. 5719.042), Owner-Contractor Agreement as modified for the Project, Drawings, Project Specifications, and other Contract Documents. Failure to comply with provisions of the Contract Documents may be cause for disqualification of the bid.

- 1.05 BONDS AND CONTRACT:** If the undersigned is notified of bid acceptance, it agrees to furnish required bonds as indicated in the Instructions to Bidders.

- 1.06 COMPLETION OF WORK:** In submitting a bid, the undersigned agrees to execute the Owner-Contractor Agreement in the form included in the Contract Documents and to complete its Work as required by the Contract Documents.

**NOTE A:** The wording of the Bid Form shall be used throughout, without change, alteration, or addition. Any change may cause it to be rejected.

**NOTE B:** Bidder is cautioned to bid only on the Brands or Standards specified.

**NOTE C:** If there is an inconsistency or conflict in the Bid amount, the lowest amount shall control, whether expressed in numbers or words.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**2.01 BID:**

Include the cost of all labor and material for the contract listed below. Bidder is to fill in all blanks related to the Bid Package for which a bid is being submitted. If no bid is submitted for an item, leave the item blank or insert "NO BID" in the blank. For alternate items, indicate whether the amount stated is in addition to or a deduction from the base bid amount (if there is no indication whether the amount for an alternate is an addition or a deduction, the amount shall be a deduction).

**2.02** Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Lump Sum – All Work, but not including alternates.

|                          |
|--------------------------|
| _____ Dollars (\$ _____) |
| (Words) (Figures)        |

**3.01 INSTRUCTIONS FOR SIGNING**

- A. The person signing for a sole proprietorship must be the sole proprietor or his authorized representative. The name of the sole proprietor must be shown below.
- B. The person signing for a partnership must be a partner or his authorized representative.
- C. The person signing for a corporation must be the president, vice president or other authorized representative; or he must show authority, by affidavit, to bind the corporation.
- D. The person signing for some other legal entity must show his authority, by affidavit, to bind the legal entity.

**4.01 BIDDER CERTIFICATIONS.** The Bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. **The Bidder acknowledges that this is a public project involving public funds, and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. The Bidder by submitting its bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Design Professional, (b) it will use its best efforts to cooperate with the Owner and the Design Professional and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Design Professional and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.**
2. The Bidder represents that it has had a competent person carefully and diligently review each part of the Contract Documents, including any Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors or omissions in the Contract Documents for which it has not notified the Design Professional in writing at least seven (7) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment or materials of the better quality or greater quantity of Work; and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any additional compensation for any conflicts, inconsistencies, errors or omissions that would have been discovered by such careful and diligent review, unless it has given such prior written notice to Design Professional.

3. The Bidder represents that it has had a competent person carefully and diligently inspect and examine the entire site for the Project and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, and carefully correlate the results of the inspection with the requirements of the Contract Documents. The Bidder agrees that its bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of conditions that could have been discovered by such an investigation.
4. The Bidder represents, understands and agrees that a) the Claim procedures in the General Conditions as modified for the Project are material terms of the Contract Documents, b) if it has a Claim, it will have its personnel provide complete and accurate information to complete and submit the Statement of Claim form on a timely basis, c) the proper completion and timely submission of a Statement of Claim form is a condition precedent to any change in the Contract Sum or the Contract Time(s), and d) the proper and timely submission of the Statement of Claim form provides the Owner and the Design Professional with necessary information so that the Owner may investigate the Claim and mitigate its damages.
5. The Bidder represents that the bid contains the name of every person interested therein and is based upon the Standards specified by the Contract Documents.
6. The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a bid by joint venture, each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices and any Alternate bid in the bid have been arrived at independently without collusion, consultation, communication or agreement, or for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices or Alternate bid; (c) no attempt has been made or will be made by the Bidder to induce any other Person to submit or not to submit a bid for the purpose of restricting competition; and (d) the statements made in this Bid Form are true and correct.
7. The Bidder will execute the form of Owner/Contractor Agreement in the form included with the Contract Documents, if a Contract is awarded on the basis of this bid, and if the Bidder does not execute the Contract Form for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the Owner.
8. The Bidder certifies that the upon the award of a Contract, the Contractor will ensure that all of the Contractor's employees, while working on the Project site, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.
9. The Bidder agrees to furnish any information requested by the Design Professional or the Owner's authorized representative to evaluate that the Bidder has submitted the lowest responsible bid and that the bid is responsive to the specifications.
10. The Bidder certifies that it has no unresolved findings for recovery issued by the Auditor of State.
11. The Bidder certifies that it is aware of and in compliance with the requirements of Ohio Revised Code Section 3517.13 regarding campaign contributions.

12. The Bidder further states that it is a duly licensed contractor, for the type of work proposed, in accordance with the local requirements, and that all fees, permits, etc., pursuant to submitting this Bid have been paid in full.

LEGAL NAME OF BIDDER: \_\_\_\_\_

BIDDER IS (check one): ☐ sole proprietor ☐ partnership ☐ corporation ☐ other legal entity

NAME & TITLE OF PERSON LEGALLY AUTHORIZED TO BIND BIDDER TO A CONTRACT:

| Name | Title |
|------|-------|
|------|-------|

|                    |                  |
|--------------------|------------------|
| DATE SIGNED: _____ | SIGNATURE: _____ |
|--------------------|------------------|

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

TELEPHONE: \_\_\_\_\_

FEDERAL TAX I.D. # \_\_\_\_\_

When the Bidder is a partnership or a joint venture, state name and address of each partner in the partnership or participant in the joint venture below:

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| Name  |       |

\_\_\_\_\_

Address

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| Name  |       |

\_\_\_\_\_

Address

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| Name  |       |

\_\_\_\_\_

Address

\_\_\_\_\_  
\_\_\_\_\_  
Name

\_\_\_\_\_  
\_\_\_\_\_  
Address

\_\_\_\_\_  
\_\_\_\_\_  
Name

\_\_\_\_\_  
\_\_\_\_\_  
Address

END OF SECTION

**END OF SECTION**



**SECTION 004500**  
**REPRESENTATIONS AND CERTIFICATIONS**  
**CONTRACTOR'S PERSONAL PROPERTY TAX AFFIDAVIT**

State of Ohio

County of \_\_\_\_\_, ss:

\_\_\_\_\_, being first duly sworn, deposes and says that he is the  
(Name)

\_\_\_\_\_ of \_\_\_\_\_ with offices located at  
(Title) (Contractor)

\_\_\_\_\_, and as its duly  
(Address of Contractor)

authorized representative, states that effective this \_\_\_\_ day of \_\_\_\_\_, 2026,

\_\_\_\_\_  
(Name of Contractor)

( ) is charged with delinquent personal property taxes on the general list of personal property as set forth below:

| <u>County</u> | <u>Amount</u> (include total amount penalties and interest thereon) |
|---------------|---------------------------------------------------------------------|
| _____ County  | \$ _____                                                            |
| _____ County  | \$ _____                                                            |

( ) is not charged with delinquent personal property taxes on the general list of personal property in any Ohio county.

\_\_\_\_\_  
(Affiant)

Sworn to and subscribed before me by the above-named affiant this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

\_\_\_\_\_  
(Notary Public)

My commission expires

\_\_\_\_\_, 20\_\_

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**END OF SECTION**

**SECTION 004513**  
**CONTRACTOR'S QUALIFICATIONS STATEMENT**

SUBMITTED TO: Warren County Career Center Board of Education  
Attn: Joel King, Superintendent  
3525 North State Route 48  
Lebanon, Ohio 45036

NAME OF PROJECT: \_\_\_\_\_

SUBMITTED BY: \_\_\_\_\_

CONTRACTOR PROJECT CONTACT NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

EMAIL: \_\_\_\_\_

PHONE: \_\_\_\_\_

PRINCIPAL OFFICE: \_\_\_\_\_

- ☐ Corporation  
☐ Partnership  
☐ Individual  
☐ Joint Venture  
☐ Other

| #                | Question                                                                                            | Response |
|------------------|-----------------------------------------------------------------------------------------------------|----------|
| 1 - Organization |                                                                                                     |          |
| 1.1              | How many years has your organization been in business as a Contractor in the construction industry? |          |
| 1.2              | How many years has your organization been in business under its present business name?              |          |
| 1.2.1            | Under what other or former names has your organization operated?                                    |          |
| 1.3              | Is your organization a corporation?<br>If yes, answer #1.3.1 – 1.3.6                                |          |
| 1.3.1            | Date of incorporation                                                                               |          |
| 1.3.2            | State of incorporation                                                                              |          |
| 1.3.3            | President's name                                                                                    |          |

|               |                                                                                                                                                                      |  |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 1.3.4         | Vice President's name(s)                                                                                                                                             |  |
| 1.3.5         | Secretary's name                                                                                                                                                     |  |
| 1.3.6         | Treasurer's name                                                                                                                                                     |  |
| 1.4           | Is your organization a partnership?<br>If yes, answer #1.4.1 – 1.4.3                                                                                                 |  |
| 1.4.1         | Date of organization                                                                                                                                                 |  |
| 1.4.2         | Type of partnership (if applicable)                                                                                                                                  |  |
| 1.4.3         | Name(s) of general partner(s)                                                                                                                                        |  |
| 1.5           | Is your organization individually owned?<br>If yes, answer #1.5.1 – 1.5.2                                                                                            |  |
| 1.5.1         | Date of organization                                                                                                                                                 |  |
| 1.5.2         | Name of owner                                                                                                                                                        |  |
| 1.6           | If the form of your organization is other than those listed above, describe it and name the principals.                                                              |  |
| 2 - Licensing |                                                                                                                                                                      |  |
| 2.1           | List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable. |  |

|                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 2.2                                                                                                                                                                                                              | List jurisdictions in which your organization's partnership or trade name is filed.                                                                                                                                                                        |  |
| 2.3                                                                                                                                                                                                              | List any suspension or revocations of any professional license of any director, officer, owner, or managerial employees of your organization, to the extent that any work to be performed on this Project is within the field of such licensed profession. |  |
| 3 - Financing: After bid opening, within 24 hours of a request made by the Owner or Design Professional, the apparent low Bidder and any other Bidder must submit additional financial information as requested. |                                                                                                                                                                                                                                                            |  |
| 4 - References                                                                                                                                                                                                   |                                                                                                                                                                                                                                                            |  |
| 4.1                                                                                                                                                                                                              | Trade References                                                                                                                                                                                                                                           |  |
| 4.2                                                                                                                                                                                                              | Bank References                                                                                                                                                                                                                                            |  |
| 4.3                                                                                                                                                                                                              | Surety – name of bonding company                                                                                                                                                                                                                           |  |
| 4.4                                                                                                                                                                                                              | Surety – name and address of agent                                                                                                                                                                                                                         |  |
| 5 – Claims and Organization History                                                                                                                                                                              |                                                                                                                                                                                                                                                            |  |
| 5.1                                                                                                                                                                                                              | Attach your organization's record for both resolved and unresolved findings of the Auditor of the State of Ohio for recovery as defined in Section 9.24 of the Ohio Revised Code. If none, state "none".                                                   |  |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 5.2 | Does your organization participate in a drug-free workplace program?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| 5.3 | Has your organization ever failed to complete any work or failed to complete any work by the substantial completion date, final completion date, or in a timely manner? If yes, attach details.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| 5.4 | <p>Within the last five years, has your organization or any of its officers prosecuted any Claims, had any Claims prosecuted against it or them, or been involved in or is currently involved in any mediation or arbitration proceedings or lawsuits related to any construction project, or has any judgments or awards outstanding against it or them? If the answer is yes, please attach the details for each Claim, including the names and telephone numbers of the persons who are parties, the amount of the Claim, the type of Claim and basis for the Claim, and the outcome.</p> <p>Note: As used in this document "Claim" means a Claim initiated under the Contract Documents for a project or relating to the Work for a project, including Claims made against performance bonds secured by the Contractor on other construction projects.</p> |  |
| 5.5 | Within the last five years, has your organization received a citation, notice of violation, or other form of written violation relating to federal, state, and local laws, rules and regulations including but not limited to the Occupational Safety and Health Act, the Ohio Prevailing Wage laws, and Ohio ethics laws? If yes, please attach details and reason(s) for each instance and the outcome including any fines or penalties imposed.                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| 5.6 | Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? If the answer is yes, please attach details for each instance, including the names and telephone numbers of the persons who are parties to the contract, and the reason(s) the contract was not completed.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| 5.7 | If any of the following members of your organization's management – president, chairman of the board, or any director – operates or has operated another construction company during the last five years, identify the member of management and the name of the construction company.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| 5.8 | If your organization is operating under a trade name registration with the Secretary of State for the State of Ohio, identify the entity for which the trade name is registered. If none, state "none."                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 5.9 | If your organization is a division or wholly-owned subsidiary of another entity or has another relationship with another entity, identify the entity of which it is a division or wholly-owned subsidiary or with which it has another relationship and also identify the nature of the relationship. If none, state "not applicable."                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 5.10           | List any projects within the previous five years where a public entity determined that your organization was not a responsible bidder, including the name of the public entity, the reasons given by the public entity, and an explanation thereof.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| 6 - Experience |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 6.1            | List the categories of work that your organization normally performs with its own forces                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 6.2            | State average annual amount of construction work your organization has performed during the last five years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| 6.3            | State total amount of work in progress and under contract                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 6.4            | Describe the size and experience of your organization's work force and your equipment and facilities, in relation to your organization's ability to complete the Project successfully and on time.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| 6.5            | <p>In the chart below, provide the following information for each contract your organization has had during the last five years, including current contracts, where the Contract Sum is/was 50% or more of the bid amount for this Project, including add alternates.<br/>Include details regarding timeliness of performance and quality of work.</p> <p>List the original contract price for each project, the amount of any change orders or cost overruns on each, and the reasons for the change orders or cost overruns, and your organization's record for complying with and meeting completion deadlines on construction projects.</p> <p>If there are more than ten of these contracts only provide information on the most recent ten contracts, including current contracts.</p> |  |

| Project/Scope of Work | Original Contract Sum | Amount of any change orders or cost overruns and reasons | Completion deadlines met? | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|-----------------------|----------------------------------------------------------|---------------------------|------------------------------------|------------------------------------------------------------------|
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| Project/Scope of Work | Original Contract Sum | Amount of any change orders or cost overruns and reasons | Completion deadlines met? | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|-----------------------|----------------------------------------------------------|---------------------------|------------------------------------|------------------------------------------------------------------|
|                       |                       |                                                          |                           |                                    |                                                                  |
|                       |                       |                                                          |                           |                                    |                                                                  |

6.6 In the chart below, provide the following information for each project your organization has had during the last five years, which your organization believes is of comparable or greater size and complexity than the Owner's project. If there are more than five of these projects, only provide information on the most recent five projects, including current projects.

| Project and Scope of Work | Contract Sum | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|---------------------------|--------------|------------------------------------|------------------------------------------------------------------|
|                           |              |                                    |                                                                  |
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6.7 In the chart below, list the construction education, training and construction experience for each person who will fill a management role on the Project, including without limitation the Project Executive, Project Engineer, Project Manager, and Project Superintendent. For each person listed, include with the other information, the last three projects on which the person worked and the name and telephone number of the design professional and the Owner. Attach a separate sheet if necessary, identifying the question number.

| Name/Role | Education and Training | Project #1,<br>Owner & A/E<br>Contact,<br>Telephone Number | Project #2,<br>Owner & A/E Contact,<br>Telephone Number | Project #3,<br>Owner & A/E<br>Contact,<br>Telephone Number |
|-----------|------------------------|------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|
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|           |                        |                                                            |                                                         |                                                            |

| Name/Role             | Education and Training                                                                                                                                                                                                                                                                                                                                                                      | Project #1,<br>Owner & A/E<br>Contact,<br>Telephone Number | Project #2,<br>Owner & A/E Contact,<br>Telephone Number | Project #3,<br>Owner & A/E<br>Contact,<br>Telephone Number |                                                                              |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------|
|                       |                                                                                                                                                                                                                                                                                                                                                                                             |                                                            |                                                         |                                                            |                                                                              |
| 6.8                   | In the chart below, list construction projects your organization has in progress with an original Contract Sum of more than \$100,000.00, giving the name of project, owner and its telephone number, design professional and its telephone number, contract amount, percent complete and scheduled completion date. Attach a separate sheet if necessary, identifying the question number. |                                                            |                                                         |                                                            |                                                                              |
| Project/Scope of Work | Contract Sum                                                                                                                                                                                                                                                                                                                                                                                | Scheduled<br>Completion<br>Date                            | %<br>Comple<br>te                                       | Owner's Contact &<br>Telephone Number                      | Engineer's or<br>Architect's<br>Representative Name<br>&<br>Telephone Number |
|                       |                                                                                                                                                                                                                                                                                                                                                                                             |                                                            |                                                         |                                                            |                                                                              |
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**Additional Criteria.** The Owner, in its discretion, reserves the right to request additional information and documentation relating to the foregoing and related to any of the criteria listed in the Bidding and Contract Documents after the bid opening. The Owner may consider such information and documentation in determining which bidder is the lowest responsible. The Owner, in its discretion, may consider and give such weight to any and all criteria as it deems appropriate.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**Certification.** The undersigned certifies for the reliance of the Owner that after diligent investigation, to the best of the undersigned's belief, the information provided with this Contractor's Qualification Statement is true, accurate and not misleading.

SIGNATURE \_\_\_\_\_

Dated at this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Name of Organization: \_\_\_\_\_

By: \_\_\_\_\_ [PRINT NAME]

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

\_\_\_\_\_, being duly sworn, deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Subscribed and sworn before me this \_\_\_\_ day of \_\_\_\_\_ 20\_\_.

\_\_\_\_\_  
Notary Public

My Commission Expires: \_\_\_\_\_

SEAL

**END OF SECTION**

**SECTION 006113**  
**BOND FORMS**  
**BID GUARANTY AND CONTRACT BOND**

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned \_\_\_\_\_ ("Contractor") as principal and \_\_\_\_\_ as surety are hereby held and firmly bound unto the **Warren County Career Center Board of Education**, as obligee in the penal sum of the dollar amount of the bid submitted by the principal to the obligee on \_\_\_\_\_, 2026, to undertake the construction of the **Medical Academy Addition** ("Project"). The penal sum referred to herein shall be the dollar amount of the principal's bid to the obligee, incorporating any additive or deductive Alternates made by the principal on the date referred to above to the obligee, which are accepted by the obligee.

In no case shall the penal sum exceed the amount of \_\_\_\_\_ Dollars (\$\_\_\_\_\_). (If the foregoing blank is not filled in, the penal sum will be the full amount of the principal's bid, including add Alternates. Alternatively, if the blank is filled in the amount stated must not be less than the full amount of the bid including add Alternates, in dollars and cents. A percentage is not acceptable.) For the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed this \_\_\_\_\_ day of \_\_\_\_\_, 2026.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas the above named principal has submitted a bid for work on the Project.

Now, therefore, if the obligee accepts the bid of the principal and the principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the event the principal pays to the obligee the difference not to exceed ten percent (10%) of the penalty hereof between the amount specified in the bid and such larger amount for which the obligee may in good faith contract with the next lowest bidder to perform the work covered by the bid; or in the event the obligee does not award the contract to the next lowest bidder and resubmits the project for bidding, the principal pays to the obligee the difference not-to-exceed ten percent (10%) of the penalty hereof between the amount specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents, required advertising, and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect; if the obligee accepts the bid of the principal and the principal within ten (10) days after the awarding of the contract enters into a proper contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract is made a part of this bond the same as though set forth herein.

Now also, if the said principal shall well and faithfully do and perform the things agreed by said principal to be done and performed according to the terms of said contract; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; and surety shall indemnify the obligee against all damage suffered by failure of the principal to perform the contract according to its provisions and in accordance with the plans, details, specifications, and bills of material therefor and to pay all lawful claims of subcontractors, materialmen, and laborers for labor performed or material furnished in carrying forward, performing, or completing the contract and surety further agrees and assents that this undertaking is for the benefit of any subcontractor, materialman, or laborer having a just claim, as well as for the obligee; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the obligations of said surety on its bond, and does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

Signed and sealed this \_\_\_\_\_ day of \_\_\_\_\_, 2026.

\_\_\_\_\_  
PRINCIPAL

By: \_\_\_\_\_  
Printed Name & Title: \_\_\_\_\_

\_\_\_\_\_  
SURETY

By: \_\_\_\_\_  
Printed Name & Title: \_\_\_\_\_

Surety's Address: \_\_\_\_\_  
\_\_\_\_\_

Surety's Telephone Number: \_\_\_\_\_

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**NOTE:** The Contract Bond form that follows is to be used **ONLY** by a bidder that is awarded a contract and submits a form of bid guaranty other than the combined Bid Guaranty and Contract Bond with its bid. If a bidder submits a combined Bid Guaranty and Contract Bond, then the bid guaranty becomes the contract bond when the contract is awarded.

**AIA Bid Bond or Payment and Performance Bond forms are not acceptable for this Project.**

**END OF SECTION**



**SECTION 006500**  
**PROJECT FORMS**

**STATEMENT OF CLAIM FORM**  
**Claim No. \_\_\_\_\_ for Contractor**

1. Name of Contractor: \_\_\_\_\_
2. Date written claim given: \_\_\_\_\_.
3. Contractor's representative to contact regarding the claim:  
Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Telephone No. \_\_\_\_\_ (office) FAX No. \_\_\_\_\_  
E-mail: \_\_\_\_\_
4. General description of claim:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Contract Documents. If the claim is based upon any part or provision in the Contract Documents, including but not limited to pages in the Drawings and/or paragraphs in the Specifications, Owner-Contractor Agreement, General Conditions or Supplementary General Conditions, state upon which parts or provisions the claim is based:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. Delay claims:  
6.1 Date delay commenced: \_\_\_\_\_  
6.2 Duration or expected duration of the delay, if known: \_\_\_\_\_  
6.3 Apparent cause of the delay and part of critical path affected:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
6.4 Expected impact of the delay and recommendations for minimizing such impact:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Additional compensation. Set forth in detail all additional compensation to which the Contractor believes it is entitled with respect to this claim:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
8. Instructions for Completing the Statement of Claim Form ("Instructions"). The Instructions are incorporated in this Form.
9. Truth of Claim. By submitting this claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-09-2026 |
|-----------------------------------------------------------|--|--------------------------------|

complied fully with the Instructions, b) the information in this State of Claim is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

CONTRACTOR: \_\_\_\_\_

By: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Date: \_\_\_\_\_

**CONTRACTOR'S ACKNOWLEDGMENT**

State of \_\_\_\_\_,  
County of \_\_\_\_\_, ss:

\_\_\_\_\_ first being sworn, states that after conscientious and thorough review, the statements made in attached Statement of Claim Form are complete and true to the best of his or her knowledge and belief.

\_\_\_\_\_  
Sworn to before me a notary public by \_\_\_\_\_ on \_\_\_\_\_, 20\_\_\_\_. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

\_\_\_\_\_  
Notary Public

WHEN COMPLETED, FORWARD A COPY OF THIS NOTICE AND STATEMENT OF CLAIM FORM TO THE OWNER AND DESIGN PROFESSIONAL.

## INSTRUCTIONS FOR COMPLETING THE STATEMENT OF CLAIM FORM

1. Completing the Statement of Claim Form ("Claim Form") is a material term of the Contract. The Claim Form tells the Owner and Design Professional that the Contractor is making a Claim and that they need to act promptly to mitigate the effects of the occurrence giving rise to the Claim. The Claim Form also provides them with information so that they can mitigate such effects. The Contractor acknowledges that constructive knowledge of the conditions giving rise to the Claim through job meetings, correspondence, site observations, etc. is inadequate notice, because knowledge of these conditions does not tell the Owner and Design Professional that the Contractor will be making a Claim and most often is incomplete.
2. If the space provided in the Claim Form is insufficient, the Contractor, as necessary to provide complete and detailed information, must attach pages to the Claim Form with the required information.
3. Paragraph 4. The Contractor must state what it wants, *i.e.*, time and/or compensation, and the reason why it is entitled to time and/or compensation.
4. Paragraph 5. The Contractor must identify the exact provisions of the Contract Documents it is relying on in making its Claim. For example, if the Claim is for a change in the scope of the Contractor's Work, the Contractor must identify the specific provisions of the Specifications, and the Plan sheets and details that provide the basis for the scope change.
5. Paragraph 6. This paragraph applies to delay claims, including delays that the Contractor believes result in constructive acceleration. The Contractor must identify the cause of the delay, party or parties responsible, and what the party did or did not do that caused the delay, *i.e.*, specific work activities. The Contractor acknowledges that general statements are not sufficient, and do not provide the Owner with sufficient information to exercise the remedies available to the Owner or to mitigate the effects of the delay.  
For example, if the Contractor claims a slow response time on submittals caused a delay, the Contractor must identify the specific submittals, all relevant dates, and then show on the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Also for example, if the Contractor claims it was delayed by another Contractor, the Contractor must identify the delaying Contractor, specifically what the delaying Contractor did or did not do that caused the delay, and then show the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Further by example, if the Contractor seeks an extension of time for unusually severe weather, the Contractor must submit comparative weather data along with a record of the actual weather at the job site and job site conditions.
6. Paragraph 6.4. Time is of the essence under the Contract Documents. If there is a delay, it is important to know what can be done to minimize the impact of the delay. It therefore is important that the Contractor provide specific recommendations on how to do so.
7. Paragraph 7. The Contractor must provide a specific and detailed breakdown of the additional compensation it seeks to recover. For future compensation, the Contractor shall provide its best estimate of such compensation.
8. Paragraph 8 and Acknowledgment. By submitting this Claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this Claim Form is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

End of Instructions

### CERTIFICATE OF SUBSTANTIAL COMPLETION

Project:  
Warren County Career Center  
Medical Academy Addition

Contract For:  
General Contract

Owner:  
Warren County Career Center Board of  
Education

CONTRACTOR: [insert name and address]  
\_\_\_\_\_

The Design Professional hereby certifies that the Date for Substantial Completion of the Contractor's Work as set forth in the Owner-Contractor Agreement is:

**August 2<sup>nd</sup>, 2026**

The Design Professional hereby certifies that the Date for Substantial Completion in the Contractor's Agreement with the Owner (the "Agreement"), as extended by Change Orders and Claims submitted by the Contractor that have been Finally Resolved, as defined below, is:

1. Date for Substantial Completion in the Agreement  
(above): August 2<sup>nd</sup>, 2026
2. Additional days added to Date for Substantial Completion  
by Change Order: \_\_\_\_\_
3. Additional days added by Claims that have been  
Finally Resolved: \_\_\_\_\_
4. Date for Substantial Completion in the Contract  
Adjusted by days under No. 2 and No. 3 \_\_\_\_\_

"Finally Resolved" means that the Design Professional has made a decision (or declined to make a decision) on the Claim under the General Conditions and that any litigation regarding the Claim has been concluded.

The Design Professional certifies that the Contractor's Work to the best of the Design Professional's knowledge, information, and belief was Substantially Complete, as Substantial Completion is defined in the Contract Documents, on \_\_\_\_\_.

The Design Professional hereby certifies that the difference between (a) the Date for Substantial Completion adjusted by the days under No. 2 and No. 3 above and (b) the date the Contractor's Work was Substantially Complete is \_\_\_\_\_ days.

**NOTICES OF DELAY.** The Design Professional hereby certifies that all "NOTICES OF DELAY" submitted by the Contractor and described in the General Conditions are attached to this Certificate. This certification is solely for the purpose of identifying all "NOTICES OF DELAY" submitted by the Contractor and is not intended to imply that any of these NOTICES OF DELAY were properly submitted in accordance with Contract Documents or are valid.

**STATEMENT OF CLAIM FORMS.** The Design Professional hereby certifies that all Statement of Claim Forms described in the General Conditions and submitted by the Contractor are attached to this Certificate. This certification is solely for the purpose of identifying all Statement of Claim Forms submitted by the Contractor and is not intended to imply that any of these Statement of Claim Forms were properly submitted in accordance with Contract Documents or are valid.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-09-2026 |
|-----------------------------------------------------------|--|--------------------------------|

PUNCHLIST ITEMS. A list of items to be completed by the Contractor is attached to this Certificate. The failure to include items on this list does not change the responsibility of the Contractor to complete its Work in accordance with the Contract Documents. The Contractor shall complete all items on the Punchlist in accordance with the Contract Documents.

Security, maintenance, utilities, damage to the Work and insurance are the responsibility of the Owner and the Contractor based on their operations pursuant to final completion of the Work.

Copies of this Certificate were provided to the Contractor and the Owner on \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**CONTRACTOR'S AFFIDAVIT AND CERTIFICATION WITH LIST OF SUBCONTRACTORS  
AND SUPPLIERS WITH ANY AMOUNTS WITHHELD**

PROJECT:  
Warren County Career Center  
Medical Academy Addition

CONTRACTOR:

In Support of PAYMENT APPLICATION No.:

For the Period Through:

STATE OF \_\_\_\_\_ :  
: SS,  
COUNTY OF \_\_\_\_\_ :

The undersigned after first being sworn swears that a) all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment; b) set forth below is a complete list of its Subcontractors and Suppliers; and c) set forth below is a complete description of all amounts withheld from any Subcontractor or Supplier and the reason why. Attach additional sheets if necessary.

| Typed or Printed Name of<br>Subcontractor or Supplier | Address of Subcontractor or<br>Supplier | Telephone Number of<br>Subcontractor or Supplier |
|-------------------------------------------------------|-----------------------------------------|--------------------------------------------------|
|                                                       |                                         |                                                  |
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| Typed or Printed Name of<br>Subcontractor or Supplier | Address of Subcontractor or<br>Supplier | Telephone Number of<br>Subcontractor or Supplier |
|-------------------------------------------------------|-----------------------------------------|--------------------------------------------------|
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WITHHOLDINGS FROM SUBCONTRACTORS AND/OR SUPPLIERS:

| Typed or Printed Name of<br>Subcontractor or Supplier | Amount Withheld | Reason for Withholding |
|-------------------------------------------------------|-----------------|------------------------|
|                                                       |                 |                        |
|                                                       |                 |                        |
|                                                       |                 |                        |
|                                                       |                 |                        |

Moreover, Contractor certifies that, except for as set forth immediately above, Contractor has paid all of its subcontractors and suppliers who were due to be paid with the proceeds of the prior Application for Payment and Contractor acknowledges that Owner is relying upon such certification when paying Contractor the amount asked for in the payment application that this Affidavit and Certification supports.

CONTRACTOR: [insert name]

BY: \_\_\_\_\_  
(Signature of authorized representative)

NOTARY PUBLIC

Subscribed and sworn to before me on this date by \_\_\_\_\_ on behalf of \_\_\_\_\_.  
The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

\_\_\_\_\_  
Signature of Notary Public

Notary Public: \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

**CONTRACTOR'S WAIVER & RELEASE AFFIDAVIT  
("AFFIDAVIT")**

Project: Warren County Career Center – Medical Academy Addition

The undersigned hereby acknowledges receipt of payment for all Work on the Project through the date of the prior Application for Payment by the **Warren County Career Center Board of Education** (the "Owner") with which it has a contract for the Project.

In return for said payment, and/or pursuant to certain contractual obligations of the undersigned, the undersigned hereby waives and releases any rights it has or may have through the date of the last Application for Payment to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Owner, for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors, and suppliers who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Owner, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Affidavit is for the benefit of, and may be relied upon by the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work of improvement, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit.

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Authorized Signature (Company Officer)

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

State of: \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this  
\_\_\_\_\_ day of \_\_\_\_\_  
\_\_\_\_\_. The notarial  
act certified hereby is a jurat. An oath or  
affirmation was administered to the signer with  
regard to the notarial act certified to hereby.

Notary Public: \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

**SUBCONTRACTOR'S, SUPPLIERS WAIVER & RELEASE AFFIDAVIT  
("AFFIDAVIT")**

Project: Warren County Career Center – Medical Academy Addition

The undersigned hereby acknowledges receipt of payment for all Work on the Project through the date of the prior Application for Payment by the Contractor ("Contractor") with which it has a contract.

In return for said payment, and/or pursuant to certain contractual obligations of the undersigned, the undersigned hereby waives and releases any rights it has or may have through the date of the Contractor's last Application for Payment and to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Contractor, the Contractor's surety, and/or the **Warren County Career Center Board of Education** (the "Owner"), for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form, a copy of which has been delivered to the Owner. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors and suppliers through the date of the Contractor's last Application for Payment who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Contractor, the Contractor's surety, and/or the Owner, except for any Claims made by properly and timely submitting a Statement of Claim form a copy of which has been delivered to the Owner. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

The undersigned agrees that upon receipt of the payment from the Contractor with respect to the Contractor's current Application for Payment, it shall, if applicable, immediately execute and cause to be filed or recorded a legally effective Satisfaction of Lien, Release of Lien, or any other legal instrument necessary to cause prejudicial dismissal and release of any lien, encumbrance, lawsuit, or other claim against the Contractor, the Contractor's surety and the Owner, the property where the Project is located, and/or any surety bond posted by the Contractor or the Owner to the extent of the foresaid payment. Upon request of the Contractor, the undersigned shall provide proof of having complied with this obligation.

This Affidavit is for the benefit of, and may be relied upon by, the Contractor, the Contractor's surety and the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, its Work, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit and from any liability, cost, or expense incurred as a result of any breach of this Affidavit by the undersigned.

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Authorized Signature (Company Officer)

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

State of: \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this  
\_\_\_\_\_ day of \_\_\_\_\_.

The notarial  
act certified hereby is a jurat. An oath or  
affirmation was administered to the signer with  
regard to the notarial act certified to hereby.

Notary Public: \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

**CONTRACTOR'S FINAL WAIVER & RELEASE AFFIDAVIT  
("AFFIDAVIT")**

Project: Warren County Career Center – Medical Academy Addition

In consideration for payment received from the Warren County Career Center Board of Education (the "Owner") in the amount requested in Contractor's Final Application for Payment to the Owner, the receipt of which is hereby acknowledged, the undersigned Contractor hereby waives and releases any rights it has or may have to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Owner, for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors, and suppliers who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Owner, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Affidavit is for the benefit of, and may be relied upon by the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work of improvement, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit,

\_\_\_\_\_

Company Name

\_\_\_\_\_

Authorized Signature (Company Officer)

\_\_\_\_\_

Title

\_\_\_\_\_

Date

State of: \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this

\_\_\_\_\_ day

of \_\_\_\_\_.

The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Notary Public: \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

**SUBCONTRACTOR'S, SUPPLIERS FINAL WAIVER & RELEASE AFFIDAVIT**  
**("AFFIDAVIT")**

Project: Warren County Career Center – Medical Academy Addition

Upon receipt of payment in the amount of \$\_\_\_\_\_ received from \_\_\_\_\_ ("Prime Contractor") the undersigned Subcontractor or Supplier waives and relinquishes all rights of lien or claim that it may have either in law or equity (including but not limited to rights under Ohio Mechanics' Lien Laws, O.R.C. 1311.01 *et seq.*) with respect to the construction project known as **Medical Academy Addition** ("the Project"), for all labor, all equipment, and/or materials provided to or on behalf of the Project throughout its entirety, except for claims previously made pursuant to the agreement in place between Subcontractor or Supplier and Prime Contractor, and any lien previously perfected and remaining unreleased.

The undersigned Subcontractor or Supplier acknowledges and agrees that such payment represents final payment in full for all such labor, equipment and/or materials including retainage, if any, and that the Subcontractor or Supplier has completed its work on the Project. The undersigned Subcontractor or Supplier certifies that all amounts have been paid by the Subcontractor or Supplier for all work or materials furnished by others to the Subcontractor or Supplier for which the Subcontractor or Supplier has received previous payments from Prime Contractor, and Subcontractor or Supplier acknowledges that Prime Contractor is now making payment to the Subcontractor or Supplier in reliance upon such certification. The undersigned Subcontractor or Supplier further certifies that it will pay all amounts lawfully owing for all work or materials furnished by others to the Subcontractor or Supplier with the payment received from Contractor referenced herein.

This Affidavit is for the benefit of, and may be relied upon by, the Contractor, the Contractor's surety and the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, its Work, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit and from any liability, cost, or expense incurred as a result of any breach of this Affidavit by the undersigned.

IN WITNESS WHEREOF, the undersigned has caused this Affidavit to be executed by its authorized representative as of the date indicated below.

SUBCONTRACTOR OR SUPPLIER:

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Authorized Signature (Company Officer)

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

State of: \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_  
day of \_\_\_\_\_.

The notarial act certified hereby is a jurat. An  
oath or affirmation was administered to the signer with  
regard to the notarial act certified to hereby.

Notary Public: \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

### CONTRACTOR'S PAYMENT APPLICATION CHECKLIST

**THE CONTRACTOR MUST COMPLETE THIS CHECKLIST AND SUBMIT IT TO THE DESIGN PROFESSIONAL WITH ITS PAYMENT APPLICATION AND ALL REQUIRED DOCUMENTATION.**

1. Contractor's Name: \_\_\_\_\_
2. Name, title, and telephone and fax numbers of Contractor's representative to contact regarding the Payment Application and required documentation:  
Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Office Telephone No.: (\_\_\_\_\_) \_\_\_\_\_ FAX No.: (\_\_\_\_) \_\_\_\_\_  
\_\_\_\_\_
3. Payment Application Number and Date:  
No. \_\_\_\_\_ Date: \_\_ \_\_\_\_, 20\_\_
4. The following is a list of required documentation that must accompany its Payment Application. The Contractor certifies that it has submitted the documentation listed below with its Payment Application. If the Contractor cannot do so, the Contractor should explain why in Paragraph 5. Such explanations shall not excuse the Contractor from the requirements for submitting this documentation.
  - \_\_\_\_\_ .1 Five (5) copies of a properly completed and executed Application for Payment with a properly completed and executed Schedule of Values attached to each;
  - \_\_\_\_\_ .2 Properly Completed Contractor's Affidavit with List of Subcontractors and Suppliers and Any Amounts Withheld;
  - \_\_\_\_\_ .3 Contractor's Waiver and Release Agreement (beginning with the second Application for Payment);
  - \_\_\_\_\_ .4 For each of its Subcontractors and Suppliers, a Subcontractor's – Supplier's Waiver and Release Agreement (beginning with the second Application for Payment);
  - \_\_\_\_\_ .5 Schedule of all materials and equipment stored on-site;
  - \_\_\_\_\_ .6 For materials and equipment stored off-site:
    - \_\_\_\_\_ A list of the materials and equipment consigned and stored off-site in connection with the Project (which shall be clearly identified), giving the place of storage, together with copies of invoices and reasons why the materials and equipment cannot be delivered to the site;
    - \_\_\_\_\_ Certification that all items have been tagged for delivery to the Project and that they will not be used for any other purpose;
    - \_\_\_\_\_ A letter from the Contractor's surety bonding company indicating agreement to the arrangements and that payment to the Contractor shall not relieve either party of its responsibility to complete the facility;
    - \_\_\_\_\_ Evidence of adequate insurance covering the material and equipment in storage, which shall name the Owner as additional insured;
    - \_\_\_\_\_ Evidence that the Design Professional has visited the Contractor's place of storage and found that all the materials and equipment set forth in the payment request and represented to be stored off-site are stored at the place of storage (any costs incurred by the Design Professional to inspect material and equipment in off-site storage shall be paid by the Contractor); and
    - \_\_\_\_\_ Itemization of the materials and equipment and their cost, which were approved on previous Pay Applications and which remain in off-site storage.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-09-2026 |
|-----------------------------------------------------------|--|--------------------------------|

\_\_\_\_\_.7 Other documentation or information required by the Contract Documents or by the Design Professional or Owner.

5. Reason why required documentation is not submitted:

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NOTE: The failure to submit required documentation, regardless of the reason, may result in non-payment, partial payment, and/or late payment.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Date

#### DESIGN PROFESSIONAL'S REVIEW

\_\_\_\_\_ Checklist and documentation complete.

\_\_\_\_\_ Checklist and documentation incomplete.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Date



## PRE-BID SUBSTITUTION FORM

Note: Certain brands of material or apparatus are specified. Each bid will be based on these brands, which may be referred to in the Contract Documents as Standards. The use of another brand (referred to as a substitution or proposed equal in the Contract Documents, when a bidder or the contractor seeks to have a different brand of material or apparatus than that specified approved by the Owner for use in the project) may be requested as provided in the Instruction to Bidders.

The detailed procedures for submitting substitutions are set forth in Paragraph J of the Instructions to Bidders.

## Specification Section

Brand or Name Specified

### Proposed Substitution

[illegible]

**END OF SECTION**



# AIA® Document A101® – 2017

## **Standard Form of Agreement Between Owner and Contractor** where the basis of payment is a Stipulated Sum

**AGREEMENT** made as of the    day of    in the year  
(In words, indicate day, month and year.)

**BETWEEN** the Owner:  
(Name, legal status, address and other information)

Warren County Career Center  
3625 North State Route 48  
Lebanon, Ohio 45036

and the Contractor:  
(Name, legal status, address and other information)

for the following Project:  
(Name, location and detailed description)

263303.00 Warren County Career Center Medical Academy Addition  
3525 OH-48  
Lebanon, Ohio 45036  
12-15,000 sf building for Medical Academy at Warren County Career Center.

The Architect:  
(Name, legal status, address and other information)

Levin Porter Associates Inc  
3011 Newmark Drive  
Miamisburg, Ohio 45342  
937-224-1931

The Owner and Contractor agree as follows.

### **ADDITIONS AND DELETIONS:**

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

## TABLE OF ARTICLES

|   |                                                 |
|---|-------------------------------------------------|
| 1 | THE CONTRACT DOCUMENTS                          |
| 2 | THE WORK OF THIS CONTRACT                       |
| 3 | DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION |
| 4 | CONTRACT SUM                                    |
| 5 | PAYMENTS                                        |
| 6 | DISPUTE RESOLUTION                              |
| 7 | TERMINATION OR SUSPENSION                       |
| 8 | MISCELLANEOUS PROVISIONS                        |
| 9 | ENUMERATION OF CONTRACT DOCUMENTS               |

## EXHIBIT A INSURANCE AND BONDS

### ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

### ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

### ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

*(Check one of the following boxes.)*

- ☐ The date of this Agreement.
- ☐ A date set forth in a notice to proceed issued by the Owner.
- ☐ Established as follows:  
*(Insert a date or a means to determine the date of commencement of the Work.)*

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

### § 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:  
(Check one of the following boxes and complete the necessary information.)

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

| Portion of Work | Substantial Completion Date |
|-----------------|-----------------------------|
|-----------------|-----------------------------|

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be (\$4,000,000.00 ), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

| Item | Price |
|------|-------|
|------|-------|

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.  
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

| Item | Price | Conditions for Acceptance |
|------|-------|---------------------------|
|------|-------|---------------------------|

§ 4.3 Allowances, if any, included in the Contract Sum:  
(Identify each allowance.)

| Item | Price |
|------|-------|
|------|-------|

§ 4.4 Unit prices, if any:  
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

| Item | Units and Limitations | Price per Unit (\$0.00) |
|------|-----------------------|-------------------------|
|------|-----------------------|-------------------------|

§ 4.5 Liquidated damages, if any:  
(Insert terms and conditions for liquidated damages, if any.)

Per Section 1B Additional Conditions

§ 4.6 Other:

*(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*

## **ARTICLE 5 PAYMENTS**

### **§ 5.1 Progress Payments**

**§ 5.1.1** Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

**§ 5.1.2** The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

**§ 5.1.3** Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than ( ) days after the Architect receives the Application for Payment.

*(Federal, state or local laws may require payment within a certain period of time.)*

**§ 5.1.4** Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

**§ 5.1.5** Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

**§ 5.1.6** In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

**§ 5.1.6.1** The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

**§ 5.1.6.2** The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

### **§ 5.1.7 Retainage**

**§ 5.1.7.1** For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

*(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)*

Per Section 1A Supplementary General Conditions

**§ 5.1.7.1.1** The following items are not subject to retainage:

*(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)*

Per Section 1A Supplementary General Conditions

**§ 5.1.7.2** Reduction or limitation of retainage, if any, shall be as follows:

*(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)*

Per Section 1A Supplementary General Conditions

**§ 5.1.7.3** Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:

*(Insert any other conditions for release of retainage upon Substantial Completion.)*

**§ 5.1.8** If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

**§ 5.1.9** Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

## **§ 5.2 Final Payment**

**§ 5.2.1** Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

**§ 5.2.2** The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

## **§ 5.3 Interest**

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

*(Insert rate of interest agreed upon, if any.)*

%

## **ARTICLE 6 DISPUTE RESOLUTION**

### **§ 6.1 Initial Decision Maker**

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

*(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)*

## **§ 6.2 Binding Dispute Resolution**

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

*(Check the appropriate box.)*

- ☐ Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- ☒ Litigation in a court of competent jurisdiction
- ☐ Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

## **ARTICLE 7 TERMINATION OR SUSPENSION**

**§ 7.1** The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

**§ 7.1.1** If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

*(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)*

**§ 7.2** The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

## **ARTICLE 8 MISCELLANEOUS PROVISIONS**

**§ 8.1** Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

**§ 8.2** The Owner’s representative:

*(Name, address, email address, and other information)*

Joel King  
3625 North State Route 48  
Lebanon, Ohio 45036  
joel.king@Mywccc.org

**§ 8.3** The Contractor’s representative:

*(Name, address, email address, and other information)*

**§ 8.4** Neither the Owner’s nor the Contractor’s representative shall be changed without ten days’ prior notice to the other party.



## § 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with a building information modeling exhibit, if completed, or as otherwise set forth below:

*(If other than in accordance with a building information modeling exhibit, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)*

§ 8.7 Other provisions:

## ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 Building information modeling exhibit, dated as indicated below:  
*(Insert the date of the building information modeling exhibit incorporated into this Agreement.)*

- .5 Drawings

| Number | Title | Date |
|--------|-------|------|
|--------|-------|------|

- .6 Specifications

| Section | Title | Date | Pages |
|---------|-------|------|-------|
|---------|-------|------|-------|

- .7 Addenda, if any:

| Number | Date | Pages |
|--------|------|-------|
|--------|------|-------|

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

- .8 Other Exhibits:

*(Check all boxes that apply and include appropriate information identifying the exhibit where required.)*

[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:  
*(Insert the date of the E204-2017 incorporated into this Agreement.)*

[ ] The Sustainability Plan:

| Title | Date | Pages |
|-------|------|-------|
|-------|------|-------|

[ ] Supplementary and other Conditions of the Contract:

| Document | Title | Date | Pages |
|----------|-------|------|-------|
|----------|-------|------|-------|

**.9** Other documents, if any, listed below:

*(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)*

This Agreement entered into as of the day and year first written above.

\_\_\_\_\_  
**OWNER** (Signature)

BY: Joel King, Superintendent

\_\_\_\_\_  
(Printed name and title)

\_\_\_\_\_  
**CONTRACTOR** (Signature)

BY:

\_\_\_\_\_  
(Printed name and title)

# **Additions and Deletions Report for**

## **AIA® Document A101® – 2017**

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 08:55:25 EDT on 09/11/2026.

### **PAGE 1:**

Warren County Career Center

3625 North State Route 48  
Lebanon, Ohio 45036

263303.00 Warren County Career Center Medical Academy Addition

3525 OH-48  
Lebanon, Ohio 45036

12-15,000 sf building for Medical Academy at Warren County Career Center.

Levin Porter Associates Inc

3011 Newmark Drive  
Miamisburg, Ohio 45342

937-224-1931

### **PAGE 3:**

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be (\$4,000,000.00), subject to additions and deductions as provided in the Contract Documents.

Per Section 1B Additional Conditions

### **PAGE 4:**

Per Section 1A Supplementary General Conditions

Per Section 1A Supplementary General Conditions

### **PAGE 5:**

Per Section 1A Supplementary General Conditions

[ x ]

Litigation in a court of competent jurisdiction

**PAGE 6:**

Joel King

3625 North State Route 48  
Lebanon, Ohio 45036

joel.king@Mywccc.org

**PAGE 8:**

BY: Joel King, Superintendent

## ***Certification of Document's Authenticity***

***AIA® Document D401™ – 2003***

I, Matthew Franklin, AIA, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 08:55:25 EDT on 09/11/2026 under Order No. 20250095661 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ - 2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, other than those additions and deletions shown in the associated Additions and Deletions Report.

---

*(Signed)*

---

*(Title)*

---

*(Dated)*



# AIA® Document A201® – 2017

## General Conditions of the Contract for Construction

### for the following PROJECT:

*(Name and location or address)*

263303.00 Warren County Career Center Medical Academy Addition  
3525 OH-48  
Lebanon, Ohio 45036

### THE OWNER:

*(Name, legal status and address)*

Warren County Career Center  
3625 North State Route 48  
Lebanon, Ohio 45036

### THE ARCHITECT:

*(Name, legal status and address)*

Levin Porter Associates Inc  
3011 Newmark Drive  
Miamisburg, Ohio 45342

### ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™–2017, Guide for Supplementary Conditions.

## TABLE OF ARTICLES

|    |                                                  |
|----|--------------------------------------------------|
| 1  | GENERAL PROVISIONS                               |
| 2  | OWNER                                            |
| 3  | CONTRACTOR                                       |
| 4  | ARCHITECT                                        |
| 5  | SUBCONTRACTORS                                   |
| 6  | CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS |
| 7  | CHANGES IN THE WORK                              |
| 8  | TIME                                             |
| 9  | PAYMENTS AND COMPLETION                          |
| 10 | PROTECTION OF PERSONS AND PROPERTY               |
| 11 | INSURANCE AND BONDS                              |
| 12 | UNCOVERING AND CORRECTION OF WORK                |
| 13 | MISCELLANEOUS PROVISIONS                         |
| 14 | TERMINATION OR SUSPENSION OF THE CONTRACT        |
| 15 | CLAIMS AND DISPUTES                              |

## INDEX

(Topics and numbers in bold are Section headings.)

### **Acceptance of Nonconforming Work**

9.6.6, 9.9.3, **12.3**

Acceptance of Work

9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, **12.3**

### **Access to Work**

**3.16**, 6.2.1, **12.1**

Accident Prevention

10

Acts and Omissions

3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.3.2, 14.1, 15.1.2, 15.2

Addenda

1.1.1

Additional Costs, Claims for

3.7.4, 3.7.5, 10.3.2, 15.1.5

### **Additional Inspections and Testing**

9.4.2, 9.8.3, 12.2.1, **13.4**

### **Additional Time, Claims for**

3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**

### **Administration of the Contract**

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

### **Allowances**

**3.8**

### **Applications for Payment**

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10

Approvals

2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10.1, 4.2.7, 9.3.2, 13.4.1

### **Arbitration**

8.3.1, 15.3.2, **15.4**

## **ARCHITECT**

**4**

### **Architect, Definition of**

**4.1.1**

Architect, Extent of Authority

2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1

Architect, Limitations of Authority and Responsibility

2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2

Architect's Additional Services and Expenses

2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.5, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1



## Architect's Copyright

1.1.7, 1.5

## Architect's Decisions

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.4.2, 15.2

## Architect's Inspections

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4

## Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2

## Architect's Interpretations

4.2.11, 4.2.12

## Architect's Project Representative

4.2.10

## Architect's Relationship with Contractor

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2

## Architect's Relationship with Subcontractors

1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3

## Architect's Representations

9.4.2, 9.5.1, 9.10.1

## Architect's Site Visits

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4

## Asbestos

10.3.1

## Attorneys' Fees

3.18.1, 9.6.8, 9.10.2, 10.3.3

## Award of Separate Contracts

6.1.1, 6.1.2

## Award of Subcontracts and Other Contracts for Portions of the Work

### 5.2

## Basic Definitions

### 1.1

## Bidding Requirements

1.1.1

## Binding Dispute Resolution

8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1

## Bonds, Lien

7.3.4.4, 9.6.8, 9.10.2, 9.10.3

## Bonds, Performance, and Payment

7.3.4.4, 9.6.7, 9.10.3, 11.1.2, 11.1.3, 11.5

## Building Information Models Use and Reliance

### 1.8

## Building Permit

3.7.1

## Capitalization

### 1.3

## Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

## Certificates for Payment

4.2.1, 4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4

## Certificates of Inspection, Testing or Approval

13.4.4

## Certificates of Insurance

9.10.2

## **Change Orders**

1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2

**Change Orders**, Definition of

### **7.2.1**

## **CHANGES IN THE WORK**

2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5

**Claims**, Definition of

### **15.1.1**

Claims, Notice of

1.6.2, 15.1.3

## **CLAIMS AND DISPUTES**

3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4

Claims and Timely Assertion of Claims

15.4.1

### **Claims for Additional Cost**

3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**

### **Claims for Additional Time**

3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**

### **Concealed or Unknown Conditions, Claims for**

#### **3.7.4**

Claims for Damages

3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7

Claims Subject to Arbitration

15.4.1

### **Cleaning Up**

**3.15**, 6.3

Commencement of the Work, Conditions Relating to

2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**

**Commencement of the Work**, Definition of

### **8.1.2**

## **Communications**

3.9.1, **4.2.4**

Completion, Conditions Relating to

3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2

## **COMPLETION, PAYMENTS AND**

### **9**

Completion, Substantial

3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2

Compliance with Laws

2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2,

15.4.3

Concealed or Unknown Conditions

3.7.4, 4.2.8, 8.3.1, 10.3

Conditions of the Contract

1.1.1, 6.1.1, 6.1.4

Consent, Written

3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2

### **Consolidation or Joinder**

#### **15.4.4**

## **CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

1.1.4, **6**

**Construction Change Directive**, Definition of

### **7.3.1**

## **Construction Change Directives**

1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1

Construction Schedules, Contractor's

3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

## **Contingent Assignment of Subcontracts**

**5.4**, 14.2.2.2

## **Continuing Contract Performance**

**15.1.4**

**Contract**, Definition of

**1.1.2**

## **CONTRACT, TERMINATION OR SUSPENSION OF THE**

5.4.1.1, 5.4.2, 11.5, **14**

Contract Administration

3.1.3, 4, 9.4, 9.5

Contract Award and Execution, Conditions Relating to

3.7.1, 3.10, 5.2, 6.1

Contract Documents, Copies Furnished and Use of

1.5.2, 2.3.6, 5.3

**Contract Documents**, Definition of

**1.1.1**

## **Contract Sum**

2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5**, **15.2.5**

**Contract Sum**, Definition of

**9.1**

Contract Time

1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5

**Contract Time**, Definition of

8.1.1

## **CONTRACTOR**

**3**

Contractor, Definition of

**3.1**, **6.1.2**

## **Contractor's Construction and Submittal Schedules**

**3.10**, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2

Contractor's Employees

2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1

## **Contractor's Liability Insurance**

**11.1**

Contractor's Relationship with Separate Contractors and Owner's Forces

3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4

Contractor's Relationship with Subcontractors

1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4

Contractor's Relationship with the Architect

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1

Contractor's Representations

3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2

Contractor's Responsibility for Those Performing the Work

3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

Contractor's Review of Contract Documents

3.2

Contractor's Right to Stop the Work

2.2.2, 9.7

## Contractor's Right to Terminate the Contract

### 14.1

#### Contractor's Submittals

3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3

#### Contractor's Superintendent

3.9, 10.2.6

#### Contractor's Supervision and Construction Procedures

1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4

#### Coordination and Correlation

1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1

#### Copies Furnished of Drawings and Specifications

1.5, 2.3.6, 3.11

#### Copyrights

1.5, **3.17**

#### Correction of Work

2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1

## **Correlation and Intent of the Contract Documents**

### **1.2**

#### **Cost, Definition of**

### **7.3.4**

#### Costs

2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14

#### **Cutting and Patching**

**3.14**, 6.2.5

#### Damage to Construction of Owner or Separate Contractors

3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4

#### Damage to the Work

3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4

#### Damages, Claims for

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7

#### Damages for Delay

6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2

#### **Date of Commencement of the Work, Definition of**

### **8.1.2**

#### **Date of Substantial Completion, Definition of**

### **8.1.3**

#### **Day, Definition of**

### **8.1.4**

#### Decisions of the Architect

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2

#### **Decisions to Withhold Certification**

9.4.1, **9.5**, 9.7, 14.1.1.3

#### Defective or Nonconforming Work, Acceptance, Rejection and Correction of

2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1

#### Definitions

1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1

#### **Delays and Extensions of Time**

**3.2**, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5

#### **Digital Data Use and Transmission**

### **1.7**

#### Disputes

6.3, 7.3.9, 15.1, 15.2

## **Documents and Samples at the Site**

### **3.11**

#### **Drawings, Definition of**

##### **1.1.5**

Drawings and Specifications, Use and Ownership of

### **3.11**

Effective Date of Insurance

### **8.2.2**

#### **Emergencies**

##### **10.4, 14.1.1.2, 15.1.5**

Employees, Contractor's

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1

Equipment, Labor, or Materials

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Execution and Progress of the Work

1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4

Extensions of Time

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**

#### **Failure of Payment**

9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

Faulty Work

(See Defective or Nonconforming Work)

#### **Final Completion and Final Payment**

4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3

Financial Arrangements, Owner's

2.2.1, 13.2.2, 14.1.1.4

## **GENERAL PROVISIONS**

### **1**

#### **Governing Law**

##### **13.1**

Guarantees (See Warranty)

#### **Hazardous Materials and Substances**

10.2.4, **10.3**

Identification of Subcontractors and Suppliers

5.2.1

#### **Indemnification**

3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3

#### **Information and Services Required of the Owner**

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4

#### **Initial Decision**

##### **15.2**

#### **Initial Decision Maker, Definition of**

1.1.8

Initial Decision Maker, Decisions

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

Initial Decision Maker, Extent of Authority

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

#### **Injury or Damage to Person or Property**

**10.2.8**, 10.4

Inspections

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 12.2.1, 13.4

## Instructions to Bidders

### 1.1.1

## Instructions to the Contractor

3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2

## Instruments of Service, Definition of

### 1.1.7

## Insurance

6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, 11

## Insurance, Notice of Cancellation or Expiration

11.1.4, 11.2.3

## Insurance, Contractor's Liability

### 11.1

## Insurance, Effective Date of

8.2.2, 14.4.2

## Insurance, Owner's Liability

### 11.2

## Insurance, Property

10.2.5, 11.2, 11.4, 11.5

## Insurance, Stored Materials

9.3.2

## INSURANCE AND BONDS

### 11

## Insurance Companies, Consent to Partial Occupancy

9.9.1

## Insured loss, Adjustment and Settlement of

11.5

## Intent of the Contract Documents

1.2.1, 4.2.7, 4.2.12, 4.2.13

## Interest

### 13.5

## Interpretation

1.1.8, 1.2.3, 1.4, 4.1.1, 5.1, 6.1.2, 15.1.1

## Interpretations, Written

4.2.11, 4.2.12

## Judgment on Final Award

15.4.2

## Labor and Materials, Equipment

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

## Labor Disputes

8.3.1

## Laws and Regulations

1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4

## Liens

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

## Limitations, Statutes of

12.2.5, 15.1.2, 15.4.1.1

## Limitations of Liability

3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1

## Limitations of Time

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5

## Materials, Hazardous

10.2.4, 10.3

Materials, Labor, Equipment and

1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2

Means, Methods, Techniques, Sequences and Procedures of Construction

3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2

Mechanic's Lien

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

**Mediation**

8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1, 15.4.1.1

**Minor Changes in the Work**

1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**

**MISCELLANEOUS PROVISIONS**

**13**

**Modifications, Definition of**

**1.1.1**

Modifications to the Contract

1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2

**Mutual Responsibility**

**6.2**

**Nonconforming Work, Acceptance of**

9.6.6, 9.9.3, **12.3**

Nonconforming Work, Rejection and Correction of

2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2

**Notice**

**1.6**, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1

Notice of Cancellation or Expiration of Insurance

11.1.4, 11.2.3

**Notice of Claims**

1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1

Notice of Testing and Inspections

13.4.1, 13.4.2

Observations, Contractor's

3.2, 3.7.4

Occupancy

2.3.1, 9.6.6, 9.8

Orders, Written

1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1

**OWNER**

**2**

**Owner, Definition of**

**2.1.1**

**Owner, Evidence of Financial Arrangements**

**2.2**, 13.2.2, 14.1.1.4

**Owner, Information and Services Required of the**

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4

Owner's Authority

1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7

**Owner's Insurance**

**11.2**

Owner's Relationship with Subcontractors

1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2

**Owner's Right to Carry Out the Work**

2.5, 14.2.2

**Owner's Right to Clean Up**

6.3

**Owner's Right to Perform Construction and to Award Separate Contracts**

6.1

**Owner's Right to Stop the Work**

2.4

**Owner's Right to Suspend the Work**

14.3

**Owner's Right to Terminate the Contract**

14.2, 14.4

**Ownership and Use of Drawings, Specifications and Other Instruments of Service**

1.1.1, 1.1.6, 1.1.7, 1.5, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3

**Partial Occupancy or Use**

9.6.6, 9.9

**Patching, Cutting and**

3.14, 6.2.5

**Patents**

3.17

**Payment, Applications for**

4.2.5, 7.3.9, 9.2, 9.3, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3

**Payment, Certificates for**

4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4

**Payment, Failure of**

9.5.1.3, 9.7, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

**Payment, Final**

4.2.1, 4.2.9, 9.10, 12.3, 14.2.4, 14.4.3

**Payment Bond, Performance Bond and**

7.3.4.4, 9.6.7, 9.10.3, 11.1.2

**Payments, Progress**

9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4

**PAYMENTS AND COMPLETION**

9

**Payments to Subcontractors**

5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2

**PCB**

10.3.1

**Performance Bond and Payment Bond**

7.3.4.4, 9.6.7, 9.10.3, 11.1.2

**Permits, Fees, Notices and Compliance with Laws**

2.3.1, 3.7, 3.13, 7.3.4.4, 10.2.2

**PERSONS AND PROPERTY, PROTECTION OF**

10

**Polychlorinated Biphenyl**

10.3.1

**Product Data, Definition of**

3.12.2

**Product Data and Samples, Shop Drawings**

3.11, 3.12, 4.2.7

**Progress and Completion**

4.2.2, 8.2, 9.8, 9.9.1, 14.1.4, 15.1.4

**Progress Payments**

9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4



**Project, Definition of**

**1.1.4**

Project Representatives

4.2.10

**Property Insurance**

10.2.5, **11.2**

**Proposal Requirements**

1.1.1

**PROTECTION OF PERSONS AND PROPERTY**

**10**

Regulations and Laws

1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4

Rejection of Work

4.2.6, 12.2.1

Releases and Waivers of Liens

9.3.1, 9.10.2

Representations

3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1

Representatives

2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1

Responsibility for Those Performing the Work

3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10

Retainage

9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3

**Review of Contract Documents and Field Conditions by Contractor**

**3.2**, 3.12.7, 6.1.3

Review of Contractor's Submittals by Owner and Architect

3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2

Review of Shop Drawings, Product Data and Samples by Contractor

3.12

**Rights and Remedies**

1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4

**Royalties, Patents and Copyrights**

**3.17**

Rules and Notices for Arbitration

15.4.1

**Safety of Persons and Property**

**10.2**, 10.4

**Safety Precautions and Programs**

3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4

**Samples, Definition of**

**3.12.3**

**Samples, Shop Drawings, Product Data and**

3.11, **3.12**, 4.2.7

**Samples at the Site, Documents and**

**3.11**

**Schedule of Values**

**9.2**, 9.3.1

Schedules, Construction

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

Separate Contracts and Contractors

1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2

**Separate Contractors, Definition of**

**6.1.1**

**Shop Drawings, Definition of**

**3.12.1**

**Shop Drawings, Product Data and Samples**

3.11, **3.12**, 4.2.7

**Site, Use of**

**3.13**, 6.1.1, 6.2.1

Site Inspections

3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4

Site Visits, Architect's

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4

Special Inspections and Testing

4.2.6, 12.2.1, 13.4

**Specifications, Definition of**

**1.1.6**

**Specifications**

1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14

Statute of Limitations

15.1.2, 15.4.1.1

Stopping the Work

2.2.2, 2.4, 9.7, 10.3, 14.1

Stored Materials

6.2.1, 9.3.2, 10.2.1.2, 10.2.4

**Subcontractor, Definition of**

**5.1.1**

**SUBCONTRACTORS**

**5**

Subcontractors, Work by

1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7

**Subcontractual Relations**

**5.3**, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1

Submittals

3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3

Submittal Schedule

3.10.2, 3.12.5, 4.2.7

**Subrogation, Waivers of**

6.1.1, **11.3**

**Substances, Hazardous**

**10.3**

**Substantial Completion**

4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2

**Substantial Completion, Definition of**

**9.8.1**

Substitution of Subcontractors

5.2.3, 5.2.4

Substitution of Architect

2.3.3

Substitutions of Materials

3.4.2, 3.5, 7.3.8

**Sub-subcontractor, Definition of**

**5.1.2**

Subsurface Conditions

3.7.4

**Successors and Assigns**

**13.2**

## **Superintendent**

3.9, 10.2.6

## **Supervision and Construction Procedures**

1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4

## **Suppliers**

1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1

## **Surety**

5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7

## **Surety, Consent of**

9.8.5, 9.10.2, 9.10.3

## **Surveys**

1.1.7, 2.3.4

## **Suspension by the Owner for Convenience**

### **14.3**

#### **Suspension of the Work**

3.7.5, 5.4.2, 14.3

#### **Suspension or Termination of the Contract**

5.4.1.1, 14

## **Taxes**

3.6, 3.8.2.1, 7.3.4.4

## **Termination by the Contractor**

14.1, 15.1.7

## **Termination by the Owner for Cause**

5.4.1.1, 14.2, 15.1.7

## **Termination by the Owner for Convenience**

### **14.4**

#### **Termination of the Architect**

2.3.3

#### **Termination of the Contractor Employment**

14.2.2

## **TERMINATION OR SUSPENSION OF THE CONTRACT**

### **14**

#### **Tests and Inspections**

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, 13.4

## **TIME**

### **8**

#### **Time, Delays and Extensions of**

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, 8.3, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5

#### **Time Limits**

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4

#### **Time Limits on Claims**

3.7.4, 10.2.8, 15.1.2, 15.1.3

#### **Title to Work**

9.3.2, 9.3.3

## **UNCOVERING AND CORRECTION OF WORK**

### **12**

#### **Uncovering of Work**

#### **12.1**

##### **Unforeseen Conditions, Concealed or Unknown**

3.7.4, 8.3.1, 10.3

##### **Unit Prices**

7.3.3.2, 9.1.2

Use of Documents

1.1.1, 1.5, 2.3.6, 3.12.6, 5.3

**Use of Site**

**3.13**, 6.1.1, 6.2.1

**Values, Schedule of**

**9.2**, 9.3.1

Waiver of Claims by the Architect

13.3.2

Waiver of Claims by the Contractor

9.10.5, 13.3.2, **15.1.7**

Waiver of Claims by the Owner

9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**

Waiver of Consequential Damages

14.2.4, 15.1.7

Waiver of Liens

9.3, 9.10.2, 9.10.4

**Waivers of Subrogation**

6.1.1, **11.3**

**Warranty**

**3.5**, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2

Weather Delays

8.3, 15.1.6.2

**Work, Definition of**

**1.1.3**

Written Consent

1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2

Written Interpretations

4.2.11, 4.2.12

Written Orders

1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

## **ARTICLE 1 GENERAL PROVISIONS**

### **§ 1.1 Basic Definitions**

#### **§ 1.1.1 The Contract Documents**

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

#### **§ 1.1.2 The Contract**

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

#### **§ 1.1.3 The Work**

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

#### **§ 1.1.4 The Project**

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### **§ 1.1.5 The Drawings**

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### **§ 1.1.6 The Specifications**

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### **§ 1.1.7 Instruments of Service**

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

#### **§ 1.1.8 Initial Decision Maker**

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

### **§ 1.2 Correlation and Intent of the Contract Documents**

**§ 1.2.1** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

**§ 1.2.1.1** The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

**§ 1.2.2** Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

**§ 1.2.3** Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

### **§ 1.3 Capitalization**

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### **§ 1.4 Interpretation**

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### **§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service**

**§ 1.5.1** The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

**§ 1.5.2** The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

### **§ 1.6 Notice**

**§ 1.6.1** Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

**§ 1.6.2** Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

### **§ 1.7 Digital Data Use and Transmission**

The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

## **§ 1.8 Building Information Models Use and Reliance**

Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

## **ARTICLE 2 OWNER**

### **§ 2.1 General**

**§ 2.1.1** The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

**§ 2.1.2** The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

### **§ 2.2 Evidence of the Owner's Financial Arrangements**

**§ 2.2.1** Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

**§ 2.2.2** Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

**§ 2.2.3** After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

**§ 2.2.4** Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

### **§ 2.3 Information and Services Required of the Owner**

**§ 2.3.1** Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements,

assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

**§ 2.3.2** The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

**§ 2.3.3** If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

**§ 2.3.4** The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

**§ 2.3.5** The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

**§ 2.3.6** Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

#### **§ 2.4 Owner's Right to Stop the Work**

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

#### **§ 2.5 Owner's Right to Carry Out the Work**

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

### **ARTICLE 3 CONTRACTOR**

#### **§ 3.1 General**

**§ 3.1.1** The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

**§ 3.1.2** The Contractor shall perform the Work in accordance with the Contract Documents.



**§ 3.1.3** The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

**§ 3.2 Review of Contract Documents and Field Conditions by Contractor**

**§ 3.2.1** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

**§ 3.2.2** Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

**§ 3.2.3** The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

**§ 3.2.4** If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

**§ 3.3 Supervision and Construction Procedures**

**§ 3.3.1** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

### **§ 3.4 Labor and Materials**

**§ 3.4.1** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**§ 3.4.2** Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

**§ 3.4.3** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

### **§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

**§ 3.5.2** All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### **§ 3.6 Taxes**

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

### **§ 3.7 Permits, Fees, Notices and Compliance with Laws**

**§ 3.7.1** Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

**§ 3.7.2** The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

**§ 3.7.3** If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### **§ 3.7.4 Concealed or Unknown Conditions**

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required

for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

**§ 3.7.5** If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

### **§ 3.8 Allowances**

**§ 3.8.1** The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

**§ 3.8.2** Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

**§ 3.8.3** Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

### **§ 3.9 Superintendent**

**§ 3.9.1** The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

**§ 3.9.2** The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

**§ 3.9.3** The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

### **§ 3.10 Contractor's Construction and Submittal Schedules**

**§ 3.10.1** The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to

completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

**§ 3.10.2** The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

**§ 3.10.3** The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

### **§ 3.11 Documents and Samples at the Site**

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

### **§ 3.12 Shop Drawings, Product Data and Samples**

**§ 3.12.1** Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

**§ 3.12.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**§ 3.12.3** Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

**§ 3.12.4** Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

**§ 3.12.6** By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**§ 3.12.7** The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

**§ 3.12.8** The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

**§ 3.12.9** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

**§ 3.12.10** The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

**§ 3.12.10.1** If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

**§ 3.12.10.2** If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

### **§ 3.13 Use of Site**

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

### **§ 3.14 Cutting and Patching**

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

### **§ 3.15 Cleaning Up**

**§ 3.15.1** The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

**§ 3.15.2** If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

### **§ 3.16 Access to Work**

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

### **§ 3.17 Royalties, Patents and Copyrights**

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### **§ 3.18 Indemnification**

**§ 3.18.1** To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

## **ARTICLE 4 ARCHITECT**

### **§ 4.1 General**

**§ 4.1.1** The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

**§ 4.1.2** Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

### **§ 4.2 Administration of the Contract**

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

**§ 4.2.2** The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

#### **§ 4.2.4 Communications**

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

**§ 4.2.5** Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

**§ 4.2.6** The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

**§ 4.2.7** The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

**§ 4.2.8** The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

**§ 4.2.9** The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and

assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

**§ 4.2.10** If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

**§ 4.2.11** The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

**§ 4.2.12** Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

**§ 4.2.13** The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

**§ 4.2.14** The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## **ARTICLE 5 SUBCONTRACTORS**

### **§ 5.1 Definitions**

**§ 5.1.1** A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

**§ 5.1.2** A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

### **§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work**

**§ 5.2.1** Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

**§ 5.2.2** The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

**§ 5.2.3** If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.



**§ 5.2.4** The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

### **§ 5.3 Subcontractual Relations**

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

### **§ 5.4 Contingent Assignment of Subcontracts**

**§ 5.4.1** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

**§ 5.4.2** Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

**§ 5.4.3** Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

## **ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

### **§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts**

**§ 6.1.1** The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with

any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

**§ 6.1.4** Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

## **§ 6.2 Mutual Responsibility**

**§ 6.2.1** The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

**§ 6.2.3** The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

**§ 6.2.4** The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

**§ 6.2.5** The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

## **§ 6.3 Owner's Right to Clean Up**

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

## **ARTICLE 7 CHANGES IN THE WORK**

### **§ 7.1 General**

**§ 7.1.1** Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

**§ 7.1.2** A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

**§ 7.1.3** Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

## **§ 7.2 Change Orders**

**§ 7.2.1** A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

## **§ 7.3 Construction Change Directives**

**§ 7.3.1** A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

**§ 7.3.2** A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

**§ 7.3.3** If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

**§ 7.3.4** If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

**§ 7.3.5** If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

**§ 7.3.6** Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

**§ 7.3.7** A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

**§ 7.3.8** The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

**§ 7.3.9** Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

**§ 7.3.10** When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

#### **§ 7.4 Minor Changes in the Work**

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

### **ARTICLE 8 TIME**

#### **§ 8.1 Definitions**

**§ 8.1.1** Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

**§ 8.1.2** The date of commencement of the Work is the date established in the Agreement.

**§ 8.1.3** The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

**§ 8.1.4** The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

#### **§ 8.2 Progress and Completion**

**§ 8.2.1** Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

**§ 8.2.2** The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

**§ 8.2.3** The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

#### **§ 8.3 Delays and Extensions of Time**

**§ 8.3.1** If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the

Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

**§ 8.3.2** Claims relating to time shall be made in accordance with applicable provisions of Article 15.

**§ 8.3.3** This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

## **ARTICLE 9 PAYMENTS AND COMPLETION**

### **§ 9.1 Contract Sum**

**§ 9.1.1** The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

**§ 9.1.2** If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### **§ 9.2 Schedule of Values**

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

### **§ 9.3 Applications for Payment**

**§ 9.3.1** At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

**§ 9.3.1.1** As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

**§ 9.3.1.2** Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

**§ 9.3.2** Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

**§ 9.3.3** The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims,

security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

#### **§ 9.4 Certificates for Payment**

**§ 9.4.1** The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

#### **§ 9.5 Decisions to Withhold Certification**

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

**§ 9.5.2** When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

**§ 9.5.3** When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

**§ 9.5.4** If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make

payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

## **§ 9.6 Progress Payments**

**§ 9.6.1** After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

**§ 9.6.2** The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

**§ 9.6.3** The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

**§ 9.6.4** The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

**§ 9.6.5** The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

**§ 9.6.6** A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

**§ 9.6.7** Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

**§ 9.6.8** Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

## **§ 9.7 Failure of Payment**

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

## **§ 9.8 Substantial Completion**

**§ 9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

**§ 9.8.2** When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.4** When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

**§ 9.8.5** The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

## **§ 9.9 Partial Occupancy or Use**

**§ 9.9.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

**§ 9.9.2** Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**§ 9.9.3** Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

## **§ 9.10 Final Completion and Final Payment**

**§ 9.10.1** Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and



belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**§ 9.10.2** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

**§ 9.10.3** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

**§ 9.10.4** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

**§ 9.10.5** Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## **ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

### **§ 10.1 Safety Precautions and Programs**

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

### **§ 10.2 Safety of Persons and Property**

**§ 10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

**§ 10.2.2** The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

**§ 10.2.3** The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

**§ 10.2.4** When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

**§ 10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

**§ 10.2.6** The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

**§ 10.2.7** The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

**§ 10.2.8 Injury or Damage to Person or Property**

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

**§ 10.3 Hazardous Materials and Substances**

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

**§ 10.3.2** Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or

entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

**§ 10.3.3** To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

**§ 10.3.4** The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

**§ 10.3.5** The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

**§ 10.3.6** If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

#### **§ 10.4 Emergencies**

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

### **ARTICLE 11 INSURANCE AND BONDS**

#### **§ 11.1 Contractor's Insurance and Bonds**

**§ 11.1.1** The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

**§ 11.1.2** The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

**§ 11.1.3** Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

**§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by

the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

## **§ 11.2 Owner's Insurance**

**§ 11.2.1** The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

**§ 11.2.2 Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

**§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

## **§ 11.3 Waivers of Subrogation**

**§ 11.3.1** The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

**§ 11.3.2** If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring

the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

#### **§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance**

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

#### **§ 11.5 Adjustment and Settlement of Insured Loss**

**§ 11.5.1** A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

**§ 11.5.2** Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

### **ARTICLE 12 UNCOVERING AND CORRECTION OF WORK**

#### **§ 12.1 Uncovering of Work**

**§ 12.1.1** If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

**§ 12.1.2** If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

#### **§ 12.2 Correction of Work**

##### **§ 12.2.1 Before Substantial Completion**

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

##### **§ 12.2.2 After Substantial Completion**

**§ 12.2.2.1** In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor

shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

**§ 12.2.2.2** The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

**§ 12.2.2.3** The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

**§ 12.2.3** The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

**§ 12.2.4** The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

**§ 12.2.5** Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

### **§ 12.3 Acceptance of Nonconforming Work**

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## **ARTICLE 13 MISCELLANEOUS PROVISIONS**

### **§ 13.1 Governing Law**

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

### **§ 13.2 Successors and Assigns**

**§ 13.2.1** The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

**§ 13.2.2** The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

### **§ 13.3 Rights and Remedies**

**§ 13.3.1** Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

**§ 13.3.2** No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

#### **§ 13.4 Tests and Inspections**

**§ 13.4.1** Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

**§ 13.4.2** If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

**§ 13.4.3** If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

**§ 13.4.4** Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

**§ 13.4.5** If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

**§ 13.4.6** Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

#### **§ 13.5 Interest**

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

### **ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT**

#### **§ 14.1 Termination by the Contractor**

**§ 14.1.1** The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

**§ 14.1.2** The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

**§ 14.1.3** If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

**§ 14.1.4** If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

## **§ 14.2 Termination by the Owner for Cause**

**§ 14.2.1** The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

**§ 14.2.2** When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

**§ 14.2.3** When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

**§ 14.2.4** If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

## **§ 14.3 Suspension by the Owner for Convenience**

**§ 14.3.1** The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

**§ 14.3.2** The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent



- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

#### **§ 14.4 Termination by the Owner for Convenience**

**§ 14.4.1** The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

**§ 14.4.2** Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

**§ 14.4.3** In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

### **ARTICLE 15 CLAIMS AND DISPUTES**

#### **§ 15.1 Claims**

##### **§ 15.1.1 Definition**

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

##### **§ 15.1.2 Time Limits on Claims**

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

##### **§ 15.1.3 Notice of Claims**

**§ 15.1.3.1** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

**§ 15.1.3.2** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

##### **§ 15.1.4 Continuing Contract Performance**

**§ 15.1.4.1** Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

**§ 15.1.4.2** The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

**§ 15.1.5 Claims for Additional Cost**

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

**§ 15.1.6 Claims for Additional Time**

**§ 15.1.6.1** If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

**§ 15.1.6.2** If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

**§ 15.1.7 Waiver of Claims for Consequential Damages**

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

**§ 15.2 Initial Decision**

**§ 15.2.1** Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

**§ 15.2.2** The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

**§ 15.2.3** In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

**§ 15.2.4** If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

**§ 15.2.5** The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

**§ 15.2.6** Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

**§ 15.2.6.1** Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

**§ 15.2.7** In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

**§ 15.2.8** If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

### **§ 15.3 Mediation**

**§ 15.3.1** Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

**§ 15.3.2** The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

**§ 15.3.3** Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

**§ 15.3.4** The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

## **§ 15.4 Arbitration**

**§ 15.4.1** If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

**§ 15.4.1.1** A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

**§ 15.4.2** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

**§ 15.4.3** The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

### **§ 15.4.4 Consolidation or Joinder**

**§ 15.4.4.1** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

**§ 15.4.4.2** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

**§ 15.4.4.3** The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

## **Additions and Deletions Report for** **AIA® Document A201® – 2017**

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 07:57:40 EDT on 09/08/2026.

### **PAGE 1:**

263303.00 Warren County Career Center Medical Academy Addition

3525 OH-48  
Lebanon, Ohio 45036

Warren County Career Center

3625 North State Route 48  
Lebanon, Ohio 45036

Levin Porter Associates Inc

3011 Newmark Drive  
Miamisburg, Ohio 45342

## ***Certification of Document's Authenticity***

***AIA® Document D401™ – 2003***

I, A201 General Conditions for Specs, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 07:57:40 EDT on 09/08/2026 under Order No. 20250095661 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ - 2017, General Conditions of the Contract for Construction, other than those additions and deletions shown in the associated Additions and Deletions Report.

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*(Signed)*

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*(Title)*

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*(Dated)*

**SECTION 013000**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General administrative requirements.
- B. Web-based project software service.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Contractor's daily reports.
- G. Progress photographs.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Requests for Interpretation (RFI) procedures.
- L. Submittal procedures.

**1.02 RELATED REQUIREMENTS**

- A. Section 007200 - General Conditions: Dates for applications for payment.
- B. Section 013216 - Construction Progress Schedule: Form, content, and administration of schedules.
- C. Section 013329.02 - Sustainable Design Reporting - LEED v4: Reporting related to sustainability certification project procedures.
- D. Section 016000 - Product Requirements: General product requirements.
- E. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.
- F. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
- G. Section 019113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
  - 1. Where submittals are indicated for review by both Architect and the Commissioning Provider (CxP), submit one extra and route to Architect first for forwarding to the Commissioning Provider.
  - 2. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Provider (CxP); otherwise, the procedures specified in this section apply to commissioning submittals.

**1.03 REFERENCE STANDARDS**

- A. AIA G716 - Request for Information; 2004.
- B. AIA G810 - Transmittal Letter; 2001.
- C. CSI/CSC Form 12.1A - Submittal Transmittal; Current Edition.
- D. CSI/CSC Form 13.2A - Request for Information; Current Edition.

**1.04 GENERAL ADMINISTRATIVE REQUIREMENTS**

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

- B. Make the following types of submittals to Architect:
1. Requests for Interpretation (RFI).
  2. Requests for substitution.
  3. Shop drawings, product data, and samples.
  4. Test and inspection reports.
  5. Design data.
  6. Manufacturer's instructions and field reports.
  7. Applications for payment and change order requests.
  8. Progress schedules.
  9. Coordination drawings.
  10. Correction Punch List and Final Correction Punch List for Substantial Completion.
  11. Closeout submittals.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### 3.01 WEB-BASED PROJECT SOFTWARE SERVICE

- A. Web-Based Project Software Service: Provide, administer, and use web-based project software to host and manage project communication and documentation.
1. Include, at minimum, the following features:
    - a. Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
    - b. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
    - c. Workflow planning, allowing customization of workflow for each project entity.
    - d. Creation, logging, tracking, and notification for project communications.
    - e. Tracking of project communication statuses in real time, including timestamped response log.
    - f. Procedures for viewing PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    - g. Processing and tracking of payment applications.
    - h. Processing and tracking of contract modifications.
    - i. Creation and distribution of meeting minutes.
    - j. Document management for drawings, specifications, and coordination drawings, including revision control.
    - k. Management of construction progress photographs.
    - l. Mobile device compatibility.
    - m. Creation of data analytics reports.
    - n. Creation and export of editable logs for software functions. Provide Owner, Architect, and Architect's consultants with rights and ability to download logs when requested.
  2. Provide up to 20 user licenses for use by Owner, Architect, Architect's consultants, and other entities involved in the project.
  3. Comply with the software service's current published licensing agreements.
  4. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
    - a. Representatives of Owner are scheduled and included in this training.
  5. Project Closeout: Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.
  6. Web-Based Project Software Services: The selected service is:

### 3.02 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.



- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Contractor.
- C. Agenda:
  - 1. Execution of Owner-Contractor Agreement.
  - 2. Submission of executed bonds and insurance certificates.
  - 3. Distribution of Contract Documents.
  - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
  - 5. Designation of personnel representing the parties to Contract, \_\_\_\_\_ and Architect.
  - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### 3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
  - 1. Contractor.
  - 2. Owner.
  - 3. Architect.
  - 4. Contractor's superintendent.
  - 5. Major subcontractors.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Review of RFIs log and status of responses.
  - 7. Review of off-site fabrication and delivery schedules.
  - 8. Maintenance of progress schedule.
  - 9. Corrective measures to regain projected schedules.
  - 10. Planned progress during succeeding work period.
  - 11. Maintenance of quality and work standards.
  - 12. Effect of proposed changes on progress schedule and coordination.
  - 13. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### 3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.
  - D. Within 10 days after joint review, submit complete schedule.
  - E. Submit updated schedule with each Application for Payment.
- 3.05 DAILY CONSTRUCTION REPORTS
- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
  - B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
    1. Date.
    2. High and low temperatures, and general weather conditions.
    3. List of subcontractors at Project site.
    4. List of separate contractors at Project site.
    5. Approximate count of personnel at Project site.
    6. Major equipment at Project site.
    7. Material deliveries.
    8. Safety, environmental, or industrial relations incidents.
    9. Meetings and significant decisions.
    10. Unusual events (submit a separate special report).
    11. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
    12. Directives and requests of authority having jurisdiction (AHJ).
    13. Testing and/or inspections performed.
    14. Signature of Contractor's authorized representative.
- 3.06 PROGRESS PHOTOGRAPHS
- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
  - B. Photography Type: Digital; electronic files.
  - C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
  - D. In addition to periodic, recurring views, take photographs of each of the following events:
  - E. Views:
    1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
    2. Consult with Architect for instructions on views required.
    3. Provide factual presentation.
    4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
  - F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
    1. Delivery Medium: Via email.
    2. File Naming: Include project identification, date and time of view, and view identification.
    3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
    4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.
- 3.07 COORDINATION DRAWINGS
- A. Review drawings prior to submission to Architect.

### 3.08 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
  - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
  - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
  - 1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  - 2. Prepare using software provided by the Electronic Document Submittal Service.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
  - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  - 2. Owner's, Architect's, and Contractor's names.
  - 3. Discrete and consecutive RFI number, and descriptive subject/title.
  - 4. Issue date, and requested reply date.
  - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
  - 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
- H. Review Time: Architect will respond and return RFIs to Contractor within 5 calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
- I.
- J. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.

### 3.09 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.

### 3.10 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data.
  - 2. Design data.
  - 3. Shop drawings.
  - 4. Samples for selection.
  - 5. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

### 3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
  - 1. Project record documents.
  - 2. Operation and maintenance data.
  - 3. Warranties.
  - 4. Bonds.
  - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

### 3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
  - 1. After review, produce duplicates.
  - 2. Retained samples will not be returned to Contractor unless specifically so stated.

### 3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
  - 1. Use a separate transmittal for each item.
  - 2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
  - 3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
  - 4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
  - 5. Schedule submittals to expedite the Project, and coordinate submission of related items.
    - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
  7. Provide space for Contractor and Architect review stamps.
  8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
  2. Do not reproduce Contract Documents to create shop drawings.
  3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
  2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

### 3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Approved", or language with same legal meaning.
    - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
  2. Not Authorizing fabrication, delivery, and installation:
- E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
    - a. "Received" - to notify the Contractor that the submittal has been received for record only.
  2. Items for which action was taken:
    - a. "Reviewed" - no further action is required from Contractor.

### **END OF SECTION**

**SECTION 013216**  
**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Construction progress schedule, bar chart type.

1.02 RELATED SECTIONS

- A. Section 011000 - Summary: Work sequence.

1.03 REFERENCE STANDARDS

- A. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016, with Addendum (2021).

1.04 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Submit updated schedule with each Application for Payment.
- E. Submit in PDF format.

1.05 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Sheet Size: Multiples of 8-1/2 x 11 inches.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

3.01 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide legend for symbols and abbreviations used.

3.02 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.03 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### 3.05 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

**END OF SECTION**

**SECTION 014000**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Quality assurance.
- B. References and standards.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Mock-ups.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 012100 - Allowances: Allowance for payment of testing services.
- B. Section 014216 - Definitions.
- C. Section 014219 - Reference Standards.
- D. Section 016000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2026.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2025.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing of Soil and Rock as Used in Engineering Design and Construction; 2026.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2026.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2026.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Contractor's Quality Control (CQC) Plan:
  - 1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:



- a. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
- b. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.

#### 1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

#### 1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 012100; see Section 012100 and applicable sections for description of services included in allowance.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

### **PART 3 EXECUTION**

#### 2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

#### 2.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

- C. Notify Architect and \_\_\_\_\_ Consultant fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
- H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

## 2.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

## 2.04 TESTING AND INSPECTION

- A. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.

- 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

#### 2.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment, and \_\_\_\_\_ as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

#### 2.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

### **END OF SECTION**

**SECTION 014100**  
**REGULATORY REQUIREMENTS**

**PART 1 GENERAL**

1.01 SUMMARY OF REFERENCE STANDARDS

- A. Regulatory requirements applicable to this project are the following:
- B. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- C. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- D. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- E. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- H. NFPA 1 - Fire Code; 2024, with Errata.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 014216**  
**DEFINITIONS**

**PART 1 GENERAL**

1.01 SUMMARY

- A. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**SECTION 014219**  
**REFERENCE STANDARDS**  
**END OF SECTION**

## **SECTION 014533**

### **CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Submittals.

##### **1.02 DEFINITIONS**

- A. Code or Building Code: ICC (IBC), International Building Code, most recent edition adopted by authority having jurisdiction, including all applicable amendments and supplements without limitation, and specifically Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. NIST: National Institute of Standards and Technology.
- D. Special Inspections and Tests: Inspections and testing of materials, installation, fabrication, erection, or placement of components and connections mandated by Building Code to safeguard public welfare.
  - 1. Special inspections and tests are separate from and independent of tests and inspections conducted by Owner or Contractor for purposes of quality assurance and contract administration.

##### **1.03 REFERENCE STANDARDS**

- A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.
- B. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291; 2025, with Editorial Revision.
- C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

##### **1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to start of work, Special Inspection Agency is required to:
  - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
  - 4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.

##### **1.05 QUALITY ASSURANCE**

- A. Special Inspection Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
  - 2. Accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.

2. Accredited by IAS according to IAS AC89.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

3.01 SPECIAL INSPECTIONS AND TESTING

- A. The Code requires special inspections and testing of certain materials, components, assemblies, and connections used in constructing the project. Special inspections and testing will be performed in accordance with the Code.

**END OF SECTION**



**SECTION 015000**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Dewatering
- B. Temporary utilities.
- C. Temporary telecommunications services.
- D. Temporary sanitary facilities.
- E. Temporary Controls: Barriers, enclosures, and fencing.
- F. Security requirements.
- G. Vehicular access and parking.
- H. Waste removal facilities and services.
- I. Project identification sign.
- J. Field offices.

1.02 RELATED REQUIREMENTS

- A. Section 015100 - Temporary Utilities.
- B. Section 015213 - Field Offices and Sheds.
- C. Section 015500 - Vehicular Access and Parking.

1.03 REFERENCE STANDARDS

1.04 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.
- B. Maintain temporary facilities in operable condition.

1.05 TEMPORARY UTILITIES - SEE SECTION 015100

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.06 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:

1.07 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.08 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.09 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.10 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.11 SECURITY - SEE SECTION 013553

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.12 VEHICULAR ACCESS AND PARKING - SEE SECTION 015500

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.13 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

- A. Provide project identification sign of design, construction, and location approved by Owner.
- B. No other signs are allowed without Owner permission except those required by law.

1.15 FIELD OFFICES - SEE SECTION 015213

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 016000**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

**PART 2 PRODUCTS**

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
  - 1. Made outside the United States, its territories, Canada, or Mexico.
  - 2. Containing lead, cadmium, or asbestos.
- C. Where other criteria are met, Contractor shall give preference to products that:
  - 1. If used on interior, have lower emissions, as defined in Section 016116.
  - 2. If wet-applied, have lower VOC content, as defined in Section 016116.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

### **PART 3 EXECUTION**

#### **3.01 SUBSTITUTION LIMITATIONS**

- A. See Section 012500 - Substitution Procedures.

#### **3.02 TRANSPORTATION AND HANDLING**

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

#### **3.03 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

### **END OF SECTION**

**SECTION 017000**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, \_\_\_\_\_.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- B. Section 078400 - Firestopping.

1.03 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.04 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.05 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.

- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.

- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and \_\_\_\_\_.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations, and \_\_\_\_\_.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

### 3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### 3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and \_\_\_\_\_): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.



- a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
  - b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- D. Protect existing work to remain.
  1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- G. Refinish existing surfaces as indicated:
  1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- H. Clean existing systems and equipment.
- I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- J. Do not begin new construction in alterations areas before demolition is complete.
- K. Comply with all other applicable requirements of this section.

### 3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### 3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### 3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### 3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### 3.11 DEMONSTRATION AND INSTRUCTION

- A. See Section 017900 - Demonstration and Training.

### 3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

### 3.13 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
  - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and \_\_\_\_\_.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### 3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### 3.15 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION**

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

**SECTION 017800**  
**CLOSEOUT SUBMITTALS**  
**END OF SECTION**

**SECTION 017900**  
**DEMONSTRATION AND TRAINING**

**PART 1 GENERAL**

1.01 SUMMARY

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Provider.
  - 2. Submit one copy to the Commissioning Provider, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Provider.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Provider in preparation of overall Training Plan; submit in editable .rtf or .docx electronic format unless otherwise approved.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**END OF SECTION**

## **SECTION 020342**

### **REMOVAL AND SALVAGE OF PERIOD CONSTRUCTION MATERIALS**

#### **PART 2 PRODUCTS (NOT USED)**

#### **PART 3 EXECUTION**

##### **2.01 PERIOD TREATMENT, GENERAL**

- A. See Section 013591 for special procedure requirements related to elements and features of historical significance and value.

##### **2.02 GENERAL PROCEDURES**

- A. Drawings indicating existing construction, building services, and site utilities are based on casual field observation and existing record documents only.
  - 1. Report discrepancies to Architect before disturbing existing historic elements.
  - 2. Beginning of work constitutes acceptance of existing conditions that are apparent upon examination at that time.
- B. Separate spaces in which removals and salvage operations are conducted from occupied spaces.
  - 1. Provide, erect, and maintain temporary dustproof partitions; see Section 015000.

##### **2.03 ENVIRONMENTAL CONTROLS**

- A. Comply with federal, state, and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment, and noise pollution.

##### **2.04 ITEMS TO BE SALVAGED**

- A. General: Salvage elements and components to the maximum extent possible. Maintain a chain of custody of salvaged materials, including the condition of such materials before and after salvage operations.

##### **2.05 MATERIALS TO BE REMOVED**

- A. Remove existing nonhistoric elements as indicated and as required to allow direct access to period construction elements indicated to be restored or salvaged for reuse.
- B. Protect existing historic elements.
  - 1. Prevent movement of structure; provide temporary, removable shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly, minimizing overcutting.

##### **2.06 MATERIALS TO BE RECYCLED**

- A. Recycle removed nonhistoric materials to the maximum extent possible. Remove recyclable materials by hand wherever possible.
- B. Recycle items indicated on drawings.

**SECTION 024100**  
**DEMOLITION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Selective demolition of building elements for alteration purposes.
- D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 312200 - Grading: Rough and fine grading.
- G. Section 312323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 DEFINITIONS

- A. Demolish: Dismantle, raze, destroy, or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Site Plan: Indicate:
  - 1. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

**PART 3 EXECUTION**

2.01 DEMOLITION

- A. Remove other items indicated, for salvage, relocation, recycling, and \_\_\_\_\_.



- B. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 312200.

## 2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 3. Provide, erect, and maintain temporary barriers and security devices.
  - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 5. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
  - 6. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
  - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.

## 2.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

## 2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
  - 1. Verify construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- C. Remove existing work as indicated and required to accomplish new work.
  - 1. Remove items indicated on drawings.

- D. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
  - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  - 3. Verify that abandoned services serve only abandoned facilities before removal.
  - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
  - 1. Prevent movement of structure. Provide shoring and bracing as required.
  - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
  - 3. Repair adjacent construction and finishes damaged during removal work.
  - 4. Patch to match new work.

#### 2.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

### **END OF SECTION**

## **SECTION 031000**

### **CONCRETE FORMING AND ACCESSORIES**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

###### A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

###### B. Related Requirements:

1. Section 33000 "Cast-in-Place Concrete" for embedded items and surface finishes related to formwork.

##### 1.2 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

##### 1.3 ACTION SUBMITTALS

1. See Section 01... for requirements.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. See General Notes in Construction Documents for additional requirements.
  2. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

##### 1.4 INFORMATIONAL SUBMITTALS

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## **PART 2 - PRODUCTS**

### 2.1 FORM-FACING MATERIALS

#### A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

- a. Plywood, metal, or other approved panel materials.

#### B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

#### C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

#### D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

### 2.2 WATERSTOPS

#### A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

1. Profile: Flat dumbbell with center bulb.
2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

#### B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell with center bulb.
2. Dimensions: 4 inches by 3/16 inch thick ; nontapered.

#### C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Dimensions: 4 inches by 3/16 inch thick; nontapered.

- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- G. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- H. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- I. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- J. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
  - 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF FORMWORK**

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes .
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
  - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
  - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.

- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
  - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
  - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 3. Place joints perpendicular to main reinforcement.
  - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
    - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 6. Space vertical joints in walls as indicated on Drawings.
    - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
  5. Clean embedded items immediately prior to concrete placement.

### 3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
1. Install in longest lengths practicable.
  2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
  4. Secure waterstops in correct position at 12 inches on center.
  5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
    - a. Miter corners, intersections, and directional changes in waterstops.
    - b. Align center bulbs.
  6. Clean waterstops immediately prior to placement of concrete.
  7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

### 3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 and manufacturer's instructions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Install forms in running bond pattern.
  1. Align joints.
  2. Align furring strips.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  1. Determine sizes and locations from trades providing such items.
  2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
  1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

### 3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work.
  1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  2. Apply new form-release agent.



- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  - 1. Align and secure joints to avoid offsets.
  - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. See Construction Documents for special inspection requirements.

**END OF SECTION**

## **SECTION 032000**

### **CONCRETE REINFORCING**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for reinforcing, hot weather fogging, calcium chloride, examination of reinforcing, vapor retarder protection, construction joints, concrete placement, position of reinforcing on chairs and repairs.

##### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
  - a. Special inspection and testing and inspecting agency procedures for field quality control.
  - b. Construction contraction and isolation joints.
  - c. Steel-reinforcement installation.

##### 1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Mechanical splice couplers.
3. Structural thermal break insulated connection system.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

- a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

#### 1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

### **PART 2 - PRODUCTS**

#### 2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

## 2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; mechanical-lap type.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Plain Galvanized ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch wire length.

## 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

# **PART 3 - EXECUTION**

## 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

## 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.

- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
  - 1. See Contract Documents for special inspections.

**END OF SECTION**

## **SECTION 033000**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.

##### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland or Portland-Limestone cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
  - a. Contractor's superintendent.
  - b. Independent testing agency responsible for concrete design mixtures.
  - c. Ready-mix concrete manufacturer.
  - d. Concrete Subcontractor.
  - e. Special concrete finish Subcontractor.
2. Review the following:
  - a. Special inspection and testing and inspecting agency procedures for field quality control.
  - b. Construction joints, control joints, isolation joints, and joint-filler strips.

- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Portland-limestone cement.
- 3. Fly ash.
- 4. Slag cement.
- 5. Aggregates.
- 6. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 7. Vapor retarders.
- 8. Floor and slab treatments.
- 9. Curing materials.
  - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 10. Joint fillers.
- 11. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 10. Intended placement method.



11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Vapor retarders.
7. Semirigid joint filler.
8. Joint-filler strips.
9. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Portland-Limestone cement.
3. Fly ash.
4. Slag cement.
5. Aggregates.
6. Admixtures:

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
  - 1. Include the following information in each test report:
    - a. Admixture dosage rates.
    - b. Slump.
    - c. Air content.
    - d. Seven-day compressive strength.
    - e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 3. Do not use frozen materials or materials containing ice or snow.
  - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
  - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
  - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.

1.10 Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

### 2.2 CONCRETE MATERIALS

- A. Source Limitations:

- 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
  - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
  - 3. Obtain aggregate from single source.
  - 4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

- 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
  - 2. Portland-Limestone Cement: ASTM C595, Type 1L.
  - 3. Fly Ash: ASTM C618, Class C or F.
  - 4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

- 1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
    - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
    - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

- 2. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

- 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable or

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder, Class C: ASTM E1745, Class C Insert rating; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
- C. Sheet Vapor Retarder/Termite Barrier: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.03 perms; complying with ICC AC380. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Low-Temperature Flexibility: Pass at minus 15 deg F; ASTM D146/D146M.
  - 2. Puncture Resistance: 224 lbf minimum; ASTM E154/E154M.
  - 3. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
  - 4. Hydrostatic-Head Resistance: 231 feet minimum; ASTM D5385.
- D. Bituminous Vapor Retarder: ASTM E1993/E1993M, 110-mil- thick, semiflexible, seven-ply sheet membrane, consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weather coating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.
  - 1. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg when tested in accordance with ASTM E154/E154M.
  - 2. Tensile Strength: 156 lbf/inch when tested in accordance with ASTM E154/E154M.
  - 3. Puncture Resistance: 140 lbf when tested in accordance with ASTM E154/E154M.

## 2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature Above 85 deg F: White.
- D. Curing Paper: 8-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Floor Slab Protective Covering: 8-feet- wide cellulose fabric.

## 2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

2.8 SMBH Add:

- A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement or portland-limestone cement in concrete as follows:
  - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
  - 2. Slag Cement: 50 percent by mass.
  - 3. Silica Fume: 10 percent by mass.
  - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
  - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- B. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- C. See General Notes for Concrete Mixture Information.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Verification of Conditions:
  - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
  - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
  - 1. Daily access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
  - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

### 3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  - 7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

### 3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  - 2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated.

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
  1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
  1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
  1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.



4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
  - a. Do not use vibrators to transport concrete inside forms.
  - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
  - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
  - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 FINISHING FORMED SURFACES

#### A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view and will not receive a coating or covering material applied directly to the concrete Insert locations.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

### 3.8 SMBH Comment - Likely won't use SF-3.0 unless you have architectural concrete.

1. ACI 301 Surface Finish SF-3.0:

- a. Patch tie holes.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Trowel Finish :

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

- C. Broom Finish : Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

- D. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings

1. Apply in accordance with manufacturer's written instructions and as follows:
  - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
  - b. Tamp aggregate flush with surface, but do not force below surface.
  - c. After broadcasting and tamping, apply float finish.
  - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

- E. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
4. After final floating, apply a trowel finish.
5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

### 3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

#### A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

#### B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

#### C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
  - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - b. Cast anchor-bolt insert into bases.
  - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

### 3.11 CONCRETE CURING

#### A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

#### B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
  - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
  - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
    - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
      - a) Lap edges and ends of absorptive cover not less than 12 inches.
      - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
    - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
      - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      - b) Cure for not less than seven days.
    - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      - a) Water.
      - b) Continuous water-fog spray.

b. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.12 TOLERANCES

- A. Conform to ACI 117.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least **[one] [six]** month(s).
  2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
  2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.
    - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
  - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
  - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.
  - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
  - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
  - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
  - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
  - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.
  - c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.

- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
1. See Contract Documents for Special Inspections.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M:
    - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M:
    - a. Cast and laboratory cure four 6-inch by 12-inch or five 4-inch by 8-inch cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M.
    - a. Test one laboratory-cured specimen at seven days and one set of two 6-inch by 12-inch or three 4-inch by 8-inch specimens at 28 days. Hold one specimen for additional testing if required.
    - b. A compressive-strength test to be the average compressive strength from a set of two 6-inch by 12-inch or three 4-inch by 8-inch specimens obtained from same composite sample and tested at age indicated.



7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:
  - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

### 3.16 PROTECTION

- A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

## **END OF SECTION**

**SECTION 033000**  
**CAST-IN-PLACE CONCRETE**

**PART 2 PRODUCTS**

**1.01 FORMWORK**

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
  - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
  - 2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
  - 3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

**1.02 REINFORCEMENT MATERIALS**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
  - 1. Type: Deformed billet-steel bars.
  - 2. Finish: Epoxy coated in accordance with ASTM A775/A775M, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
- C. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
  - 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

**1.03 CONCRETE MATERIALS**

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Calcined Pozzolan: ASTM C618, Class N.
- E. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.
- F. Silica Fume: ASTM C1240, proportioned in accordance with ACI PRC-211.1.
- G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
  - 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
  - 2. Color(s): As indicated on drawings.
- H. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
- I. Structural Fiber Reinforcement: ASTM C1116/C1116M.
  - 1. Fiber Length: 2.0 inch , nominal.
  - 2. Fiber Type: Alkali-resistant synthetic.
    - a. Products:
      - 1) Euclid Chemical Company; TUF-STRAND \_\_\_\_: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
      - 2) Forta Corporation; FORTA-FERRO (2-1/4"): [www.forta-ferro.com/#sle](http://www.forta-ferro.com/#sle).

#### 1.04 ADMIXTURES

- A. Chemical Admixture:
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- G. Retarding Admixture: ASTM C494/C494M Type B.
- H. Water Reducing Admixture: ASTM C494/C494M Type A.
- I. Moisture Vapor Reducing Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs). Closes capillary systems formed during concrete curing to reduce moisture vapor emission and transmission. Reduces concrete shrinkage with no adverse effect on concrete properties or applied flooring.

#### 1.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
  - 1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
  - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
  - 3. Products:
    - a. FullForce by ABC Polymers Industries, LLC; VaporForce - 15 Mil: [www.fullforcesolutions.us/#sle](http://www.fullforcesolutions.us/#sle).
    - b. Henry, a Carlisle Company; Moistop Ultra 15: [www.henry.com/#sle](http://www.henry.com/#sle).
    - c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): [www.isibp.com/#sle](http://www.isibp.com/#sle).
    - d. Stego Industries, LLC; Stego Wrap 15 mil: [www.stegoindustries.com/#sle](http://www.stegoindustries.com/#sle).
    - e. Tex-Trude, LP; Xtreme Vapor Barrier (15-mil): [www.tex-trude.com/#sle](http://www.tex-trude.com/#sle).
    - f. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - g. \_\_\_\_\_.

#### 1.06 BONDING AND JOINTING PRODUCTS

- A. Epoxy Bonding System:
- B. Waterstops: Bentonite and butyl rubber. Rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- C. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
- D. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.

#### 1.07 CURING MATERIALS

- A. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
  - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
  - 2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
  - 3. VOC Content: Less than 100 g/L.

- B. Curing and Sealing Compound, Moisture Emission-Reducing, Penetrating: Clear, water-based, non-film-forming curing agent; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission, moisture vapor emission, and alkalinity.
  - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
  - 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C39/C39M.
  - 3. Chloride Ion Resistance of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C1202.
  - 4. Comply with ASTM C309 and ASTM C1315 Type I Class A.
- C. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
- D. Moisture-Retaining Sheet: ASTM C171.
  - 1. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
- E. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.
- F. Water: Potable, not detrimental to concrete.

#### 1.08 CONCRETE MIX DESIGN

- A. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
  - 1. Use water reducing high range water reducing or plasticizing admixture in concrete as required for workability and placement.
  - 2. Use water reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water reducing admixture in pumped concrete, concrete for heavy use industrial slabs and parking structure slabs, concrete required to be water tight, and concrete with a w/c ratio below 0.50.
- B. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.
- C. Normal Weight Concrete:
  - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
  - 2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
  - 3. Calcined Pozzolan Content: Maximum 25 percent combined fly ash and pozzolan
  - 4. Silica Fume Content: Maximum 10 percent of cementitious materials by weight.
  - 5. Combined fly ash, pozzolans, and silica fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 6. Combined fly ash or pozzolans, slag cement, and silica fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 7. Water-Cement Ratio: Maximum 40 percent by weight.
  - 8. Maximum Aggregate Size: 5/8 inch.

#### 1.09 MIXING

- A. Ready mixed concrete: Measure, batch, mix, and deliver concrete according to ASEM C94/C94M, and furnish batch ticket information
  - 1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F reduce mixing and delivery time to 60 minutes.
- B. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
2. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.
- D. Do not use shrinkage-reducing admixture (SRA) in same concrete batch with MVRA or PIA.

### **PART 3 EXECUTION**

#### **2.01 EXAMINATION**

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

#### **2.02 PREPARATION**

- A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R, \_\_\_\_\_.
- E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
  1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
- F. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- G. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- H. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

#### **2.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS**

- A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- B. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

#### **2.04 PLACING CONCRETE**

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Place concrete with shrinkage-compensating expansive component in accordance with ACI PRC-223.
- D. Notify Architect not less than 24 hours prior to commencement of placement operations.

- E. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- F. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- G. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- H. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

#### 2.05 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

#### 2.06 SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B. Place required dividers, edge strips, reinforcing, and other items to be cast in.
- C. Apply bonding agent to substrate in accordance with manufacturer's instructions.

#### 2.07 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
  - 1. Exposed Concrete Floors: 1/4 inch in 10 feet.
  - 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
  - 3. Under Carpeting: 1/4 inch in 10 feet.
- B. Correct the slab surface if tolerances are less than specified.
- C. Refer to drawings for any special flatness location.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

#### 2.08 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
- D. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
  - 1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
  - 2. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.

- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

## 2.09 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
  - 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
  - 2. Final Curing: Begin after initial curing but before surface is dry.

## 2.10 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

## 2.11 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

## 2.12 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

## 2.13 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Footings - normal weight concrete
  - 1. Minimum Compressive Strength: 3000 psi at 28 days
  - 2. Maximum W/C Ratio: 0.52
  - 3. Aggregate not to exceed 1-1/2 inch
  - 4. Slump limit: 4 inches, plus or minus 1 inch
- B. Foundation Walls (non exposed): Normal weight concrete
  - 1. Minimum Compressive Strength: 4000 psi at 28 days
  - 2. Maximum W/C Ratio: 0.48
  - 3. Aggregate not to exceed 1-1/2 inch
  - 4. Slump limit: 5 inches, plus or minus 1 inch
- C. Foundation Walls (exposed to weather) - Normal Weight Concrete
  - 1. Minimum Compressive Strength: 4500 psi at 28 days
  - 2. Maximum W/C Ratio: 0.45
  - 3. Slump limit: 4 inches, plus or minus 1 inch
  - 4. Air Content: 6 percent plus or minus 1.5 percent at point of delivery for 1 inch nominal maximum aggregate size
- D. Slabs on Grade: normal weight concrete
  - 1. Minimum Compressive Strength: 4000 psi at 28 days
  - 2. Maximum W/C Ratio: 0.48

3. Slump limit: 4 inches, plus or minus 1 inch
  4. Air Content: Do not allow air content of trowel finished floors to exceed 3 percent
  5. Synthetic macro fiber: uniformly disperse in concrete mixture at manufacturer's recommended rate but not less than 3 lb/ cy yd
- E. Suspended Slabs and Building Frame Members: Normal weight concrete
1. Minimum Compressive Strength: 4000 psi at 28 days
  2. Maximum W/C Ratio: 0.48
  3. Minimum Cementitious Materials Content: 540 lb / cu Yd
  4. Aggregate not to exceed 3/4 inch
  5. Slump limit: 5 inches, plus or minus 1 inch
  6. Air Content: Do not allow air content of trowel finish floors to exceed 3 percent.
- F. Columns: Normal weight concrete
1. Minimum Compressive Strength: 5000 psi at 28 days
  2. Maximum W/C Ratio: 0.41
  3. Slump limit: 5 inches, plus or minus 1 inch
- G. Slabs on Metal Deck: Normal Weight Concrete
1. Minimum Compressive Strength: 3500 psi at 28 days
  2. Maximum W/C Ratio: 0.50
  3. Maximum Cementitious Materials Content: 520 lb cu yd
  4. Slump limit: 4 inches, plus or minus 1 inch
  5. Air Content: Do not allow air content of trowel finish floors to exceed 3 percent.
  6. Synthetic macro fiber: uniformly disperse in concrete mixture at manufacturer's recommended rate but not less than 3 lb/ cy yd
- H. Slabs on Metal Deck: Lightweight Concrete
1. Minimum Compressive Strength: 3500 psi at 28 days
  2. Maximum W/C Ratio: 0.50
  3. Maximum Cementitious Materials Content: 520 lb cu yd
  4. Slump limit: 4 inches, plus or minus 1 inch
  5. Unit Weight: 110 pcf (+/- 5pcf) dry weight
  6. Air Content: Do not allow air content of trowel finish floors to exceed 3 percent.
  7. Synthetic macro fiber: uniformly disperse in concrete mixture at manufacturer's recommended rate but not less than 4 lb/ cy yd
- I. Metal Pan Filled Stairs
1. Minimum Compressive Strength: 3000 psi at 28 days
  2. Maximum W/C Ratio: 0.52
  3. Maximum Cementitious Materials Content: 520 lb cu yd
  4. Slump limit: 4 inches, plus or minus 1 inch
  5. Air Content: Do not allow air content of trowel finish floors to exceed 3 percent.
- J. Utility Trench Backfill
1. Minimum Compressive Strength: 100 psi at 28 days
  2. Unconfined Compression strength per ASTM D4832
- K. Flowable Fill at Foundations: proportion normal weight concrete mixture as follows:
1. Minimum compressive strength 100 psi at 28 days
  2. Unconfined Compression strength per ASTM D4832
- L. Lean concrete fill at soft soils: proportion normal weight concrete mixture as follows:
1. Minimum compressive strength 1500 psi at 28 days
  2. Unconfined Compression strength per ASTM D4832

**END OF SECTION**



**SECTION 033511**  
**CONCRETE FLOOR FINISHES**

**PART 2 PRODUCTS**

**END OF SECTION**

**SECTION 040100**  
**MAINTENANCE OF MASONRY**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Water cleaning of masonry surfaces.
- B. Replacement of damaged units.
- C. Repointing mortar joints.
- D. Repair of damaged masonry.

1.02 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
  - 1. Require attendance of parties directly affecting work of this section.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on cleaning compounds.
- C. Samples: Submit four samples of decorative block, face brick, and stone units to illustrate matching color, texture and extremes of color range.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry neatly stacked and tied on pallets. Store clear of ground with adequate waterproof covering.

1.06 FIELD CONDITIONS - MASONRY WORK

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Restoration and Cleaning Chemicals:
  - 1. Diedrich Technologies, Inc: [www.diedrichtechnologies.com/#sle](http://www.diedrichtechnologies.com/#sle).
  - 2. HMK Stone Care System: [www.hmkstonecare.com/#sle](http://www.hmkstonecare.com/#sle).
  - 3. PROSOCO: [www.prosoco.com/#sle](http://www.prosoco.com/#sle).

2.02 CLEANING MATERIALS

- A. Cleaning Agent: 0.5 lb of sodium hydrosulfite mixture to one gallon of water.

2.03 MORTAR MATERIALS

- A. Comply with requirements of Section 042000.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surfaces to be cleaned and restored are ready for work of this section.

#### **3.02 PREPARATION**

- A. Protect surrounding elements from damage due to restoration procedures.
- B. Carefully remove and store removable items located in areas to be restored, including fixtures, fittings, finish hardware, and accessories; reinstall upon completion.
- C. Separate areas to be protected from restoration areas using means adequate to prevent damage.
- D. Cover existing landscaping with tarpaulins or similar covers.
- E. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures.

#### **3.03 REBUILDING**

- A. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to any adjacent remaining materials.
- B. Support structure as necessary in advance of cutting out units.
- C. Cut away loose or unsound adjoining masonry to provide firm and solid bearing for new work.
- D. Build in new units following procedures for new work specified in other section(s).
- E. Mortar Mix: Colored and proportioned to match existing work.
- F. Ensure that anchors are correctly located and built in.
- G. Install built in masonry work to match and align with existing, with joints and coursing true and level, faces plumb and in line. Build in all openings, accessories and fittings.

#### **3.04 REPOINTING**

- A. Perform repointing prior to cleaning masonry surfaces.
- B. Cut out loose or disintegrated mortar in joints to minimum 1/2 inch depth or until sound mortar is reached.
- C. Use power tools only after test cuts determine no damage to masonry units will result.
- D. Do not damage masonry units.
- E. When cutting is complete, remove dust and loose material by brushing.
- F. Premoisten joint and apply mortar. Pack tightly in maximum 1/4 inch layers. Form a smooth, compact concave joint to match existing.

#### **3.05 CLEANING EXISTING MASONRY**

- A. Cleaning Detergent: Brush clean masonry surfaces at all existing exterior locations with cleaning agent in accordance with the manufacturer's instructions. Saturate masonry with clean water and flush loose mortar and dirt.

#### **3.06 CLEANING NEW MASONRY**

- A. Verify mortar is fully set and cured.
- B. Clean surfaces and remove large particles with wood scrapers, brass or nylon wire brushes.
- C. Scrub walls with cleaning agent solution using stiff brush. Thoroughly rinse and wash off cleaning solution, dirt and mortar crumbs using clean, pressurized water.

#### **3.07 CLEANING**

- A. Immediately remove stains, efflorescence, or other excess resulting from the work of this section.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.
- C. Clean surrounding surfaces.

**END OF SECTION**

**SECTION 040511**  
**MASONRY MORTARING AND GROUTING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Installation of mortar and grout.
- B. Section 042613 - Masonry Veneer: Installation of mortar.

1.03 REFERENCE STANDARDS

- A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2024.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2026c.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2026.
- E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.
- F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2026.
- G. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- H. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2026.
- I. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.07 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

**PART 2 PRODUCTS**

2.01 MORTAR AND GROUT APPLICATIONS

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

- B. Mortar Mix Designs: ASTM C270, Property Specification.
  - 1. Masonry below grade and in contact with earth: Type S.
  - 2. Exterior Masonry Veneer: Type N.
  - 3. Exterior, Loadbearing Masonry: Type S.
  - 4. Exterior, Non-loadbearing Masonry: Type N.
  - 5. Exterior Repointing Mortar: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
  - 6. Interior, Loadbearing Masonry: Type S.
  - 7. Interior, Non-loadbearing Masonry: Type N.
  - 8. Glass Unit Masonry: Type N mortar and Type O pointing mortar.

## 2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  - 1. Color: Selected from manufacturer full range.
- B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, graded sand, and chemical admixtures complying with ASTM C91/C91M with the addition of water only.
  - 1. Color: To match adjacent mortar color.
- C. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- D. Portland Cement: ASTM C150/C150M.
  - 1. Type: Type I - Normal; ASTM C150/C150M.
  - 2. Color: Color as required to produce approved color sample.
- E. Masonry Cement: ASTM C91/C91M.
  - 1. Type: Type N; ASTM C91/C91M.
- F. Hydrated Lime: ASTM C207, Type S.
- G. Quicklime: ASTM C5, non-hydraulic type.
- H. Mortar Aggregate: ASTM C144.
- I. Water: Clean and potable.

## 2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.

## 2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of grout.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.
- E. Remove excess mortar from grout spaces.

#### **3.02 GROUTING**

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
- B. Low-Lift Grouting:
  - 1. Limit height of pours to 12 inches.
  - 2. Limit height of masonry to 16 inches above each pour.
  - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
  - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
  - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
  - 2. Place grout for spanning elements in single, continuous pour.

#### **3.03 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 014000 - Quality Requirements.

### **END OF SECTION**

**SECTION 042000**  
**UNIT MASONRY**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Lintels.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 040511 - Masonry Mortaring and Grouting.
- B. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2026.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
- E. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.
- F. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.
- G. ASTM C129 - Standard Specification for Dry-Cast Nonloadbearing Concrete Masonry Units; 2026.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2026.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- J. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- K. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- L. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls; 2025.
- M. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- N. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).
- O. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit 2 samples of decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.



- E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

#### 1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Fire Rated Assemblies: Comply with applicable code for any requirements for fire rated masonry construction.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

### **PART 2 PRODUCTS**

#### 2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
  - 2. Special Shapes: Provide nonstandard blocks configured for corners.
    - a. Provide bullnose units for outside corners.
  - 3. Load-Bearing Units: ASTM C90, normal weight.
  - 4. Nonloadbearing Units: ASTM C129.
    - a. Lightweight.
  - 5. Acoustic Units with Field-Installed Insulation Inserts:
    - a. Load-Bearing Units: ASTM C90, normal weight, nominal face dimensions of 16 by 8 inches and nominal depth of 12 inches.
    - b. Nonloadbearing Units: ASTM C129, lightweight, nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.

#### 2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 040511.

#### 2.03 REINFORCEMENT AND ANCHORAGE

- A. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- B. Single Wythe Joint Reinforcement: ASTM A951/A951M.
  - 1. Type: Truss or ladder.
  - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
  - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure. 9 gage.
- C. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
  - 1. Type: Truss.
  - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
  - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure. 9 gage.
- D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
  - 1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches.
- G. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

#### 2.04 FLASHINGS

- A. Metal Flashing Materials:
  - 1. Stainless Steel Flashing: ASTM A666/A666M, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.
- B. Membrane Asphaltic Flashing Materials:
  - 1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; 8 mil cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
- C. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
- D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
- E. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- F. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

#### 2.05 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
- B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

#### 2.06 LINTELS

- A. Prefabricated Steel Lintels:

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

#### 3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### 3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

### 3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
- D. Acoustical Concrete Masonry Units:
  - 1. Bond: running bond where structural and stacked bond where not structural. confirm with architect prior to laying masonry..
  - 2. Orientation of Slotted Units: Slotted face to face area where sound absorption and diffusion is desired.
  - 3. Coursing: One unit and one mortar joint to equal 8 inches.
  - 4. Mortar Joints: Concave.

### 3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

### 3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

### 3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place continuous joint reinforcement in first and second joint below top of walls.
- C. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.
- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

### 3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

### 3.10 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

### 3.11 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at nonmasonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
  - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
  - 2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Extend plastic, laminated, EPDM, and \_\_\_\_\_ flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- F. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

### 3.12 LINTELS

- A. Install loose steel lintels over openings.

- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
  - 1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
  - 2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
  - 3. Openings over 78 inches: Reinforce openings as detailed.
  - 4. Do not splice reinforcing bars.
  - 5. Place and consolidate grout fill without displacing reinforcing.
  - 6. Allow masonry lintels to attain specified strength before removing temporary supports.
- C. Maintain minimum 16 inch bearing on each side of opening.

### 3.13 GROUTED COMPONENTS

- A. Lap splices as noted on the drawings, but minimum 24 bar diameters where not noted otherwise.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.
- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

### 3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

### 3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

### 3.16 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.

### 3.17 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

### 3.18 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### 3.19 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

## **END OF SECTION**

**SECTION 042613**  
**MASONRY VENEER**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Clay facing brick.
- B. Reinforcement and anchorage.
- C. Flashings.
- D. Installation of lintels.
- E. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 040511 - Masonry Mortaring and Grouting.
- B. Section 054000 - Cold-Formed Metal Framing: Steel stud backup for masonry veneer.
- C. Section 055000 - Metal Fabrications: Loose steel lintels.
- D. Section 061000 - Rough Carpentry: Wood stud backup for masonry veneer.
- E. Section 076200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- F. Section 079200 - Joint Sealants: Sealing control and expansion joints.

**1.03 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2026.
- C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
- D. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2026a.
- E. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).
- F. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- G. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls; 2025.
- H. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- I. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
- C. Samples: Submit four samples of decorative block and facing brick units to illustrate color, texture, and extremes of color range.

**1.05 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.06 MOCK-UP

- A. Locate where directed.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

#### 1.08 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### **PART 2 PRODUCTS**

#### 2.01 CONCRETE MASONRY UNITS

#### 2.02 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
  - 1. Color and Texture: as indicated on drawings.
  - 2. Nominal Size: As indicated on drawings.
  - 3. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

#### 2.03 REINFORCEMENT AND ANCHORAGE

- A. Joint Reinforcement Type: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- B. Joint Reinforcement Standard: ASTM A951/A951M.
  - 1. Type: Truss or ladder.
  - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
  - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches.
- D. Strap Anchors: Bent steel shapes, 1-1/2-inch width, 0.105-inch thickness, 24-inch length; with 1-1/2 inches long, 90-degree bend at each end to form U or Z shape or with cross pins; hot-dip galvanized in accordance with ASTM A153/A153M Class B.
- E. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

#### 2.04 FLASHINGS

- A. Metal Flashing Materials: Stainless Steel, as specified in Section 076200.
- B. Membrane Non-Asphaltic Flashing Materials:
  - 1. EPDM Flashing: ASTM D4637/D4637M, Type I, 0.040 inch thick.
- C. Factory-Fabricated Flashing Corners and Ends: Stainless steel.

- D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane, or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
- E. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- F. Drip Edge: Stainless steel; compatible with membrane and adhesives.
- G. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

## 2.05 ACCESSORIES

- A. Weeps:
  - 1. Type: Extruded propylene with honeycomb design.
  - 2. Color(s): As selected by Architect from manufacturer's full range.
- B. Cavity Vents:
  - 1. Type: Polyester mesh.
- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  - 1. Mortar Diverter: Panels installed at flashing locations.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### 3.02 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.

### 3.03 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.



- H. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

#### 3.04 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

#### 3.05 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

#### 3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.
- D. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

#### 3.07 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 1 inch, minimum, to form watertight pan at non-masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
  - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
  - 2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
- C. Install flashing in accordance with manufacturer's instructions.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Support flexible flashings across gaps and openings.
- F. Extend plastic, EPDM, and \_\_\_\_\_ flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- G. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

#### 3.08 LINTELS

- A. Install loose steel lintels over openings.

3.09 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.10 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.

3.11 CUTTING AND FITTING

- A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

3.12 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

3.13 PROTECTION

**END OF SECTION**

**SECTION 047200**  
**CAST STONE MASONRY**

**PART 2 PRODUCTS**

1.01 MATERIALS

- A. Portland Cement: ASTM C150/C150M.
  - 1. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi), deformed bars, galvanized.
  - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

**END OF SECTION**

## **SECTION 051200**

### **STRUCTURAL STEEL FRAMING**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.

##### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

##### 1.3 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 anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. The following statements shall be placed on the front cover or initial sheet of each shop drawing submittal:

- a. Steel Fabricator Certification: The steel fabricator identified below certifies that for this project all load-bearing structural steel (as defined by the State of Ohio Department of Administrative Services, Directive Number GS-D-07, dated August 1, 2009) has been fabricated or produced, to the best of its knowledge, only from steel made in the United States in accordance with Sections 153.011 and 153.99, of the Ohio Revised Code (ORC). Further, the steel fabricator hereby certifies that it has read and understands that a monetary penalty for violations may be imposed under the authority of the referenced sections of the ORC. [Printed or Typed Name of Fabrication Company] by [Printed or typed Name of Company Official] Signature of Company Official \_\_\_\_\_ Date \_\_\_\_\_

- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
  1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
  2. Shear stud connectors.
  3. Nonshrink grout
  4. .
- F. Source quality-control reports.
- G. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Fabricator Qualifications: A qualified fabricator with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the fabrication processes and operations indicated.
- C. Installer Qualifications: A qualified installer with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the installation processes and operations indicated.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 341.
  - 3. ANSI/AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
  - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
  - b. Use Allowable Stress Design; data are given at service-load level.
2. Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.
  - a. Use Allowable Stress Design; data are given at service-load level.

C. DOMESTIC STEEL USE REQUIREMENTS AS SPECIFIED IN SECTION 153.011 OF THE REVISED CODE APPLY TO THIS PROJECT. COPIES OF SECTION 153.011 MAY BE OBTAINED FROM THE OFFICE OF THE OHIO FACILITIES CONSTRUCTION COMMISSION.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M-Shapes: ASTM A36/A36M.
- C. Channels, Angles, S-Shapes: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C or structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
  1. Weight Class: Standard.
  2. Finish: Galvanized.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  1. Finish: Hot-dip zinc coating Mechanically deposited zinc coating Hot-dip or mechanically deposited zinc coating.
- C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36 .
  - 1. Configuration: Straight Hooked.
  - 2. Nuts: ASTM A563 heavy-hex carbon steel.
  - 3. Plate Washers: ASTM A36/A36M carbon steel.
  - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
  - 1. Nuts: ASTM A563 heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- C. Threaded Rods: ASTM A36/A36M.
  - 1. Nuts: ASTM A63 heavy-hex carbon steel.
  - 2. Washers: ASTM F436, Type 1, hardened ASTM A36/A36M carbon steel.
  - 3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

## 2.6 PRIMER

- A. Steel Primer:
  - 1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Galvanized-Steel Primer: MPI#26 MPI#80, MPI#134.
  - 1. Etching Cleaner: MPI#25, for galvanized steel.
  - 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A780/A780M.

## 2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.



- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
  - 4. Mark and match-mark materials for field assembly.
  - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces of high-strength bolted, slip-critical connections.
  4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  5. Galvanized surfaces unless indicated to be painted.
  6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 2.
  2. SSPC-SP 3.
  3. SSPC-SP 7 (WAB)/NACE WAB-4.
  4. SSPC-SP 14 (WAB)/NACE WAB-8.
  5. SSPC-SP 11.
  6. SSPC-SP 6 (WAB)/NACE WAB-3.
  7. SSPC-SP 10 (WAB)/NACE WAB-2.
  8. SSPC-SP 5 (WAB)/NACE WAB-1.
  9. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner **[or in accordance with SSPC-SP 16]**.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E164.
    - d. Radiographic Inspection: ASTM E94/E94M.
  4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
  5. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  1. Joint Type: Snug tightened Pretensioned Slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

### 3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
1. See Construction Drawings for Special Instruction requirements.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

**END OF SECTION**

## **SECTION 052100**

### **STEEL JOIST FRAMING**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. Steel joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

##### 1.2 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

##### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

##### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

#### 1.7 SEQUENCING

- A. Deliver steel bearing plates to be built into masonry construction.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Canam Steel Corporation; Canam Group, Inc.
  - 2. Gooder-Henrichsen Co.
  - 3. New Millennium Building Systems, LLC.
  - 4. Structures of U.S.A., Inc.
  - 5. Valley Joist.
  - 6. Vulcraft; Nucor Corporation, Verco Group.
  - 7. .

#### 2.2 PERFORMANCE REQUIREMENTS

- A. .



## 2.3 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
  2. Provide holes in chord members for connecting and securing other construction to joists.
  3. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
  4. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
  5. Camber joists according to SJI's "Specifications."
  6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

## 2.4 PRIMERS

- A. Primer:
1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## 2.5 STEEL JOIST ACCESSORIES

- A. Bridging:
1. Provide bridging anchors and number of rows of horizontal diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint Hot-dip zinc coat according to ASTM A123/A123M.
- C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
  2. Finish: Plain, uncoated .

SMBH Add - ASTM A307 bolts are not included in the specification but are covered in our General Notes. Lighter joists and joist girders only require A307 bolts.

- A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
- B. Other Bolts : ASTM A307. Refer to SJI Specifications for where each type of bolt is required.
1. Finish: Plain.

- C. Welding Electrodes: Comply with AWS standards.
- D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.7 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 power-tool cleaning, SSPC-SP 3.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications joist manufacturer's written instructions, and requirements in this Section."
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.

- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

**END OF SECTION**

## **SECTION 053100**

### **STEEL DECKING**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

###### A. Section Includes:

1. Roof deck.

###### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data:

1. Roof deck.

###### B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Welding certificates.

###### B. Product Certificates: For each type of steel deck.

###### C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - a. Power-actuated mechanical fasteners.
  - b. Acoustical roof deck.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

###### D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
  - 1. AWS D1.1/D1.1M.
  - 2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Canam Steel Corporation; Canam Group, Inc.
  - 2. New Millennium Building Systems, LLC.
  - 3. Nucor Corporation.
  - 4. Nucor Corporation, Verco Group.
  - 5. Vulcraft; Nucor Corporation, Verco Group.
  - 6. .
- B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
  - 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 50 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard Gray White Gray top surface with white underside.
  - 2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), , Grade 50 G60 zinc coating.

3. Deck Profile: Type WR, wide rib.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Span Condition: As indicated Simple span Double span Triple span or more.
7. Side Laps: Overlapped Interlocking seam Overlapped or interlocking seam at Contractor's option.

## 2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A780/A780M SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

### 3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
  - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld .
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
  1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.
  2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

## **END OF SECTION**



## **SECTION 055000**

### **METAL FABRICATIONS**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

##### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

##### 1.3 ACTION SUBMITTALS

- A. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
2. Welding certificates.
3. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

B. Research Reports: For post-installed anchors.

C. Delegated design engineer qualifications.

#### 1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.6 FIELD CONDITIONS

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

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. Structural Performance of Aluminum Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

#### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304 Type 316L.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304 Type 316L.

- E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A53/A53M, Standard Weight unless otherwise indicated.
- G. Zinc-Coated Steel Wire Rope: ASTM A741.
  - 1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- H. Stainless Steel Wire Rope: Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.
  - 1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Galvanized Steel: ASTM A653/A653M, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.
  - 3. Cold-Rolled Steel: ASTM A1008/A1008M, structural steel, Grade 33; 0.0677-inch minimum thickness; hot-dip galvanized after fabrication.
- J. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- K. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- L. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- M. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- N. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- O. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).
- P. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).
- Q. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.
- R. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening aluminum stainless steel nickel silver.
  - 2. Provide bronze fasteners for fastening bronze.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1 Group 2.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. 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.

- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel pipe columns for supporting construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
  - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  - 2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.

## 2.7 PREFABRICATED BUILDING COLUMNS

- A. Source Limitations: Obtain prefabricated building column from single source from single manufacturer.
- B. General: Provide prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.
- C. Fire-Resistance Ratings: Provide prefabricated building columns listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.

1. Fire-Resistance Rating: As indicated.

## 2.8 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  1. Provide mitered and welded units at corners.
  2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.9 METAL LADDERS

- A. General:
  1. Comply with ANSI A14.3.
  2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
  1. Space siderails 16 inches apart unless otherwise indicated.
  2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
  3. Rungs: 3/4-inch- diameter, steel bars.
  4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallicity bonded to rung.
  7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
  8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
  9. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
  10. Galvanize and prime exterior ladders, including brackets.
  11. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.
- C. Aluminum Ladders:
  1. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
  2. Space siderails 16 inches apart unless otherwise indicated.

3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
5. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
6. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
8. Provide minimum 72-inch- high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.
  - a. UPNOVR, Inc.

## 2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.

## 2.11 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

## 2.12 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.13 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.



## 2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning." requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.15 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

# **PART 3 - EXECUTION**

## 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for ceiling hung toilet partitions operable partitions overhead doors overhead grilles securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with expansion anchors .
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, "Specifications for Structural Steel Buildings," and with requirements applicable to listing and labeling for fire-resistance rating indicated.

3.4 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.5 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION**

**SECTION 055133**  
**METAL LADDERS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Shop-fabricated metal ladders.
- B. Prefabricated ladders.
- C. Prefabricated ship ladders.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ANSI A14.3 - American National Standard for Ladders - Fixed - Safety Requirements; 2008 (Reaffirmed 2018).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2025.
- I. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2025.
- J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- K. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2026.
- L. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2023.
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Specimen warranty.
- D. Executed warranty.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for material and workmanship. Complete forms in Owner's name and register with manufacturer.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A307, plain.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

### **2.02 MATERIALS - ALUMINUM**

- A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6061 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
- G. Bolts, Nuts, and Washers: Stainless steel.

### **2.03 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

### **2.04 FABRICATED LADDERS**

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
  - 1. Side Rails: 3/8 by 2 inches members spaced at 20 inches.
  - 2. Rungs: One inch diameter solid round bar spaced 12 inches on center.
  - 3. Space rungs 7 inches from wall surface.

### **2.05 PREFABRICATED LADDERS**

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
  - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
  - 2. Materials: Aluminum; 6063 alloy, T52 temper.
  - 3. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.

- B. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
  - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
  - 2. Materials: Aluminum; 6063 alloy, T52 temper.
  - 3. Incline: as shown on drawings degrees.
  - 4. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.

#### 2.06 FINISHES - STEEL

- A. Prime Painting: One coat.

#### 2.07 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I natural anodized.
- B. Interior Aluminum Surfaces: Class I natural anodized.
- C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

#### 2.08 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

#### 3.02 PREPARATION

- A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

#### 3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

#### 3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

### **END OF SECTION**

**SECTION 055213**  
**PIPE AND TUBE RAILINGS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- C. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- D. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
  - 1. Include the design engineer's seal and signature on each sheet of shop drawings.

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

**PART 2 PRODUCTS**

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Comply with ASTM E985.
- C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- E. Allow for expansion and contraction of members and building movement without damage to connections or members.
- F. Dimensions: See drawings for configurations and heights.
  - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
  - 2. Intermediate Rails: 1-1/2 inches diameter, round.
  - 3. Posts: 1-1/2 inches diameter, round.
  - 4. Balusters: 1/2 inch round solid bar.

- G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

## 2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

## 2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
  - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
  - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

## 3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

## 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

## 3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

## **END OF SECTION**



**SECTION 061000**  
**ROUGH CARPENTRY**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Subflooring.
- F. Underlayment.
- G. Roof-mounted curbs.
- H. Roofing nailers.
- I. Roofing cant strips.
- J. Preservative treated wood materials.
- K. Fire retardant treated wood materials.
- L. Miscellaneous framing and sheathing.
- M. Communications and electrical room mounting boards.
- N. Concealed wood blocking, nailers, and supports.
- O. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 REFERENCE STANDARDS

- A. ANSI/AWC PWF - Permanent Wood Foundation Design Specification; 2021.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- E. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
- F. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2026.
- G. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ITS (DIR) - Directory of Listed Products; Current Edition.
- J. PS 20 - American Softwood Lumber Standard; 2025.
- K. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide technical data on insulated sheathing and application instructions.
- C. Product Data: Submit technical data on wood treatment.
- D. Samples: For rough carpentry members exposed to view, submit two samples, illustrating wood grain, color, and general appearance.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

#### 1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for materials and workmanship commencing on Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
  - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at [www.alsc.org](http://www.alsc.org), and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

#### 2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Stud Framing (2 by 2 through 2 by 6 ):
  - 1. Grade: No. 2.
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 ):
  - 1. Species: Allowed under grading rules.
  - 2. Grade: No. 1 and Better.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

#### 2.03 EXPOSED DIMENSION LUMBER

- A. Sizes: Nominal sizes as indicated on drawings.
- B. Surfacing: S4S.
- C. Moisture Content: S-dry or MC19.

#### 2.04 EXPOSED BOARDS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Moisture Content: Kiln-dry (15 percent maximum).
- C. Surfacing: S4S.
- D. Species: Douglas Fir.

E. Grade: No. 2, 2 Common, or Construction.

## 2.05 CONSTRUCTION PANELS

- A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.
1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Edges: Square.
  4. Products:
    - a. CertainTeed Corporation; GlasRoc Brand: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
    - b. Georgia-Pacific Gypsum; DensGlass Sheathing: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: [www.goldbondbuilding.com/#sle](http://www.goldbondbuilding.com/#sle).
    - d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Regular 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).
    - e. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode USGX 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).

## 2.06 FIRE-RETARDANT TREATMENT (FRT)

- A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.
- B. Kiln-dry after treatment (KDAT) to maximum moisture content of 19 percent for sawn material and 15 percent for plywood.
- C. Fabrication of FRT Wood:
1. Ripping or milling of boards, lumber, and timber after treatment is not permitted.
  2. Field cutting to length and drilling of holes in boards, lumber, and timber are permitted without additional treatment.
  3. Field cutting and drilling of holes in plywood are permitted.
- D. Label or brand FRT wood with classification mark of UL (DIR) or ITS (DIR) or other approved inspection agency, the treatment plant, name of treatment, species of wood, flame spread and smoke developed index, method of drying after treatment, and treating standard.

## 2.07 PRESSURE-PRESERVATIVE TREATMENT (PPT)

- A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.
- B. Applications - Treat the Following:
1. Lumber and plywood in permanent wood foundations: Use Category \_\_\_\_.
  2. Posts and columns supporting permanent structures and supported by concrete or masonry slab or footing in direct contact with earth: Use Category \_\_\_\_.
  3. Within crawl spaces and unexcavated areas within building perimeter, treat joists and floors less than 18 inches above grade: Use Category \_\_\_\_.
  4. Within crawl spaces and unexcavated areas within building perimeter, treat girders less than 12 inches above grade: Use Category \_\_\_\_.
  5. Sleepers and sills on concrete or masonry in direct contact with earth: Use Category \_\_\_\_.
  6. Wood framing members in direct contact with interior of exterior masonry or concrete walls below grade: Use Category \_\_\_\_.
  7. Girder that has ends in masonry or concrete unless 1/2-inch airspace is provided at top, sides, and end of member: Use Category \_\_\_\_.
  8. Lumber and plywood in contact with membrane roofing and flashing: Use Category \_\_\_\_.
  9. Lumber and plywood in contact with waterproofing and flashing: Use Category \_\_\_\_.
- C. Kiln-dry wood after treatment with waterborne preservative to maximum moisture content of 19 percent for lumber and 15 percent for plywood.

- D. Fabricate to maximum extent possible before treatment.
- E. Label preservative-treated wood with marking as required by AWP A U1 and ICC (IBC). Unless otherwise permitted by standard U1 and building code, include the following markings: AWP A U1, accredited inspection agency mark, treating plant identification, type of preservative, preservative retention, and permitted end use.
- F. Field Treatment for Cuts and Holes in Preservative-Treated Wood: Comply with AWP A M4.

## 2.08 ACCESSORIES

- A. Metal and Finish of Fasteners:
  - 1. Fire-Retardant-Treated Wood:
    - a. Nails, timber rivets, wood screws, and lag screws: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
  - 2. Preservative-Treated Wood:
    - a. Fasteners in permanent wood foundations:
      - 1) Comply with ANSI/AWC PWF.
    - b. Nails, timber rivets, wood screws, and lag screws - general use: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
      - 1) Exception: See fasteners for permanent wood foundation.
  - 3. Untreated Wood: Unfinished steel.
- B. Sill Flashing: See Section 076200.

## **PART 3 EXECUTION**

### 3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.
- B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- C. Coordinate installation of rough carpentry members specified in other sections.

### 3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

### 3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and \_\_\_\_\_.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

### 3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide nonstructural framing and blocking to support the following:
  - 1. Cabinets and shelf supports.
  - 2. Wall brackets.
  - 3. Handrails.
  - 4. Grab bars.
  - 5. Towel and bath accessories.
  - 6. Wall-mounted door stops.
  - 7. Chalkboards and marker boards.
  - 8. Wall paneling and trim.
  - 9. Joints of rigid wall coverings that occur between studs.
  - 10. Other wall- or ceiling-mounted items indicated on drawings.

### 3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

### 3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Wall Sheathing and Roof Sheathing with Laminated Water-Resistive Barrier and Air Barrier: Secure to studs in accordance with manufacturer's installation instructions.
  - 1. Install with laminated water-resistive and air barrier on exterior side of sheathing.
  - 2. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
  - 3. Use only mechanically attached and drainable EIFS and exterior insulation with wall sheathing with laminated water-resistive and air barrier.
  - 4. Apply manufacturer's standard seam tape to joints between sheathing panels; use tape gun or hard rubber roller in accordance with manufacturer's installation instructions.

### 3.07 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

### 3.08 CLEANING

- A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
  - 1. Comply with applicable regulations.
  - 2. Do not burn scrap on project site.
  - 3. Do not burn scraps that have been pressure treated.
  - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**

**SECTION 061600**  
**SHEATHING - USG**

**PART 2 PRODUCTS**

1.01 MANUFACTURERS

- A. USG Corporation; \_\_\_\_\_: [www.usg.com/#sle](http://www.usg.com/#sle).

1.02 SHEATHING

- A. Structural cementitious roof sheathing panels.
1. Size: 48 by 96 inches, nominal.
  2. Thickness: 3/4 inch, nominal.
  3. Edges: Square.
  4. Span: 48 inches, maximum.
  5. Fire Resistance: Noncombustible, when tested in accordance with ASTM E136.
  6. Surface Burning Characteristics: Flame spread index of 0; smoke developed index of 0; when tested in accordance with ASTM E84.
  7. Mold Resistance: Rating of 10, when tested in accordance with ASTM D3273.
  8. Density: 75 psf in accordance with ASTM C1185.
  9. Weight: 5 psf in accordance with ASTM D1037 at thickness of 3/4 inch.
  10. pH Value: 10 when tested in accordance with ASTM D1293.
  11. Termite Resistance: 9.8 when tested in accordance with AWPA E1.
  12. Products:
    - a. USG Corporation; Structural Panel Concrete Roof Deck.
- B. Glass-mat-faced gypsum wall sheathing, comply with ASTM C1177/C1177M.
1. Thickness: 1/2 inch.
  2. Edges: Square.
  3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  4. Products:
    - a. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Regular.
- C. Glass-mat-faced gypsum wall sheathing with integral water-resistive and air barrier, comply with ASTM C1177/C1177M.
1. Size: 48 by 96 inches, nominal.
  2. Thickness: 1/2 inch.
  3. Edges: Square.
  4. Water Vapor Permeance: 1 perm, minimum, when tested in accordance with ASTM E96/E96M.
  5. Air Permeance, Sheathing: 0.001 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
  6. Air Permeance, Assembly: 0.04 cfm/sq ft, maximum, when tested in accordance with ASTM E2357.
  7. Products:
    - a. USG Corporation; Securock ExoAir 430 Panel.

1.03 SUBFLOORING

- A. Structural cementitious subfloor panels.
1. Size: 48 by 96 inches, nominal.
  2. Thickness: 3/4 inch, nominal.
  3. Edges: Squared along width; tongue and grooved along length.
  4. Span: 24 inches, maximum.
  5. Fire Resistance: Noncombustible, when tested in accordance with ASTM E136.

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| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
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6. Surface Burning Characteristics: Flame spread index of 0; smoke developed index of 0; when tested in accordance with ASTM E84.
7. Mold Resistance: Rating of 10, when tested in accordance with ASTM D3273.
8. Density: 75 psf in accordance with ASTM C1185.
9. Weight: 5 psf in accordance with ASTM D1037 at thickness of 3/4 inch.
10. pH Value: 10 when tested in accordance with ASTM D1293.
11. Termite Resistance: 9.8 when tested in accordance with AWPA E1.
12. Products:
  - a. USG Corporation; Structo-Crete Brand Structural Panels.

#### 1.04 ACCESSORIES

### **END OF SECTION**



**SECTION 062000**  
**FINISH CARPENTRY**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Finish carpentry items.

1.02 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.
- D. PS 1 - Structural Plywood; 2023.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

**PART 2 PRODUCTS**

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Interior Woodwork Items:
  - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
  - 2. Loose Shelving: Birch plywood; prepare for paint finish.

2.02 LUMBER MATERIALS

- A. Softwood Lumber: \_\_\_\_\_ species, \_\_\_\_\_ sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.
- B. Hardwood Lumber: \_\_\_\_\_ species, \_\_\_\_\_ sawn, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.

2.03 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- C. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Primer: Alkyd primer sealer.
- C. Wood Filler: Solvent base, tinted to match surface finish color.

2.05 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

**END OF SECTION**

**SECTION 064100**  
**ARCHITECTURAL WOOD CASEWORK**

**PART 2 PRODUCTS**

1.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
  - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
  - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
  - 3. Casework Construction Type: Type A - Frameless.
  - 4. Adjustable Shelf Loading: 40 psf.
  - 5. Cabinet Style: Flush overlay.

1.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

1.03 PANEL CORE MATERIALS

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.

1.04 HARDWOOD PLYWOOD PANELS

- A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
  - 1. Woodwork Quality Standard: Panels complying with specified woodwork quality standard.

1.05 LAMINATE MATERIALS

- A. Manufacturers:
  - 1. Arborite: [www.arborite.com/#sle](http://www.arborite.com/#sle).
  - 2. Formica Corporation; \_\_\_\_: [www.formica.com/#sle](http://www.formica.com/#sle).
  - 3. Wilsonart LLC; \_\_\_\_: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).

1.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.

1.07 HARDWARE

1.08 FABRICATION

**END OF SECTION**

**SECTION 071113**  
**BITUMINOUS DAMPPROOFING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Bituminous dampproofing.

1.02 REFERENCE STANDARDS

- A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).
- B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2024).
- C. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013 (Reapproved 2024).

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

**PART 2 PRODUCTS**

2.01 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
  - 1. Asphalt-Base Emulsion for Metal Protective Coating: ASTM D1187/D1187M, Type I - Continuous water exposure within few days after drying or Type II - Continuous weather exposure after drying.
  - 2. Emulsified Asphalt for Roofing Protective Coating: ASTM D1227/D1227M, Type II, Class 1 - Mineral colloid emulsifying agents with non-asbestos fibers.
  - 3. VOC Content: Not more than permitted by local, State, and federal regulations.
  - 4. Applied Thickness: 1/16 inch, minimum, wet film.

2.02 BITUMEN MATERIALS

- A. Cold Asphaltic Type:
  - 1. Emulsified Asphalt: ASTM D1227/D1227M, with fiber reinforcement other than asbestos, Type II, Class 1 or 2.
  - 2. Asphalt Primer: ASTM D41/D41M, compatible with substrate.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

### 3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

### 3.03 APPLICATION

- A. Foundation Walls: Apply two coats of dampproofing.
- B. Foundation Walls: Patch disturbed areas of existing dampproofing with two additional coats of dampproofing of the same generic type.
- C. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- D. Apply bitumen with roller.
- E. Seal items watertight with mastic, that project through dampproofing surface.

### **END OF SECTION**

**SECTION 071400**  
**FLUID-APPLIED WATERPROOFING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Polyurethane waterproofing.

1.02 REFERENCE STANDARDS

- A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
- B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- C. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.
- E. ASTM D6506/D6506M - Standard Specification for Asphalt-Based Protection Board for Below-Grade Waterproofing; 2001, with Editorial Revision (2024).
- F. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Warranty Documentation:
  - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Installer Warranty: Provide 2-year warranty for waterproofing failing to resist penetration of water commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

**PART 2 PRODUCTS**

2.01 FLUID-APPLIED WATERPROOFING APPLICATIONS

- A. Polyurethane Waterproofing:
  - 1. Location: below grade basement walls.
  - 2. Cover with protection board.

## 2.02 FLUID-APPLIED WATERPROOFING MATERIALS

- A. Polyurethane Waterproofing: Cold-applied, high solids content polyurethane waterproofing complying with ASTM C836/C836M.
  - 1. Cured Thickness: 60 mil, 0.060 inch, minimum.
  - 2. Tensile Strength: 400 psi, minimum, measured in accordance with ASTM D412.
  - 3. Ultimate Elongation: 168 percent, minimum, measured in accordance with ASTM D412.
  - 4. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240.
  - 5. Adhesion: 150 psi, minimum, measured in accordance with ASTM D4541.
  - 6. Products:
    - a. GCP Applied Technologies; Silcor 900 MP: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - b. Henry, a Carlisle Company; Prodeq System - Spray-Applied, Instant Setting Waterproofing System: [www.henry.com/#sle](http://www.henry.com/#sle).
    - c. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

## 2.03 ACCESSORIES

- A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.
- B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
  - 1. Hardboard, 1/8 inch thick.
  - 2. Multi-layer internally-reinforced asphaltic panels, 1/8 inch thick, nominal, complying with ASTM D6506/D6506M.
- C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
  - 1. Composition: Dimpled polyethylene, polypropylene, or polystyrene core; polypropylene or polyester filter fabric.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

## 3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.

## 3.03 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.

- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.
- D. At joints from 1/2 inch to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch, and extend sheet at least 6 inches on either side of expansion joint.
- E. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- F. Seal membrane and flashings to adjoining surfaces.

#### 3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

#### 3.05 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.



**SECTION 071900**  
**WATER REPELLENTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Water repellents applied to exterior and interior, masonry, stone, and concrete surfaces.

1.02 REFERENCE STANDARDS

- A. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2026a.
- B. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete; 2021.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

1.06 FIELD CONDITIONS

- A. Protect liquid materials from freezing.
- B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty

**PART 2 PRODUCTS**

2.01 MATERIALS

- A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
  - 1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
  - 2. Number of Coats: One.
  - 3. Maintains dry appearance when wetted.
  - 4. Water-based siloxane, silane, or blend that reacts chemically with concrete and masonry.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

### 3.02 PREPARATION

- A. Protection of Adjacent Work:
  - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
  - 2. Protect adjacent surfaces not intended to receive water repellent.
- B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.
- C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
- D. Remove loose particles and foreign matter.
- E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.
- F. Scrub and rinse surfaces with water and let dry.
- G. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

### 3.03 APPLICATION

- A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
- B. Apply one coat, minimum on all brick.
- C. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

**END OF SECTION**

**SECTION 072100**  
**THERMAL INSULATION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, exterior wall behind \_\_\_\_\_ wall finish, and interior wall with facer providing exposed finish.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2026.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.04 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); [www.airbarrier.org/#sle](http://www.airbarrier.org/#sle): Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**PART 2 PRODUCTS**

2.01 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) board.
- D. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- E. Insulation in Wood Framed Walls: Batt insulation with integral vapor retarder.
- F. Insulation in Wood Framed Ceiling Structure: Batt insulation with integral vapor retarder.
- G. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.
- H. Insulation in Interior Partition Walls: Batt Insulation unfaced, mineral wool

## 2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
  - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  - 3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
- B. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Comply with ASTM C578, and manufactured using carbon black technology.
  - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  - 3. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
  - 4. Board Size: 15-3/4 inch by 96 inch.
  - 5. Board Thickness: 1-3/4 inch.
  - 6. Board Edges: Square.

## 2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
  - 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  - 2. Facing: Aluminum foil, flame spread 25 rated; one side.
- B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
  - 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

## 2.04 ACCESSORIES

- A. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
  - 1. Width: 5-1/2 inches.
  - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- B. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- C. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- D. Adhesive: Type recommended by insulation manufacturer for application.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

## 3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

## 3.03 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- F. Staple or nail facing flanges in place at maximum 6 inches on center.
- G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

**END OF SECTION**

**SECTION 072123**  
**LOOSE-FILL INSULATION**

**PART 2 PRODUCTS**

1.01 MATERIALS

1.02 APPLICATIONS

A. Provide loose-fill insulation in the following application(s) as indicated on drawings:

**SECTION 072500**  
**WEATHER BARRIERS**

**PART 2 PRODUCTS**

**END OF SECTION**

**SECTION 072600**  
**VAPOR RETARDERS**

**PART 2 PRODUCTS**

**END OF SECTION**



**SECTION 072700**  
**AIR BARRIERS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Air barriers.

1.02 DEFINITIONS

- A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.03 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2025.
- B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- C. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, limitations, and \_\_\_\_\_.
- C. Shop Drawings: Provide drawings of special joint conditions.

1.05 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

**PART 2 PRODUCTS**

2.01 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

- A. Air Barrier, Fluid Applied: Vapor semi-permeable, elastomeric waterproofing.
  - 1. Air Barrier Coating:
    - a. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
    - b. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
    - c. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.
    - d. Comply with NFPA 285 requirements for wall assembly.
    - e. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
    - f. Sealants, Tapes and Accessories: As recommended by coating manufacturer.

2.02 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
- B. Primer: Liquid applied polymer.
  - 1. Color: Green.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surfaces and conditions are ready for work of this section.
- B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- C. Do not proceed with this work until unsatisfactory conditions have been corrected.

#### **3.02 PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

#### **3.03 INSTALLATION**

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Fluid-Applied Coatings or Membranes:
  - 1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
  - 2. Where exterior masonry veneer is being installed, install masonry anchors before installing air barrier over masonry; provide airtight seal around anchors.
  - 3. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4 inch along coating seams, rough cuts, and as recommended by manufacturer.
  - 4. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.
- E. Openings and Penetrations in Exterior Air Barriers:
  - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
  - 2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
  - 3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
  - 4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
  - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
  - 6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Coordination of ABAA Tests and Inspections:
  - 1. Provide testing and inspection required by ABAA QAP.
  - 2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
  - 3. Cooperate with ABAA testing agency.
  - 4. Allow access to air barrier work areas and staging.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

5. Do not cover air barrier work until tested, inspected, and accepted.

**END OF SECTION**

**SECTION 074213**  
**METAL WALL PANELS**

**PART 2 PRODUCTS**

**1.01 METAL WALL PANEL SYSTEM**

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
  - 1. Provide exterior wall panels, interior liner panels, soffit panels, retrofit wall panels, and subgirt framing assembly.
  - 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
  - 3. Maximum Allowable Deflection of Panel:  $L/180$  for length(L) of span.
  - 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
  - 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
  - 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
  - 7. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.
- B. Exterior Wall Panels:
  - 1. Profile: Vertical; style as indicated.
  - 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
  - 3. Panel Width: \_\_\_\_ inches.
- C. Interior Liner Panels:
  - 1. Profile: Vertical; style as indicated.
  - 2. Side Seams: Interlocking, sealed with continuous bead of sealant.
  - 3. Panel Width: \_\_\_\_ inch.
- D. Soffit Panels:
  - 1. Profile: Style as indicated, with venting provided.
- E. Retrofit Wall Panels:
  - 1. Profile: Vertical; style as indicated.
  - 2. Side Seams: Lapped.
  - 3. Condensation Control: Factory-applied membrane to reduce drips resulting from backside condensation.
  - 4. Panel Width: \_\_\_\_ inches.
- F. Subgirt Framing Assembly:
- G. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- H. Expansion Joints: Same material, thickness and finish as exterior sheets; \_\_\_\_ gauge, \_\_\_\_ inch thick; manufacturer's standard brake formed type, of profile to suit system.
- I. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- J. Anchors: Galvanized steel.

**END OF SECTION**

**SECTION 075400**  
**THERMOPLASTIC MEMBRANE ROOFING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic roofing membrane.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Cover boards.
- E. Flashings.
- F. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 077100 - Roof Specialties: Prefabricated roofing expansion joint flashing.

1.03 REFERENCE STANDARDS

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- B. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- D. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2024.
- E. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2017a (Reapproved 2022).
- F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.
- G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
- H. ASTM C1484 - Standard Specification for Vacuum Insulation Panels; 2010 (Reapproved 2026).
- I. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2026.
- J. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2024.
- K. FM (AG) - FM Approval Guide; Current Edition.
- L. NRCA (RM) - The NRCA Roofing Manual; 2026.
- M. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's qualification statement.
- F. Warranty Documentation:
  - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

#### 1.07 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above \_\_\_\_ degrees F.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

#### 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
  1. Warranty Term: 20 years.
  2. For repair and replacement include costs of both material and labor in warranty.
  3. Exceptions are not Permitted:

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
  1. Carlisle SynTec Systems; Sure-Weld TPO: [www.carlisle-syntec.com/#sle](http://www.carlisle-syntec.com/#sle).
  2. Elevate; UltraPly TPO Membrane: [www.holcimelevate.com/#sle](http://www.holcimelevate.com/#sle).
  3. GAF; EverGuard TPO: [www.gaf.com/#sle](http://www.gaf.com/#sle).
  4. Johns Manville; JM TPO - 45 mil: [www.jm.com/#sle](http://www.jm.com/#sle).
- B. Insulation:
  1. BASF Corporation: [www.neopor.basf.us/#sle](http://www.neopor.basf.us/#sle).
  2. Carlisle SynTec Systems: [www.carlisle-syntec.com/#sle](http://www.carlisle-syntec.com/#sle).
  3. DuPont de Nemours, Inc: [building.dupont.com/#sle](http://building.dupont.com/#sle).
  4. GAF: [www.gaf.com/#sle](http://www.gaf.com/#sle).
  5. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  6. Owens Corning Corporation: [www.owenscorning.com/en-us/#sle](http://www.owenscorning.com/en-us/#sle).

#### 2.02 ROOFING - UNBALLASTED APPLICATIONS

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:

1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
    - a. Calculate SRI in accordance with ASTM E1980.
    - b. Field applied coating may not be used to achieve specified SRI.
  2. Insulation Thermal Resistance (R-Value): 3 per inch, minimum; provide insulation of thickness required.
- C. Acceptable Insulation Types - Constant Thickness Application: Any of types specified.
1. Minimum 2 layers of polyisocyanurate or composite board.
  2. Bottom layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, composite, or cellular glass board covered with single layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.
- D. Acceptable Insulation Types - Tapered Application: Any of types specified.
1. Tapered polyisocyanurate board.
  2. Tapered polyisocyanurate board covered with uniform thickness polyisocyanurate board.
  3. Uniform thickness polyisocyanurate board covered with tapered polyisocyanurate board.

## 2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrim.
    - a. Thickness: 60 mil, 0.060 inch, minimum.
  2. Sheet Width:
    - a. Adhered Application: Limit width to 120 inches, maximum, when ambient temperatures are less than 40 degrees F for extended period of time during installation.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
1. Fire-retardant adhesive.
- D. Flexible Flashing Material: Same material as membrane.

## 2.04 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
1. Thickness: 1/4 inch, fire-resistant.
  2. Products:
    - a. Georgia-Pacific; DensDeck: [www.densdeck.com/#sle](http://www.densdeck.com/#sle).
    - b. Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell Glass Mat Roof Board: [www.goldbondbuilding.com/#sle](http://www.goldbondbuilding.com/#sle).
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell FA Glass Mat Roof Board: [www.goldbondbuilding.com/#sle](http://www.goldbondbuilding.com/#sle).

## 2.05 INSULATION

- A. Cellulose Fiber Board Insulation: ASTM C208 Type II; natural finish.
- B. Perlite Board Insulation: Expanded perlite mineral aggregate, complying with ASTM C728.
- C. Expanded Polystyrene (EPS) Board Insulation: Comply with ASTM C578, with drainage channels on one face.
1. Board Size: 48 by 96 inches.
- D. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
    - a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
      - 1) Class 1 - Non-reinforced core foam.

- 2) Compressive Strength: 16 psi, minimum.
- 3) Thermal Resistance, R-value: At 1-1/2 inches thick; 9.0, minimum, at 75 degrees F.
2. Board Size: 48 by 96 inches.
3. Board Thickness: 1.5 inches.
- E. Mineral Wool Board Insulation: Rigid mineral wool fiber complying with ASTM C726; top surface coated with asphalt and Kraft paper.
  1. Board Size: 48 by 48 inches.
  2. Board Thickness: 1 inch.
- F. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578, with natural skin surface and drainage channels on one face.
- G. Composite Vacuum Insulated Panel Insulation: Comply with ASTM C1484.
  1. Integral Protection Boards: Manufacturer's standard.
- H. Cellular Glass Board Insulation: Comply with ASTM C552, Type IV.
  1. Board Size: 24 by 48 inches, nominal.
  2. Board Thickness: 2 inches, nominal.

## 2.06 ACCESSORIES

- A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.
- B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- C. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
- E. Membrane Adhesive: As recommended by membrane manufacturer.
- F. Sealants: As recommended by membrane manufacturer.
- G. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
  1. Composition: Porous rubber with natural surface.
  2. Size: 18 by 18 inches.
  3. Surface Color: White.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

### 3.02 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.



- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

### 3.03 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
  - 1. Extend vapor retarder under cant strips and blocking to deck edge.
  - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
- C. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- F. Do not install more insulation than can be covered with membrane in same day.

### 3.04 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate of \_\_\_\_ gallons per square foot. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
  - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
  - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints where indicated. Make joints watertight.
  - 1. Install prefabricated joint components in accordance with manufacturer's instructions.
- H. Coordinate installation of roof drains and sumps and related flashings.

### 3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.
- C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

### 3.06 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

### 3.07 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

**END OF SECTION**

**SECTION 076200**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, exterior penetrations, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.
- C. Precast concrete splash pads.

1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- D. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products; 2018 (Reapproved 2024).
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement; 2025.
- H. CDA A4050 - Copper in Architecture - Handbook; Current Edition.
- I. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

**PART 2 PRODUCTS**

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal.

- B. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 0.032 inch thick; clear anodized finish.
- C. Stainless Steel: ASTM A666/A666M, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch thick; smooth No. 4 - Brushed finish.

## 2.02 PREPAINTED, METALLIC-COATED STEEL SHEETS

- A. Description: Factory-applied coatings applied to metallic-coated steel sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed, top side of sheet; washcoats on bottom, unexposed sheet side.
- B. Comply with ASTM A755/A755M.
- C. Metallic-Coated Steel Sheet Substrates:
  - 1. Zinc-Coated, Galvanized, Steel Sheets: Commercial steel sheets, galvanized by hot-dip process; comply with ASTM A653/A653M; coating designation G90.
- D. Substrate Preparation for Prefinishing: Clean and prepare substrate surfaces in accordance with coating manufacturer's recommendations for substrate type and application.
- E. Washcoats or Backercoats: Provide washcoats or backercoats in accordance with organic coating manufacturer's recommendations.
- F. Primer Coats: Provide basecoat primers in accordance with coating manufacturer's recommendations for substrate type, topcoat, and application.
- G. High-Performance Organic Coating System: Provide thermally cured, 50-percent PVDF or silicone-modified polyester systems in accordance with AAMA 2604; tested for weathering for 5 years with 5 delta units maximum of color change.
- H. Application: Coving Caps, Parapet Caps, Cleats, Flashing, Counterflashing, Sill Flashing, Gravel Stops, Gutters, Downspouts, Scuppers, Roof Expansion Joints, Trim, and \_\_\_\_\_.
  - 1. Base Metal Thickness: 22 gauge, 0.030 inch, minimum.
  - 2. Coating System: High-performance organic coating system.

## 2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of \_\_\_\_\_ type sheet metal, minimum \_\_\_\_\_ inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Fabricate flashings to allow toe to extend 2 inches over roofing \_\_\_\_\_. Return and brake edges.

## 2.04 GUTTERS AND DOWNSPOUTS

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with ICC (IPC).
- D. Accessories: Profiled to suit gutters and downspouts.
  - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
  - 2. Gutter Supports: Brackets.
  - 3. Downspout Supports: Brackets.

- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.
- F. Downspout Boots: Steel.
- G. Downspout Extenders: Same material and finish as downspouts.
- H. Seal metal joints.

#### 2.05 FLASHING

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

#### 2.06 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer Type: Zinc chromate.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- F. Reglets: Recessed type, galvanized steel; face and ends covered with plastic tape.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

#### 3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

#### 3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Secure gutters and downspouts in place with concealed fasteners.
- F. Slope gutters 1/4 inch per 10 feet, minimum.
- G. Connect downspouts to downspout boots, and grout connection watertight.
- H. Set splash pads under downspouts.

### **END OF SECTION**

**SECTION 077100**  
**ROOF SPECIALTIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings, fascias, and gravel stops.
- B. Roof control and expansion joint covers.

1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- D. NRCA (RM) - The NRCA Roofing Manual; 2026.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Roof Edge Flashings and Copings:
  - 1. Architectural Products Co; \_\_\_\_: [www.archprod.com/#sle](http://www.archprod.com/#sle).
  - 2. ATAS International, Inc; Rapid-Lok Fascia: [www.atas.com/#sle](http://www.atas.com/#sle).
  - 3. Drexel Metals Inc; \_\_\_\_: [www.drexmet.com/#sle](http://www.drexmet.com/#sle).
  - 4. GAF: [www.gaf.com/#sle](http://www.gaf.com/#sle).
  - 5. Hickman Edge Systems; \_\_\_\_: [www.hickmanedgesystems.com/#sle](http://www.hickmanedgesystems.com/#sle).
  - 6. Metal-Era Inc; \_\_\_\_: [www.metalera.com/#sle](http://www.metalera.com/#sle).
  - 7. Metal Roofing Systems, Inc; Rapid Lock Coping: [www.metalroofingsystems.biz/#sle](http://www.metalroofingsystems.biz/#sle).
- B. Control and Expansion Joint Covers:
  - 1. Construction Specialties, Inc; Roof Covers: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
  - 2. Sika Emseal; Emseal RoofJoint: [www.emseal.com/#sle](http://www.emseal.com/#sle).
  - 3. Hickman Edge Systems; \_\_\_\_: [www.hickmanedgesystems.com/#sle](http://www.hickmanedgesystems.com/#sle).
  - 4. Johns Manville; \_\_\_\_: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 5. Metal-Era Inc; \_\_\_\_: [www.metalera.com/#sle](http://www.metalera.com/#sle).
  - 6. MM Systems Corp; \_\_\_\_: [www.mmsystemscorp.com/#sle](http://www.mmsystemscorp.com/#sle).

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
  - 1. Configuration: Fascia, cant, and edge securement for roof membrane.

2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
  3. Exposed Face Height: As indicated on drawings.
  4. Material: Formed steel sheet, galvanized, 22 gauge, 0,03 inch thick, minimum.
  5. Finish: 70 percent polyvinylidene fluoride (PVDF).
  6. Color: As selected by Architect from manufacturer's full range.
- B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
  2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
  3. Wall Width: As indicated on drawings.
  4. Inside Face Height: 4 inches.
  5. Material: Formed steel sheet, galvanized, 22 gauge, 0,03 inch thick, minimum.
  6. Finish: 70 percent polyvinylidene fluoride.
  7. Color: As selected by Architect from manufacturer's full range.
- C. Control and Expansion Joint Covers: Composite construction of \_\_\_\_-inch wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.
- D. Expansion Joint Covers: Roof-to-roof joint cover comprised of continuous rails fastened to continuous cleat and covered with metal cap.
1. Material: Galvanized steel sheet, 24 gauge, 0.0239 inch.
  2. Length: 12 inches.
  3. Fasteners: Concealed. Factory-punched fastener holes.
  4. Color: As selected by Architect from manufacturer's standard range.
- E. Lightning Rod Bracket: For attaching lightning rod to roof system; fastened to underside of coping.
1. Material: Stainless steel, 20 gauge, 0.0375 inch.
  2. Width: 12 inches.
  3. Fasteners: Concealed. Factory-punched fastener holes.

## 2.03 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as indicated.
- B. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

## 2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

**END OF SECTION**



**SECTION 077200**  
**ROOF ACCESSORIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Roof curbs.
- B. Roof penetrations mounting curbs.
- C. Roof hatches.
- D. Roof hatches with access ladders.
- E. Rooftop stairs.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
- D. Warranty Documentation:
  - 1. Submit manufacturer warranty.
  - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for \_\_\_\_\_. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

**PART 2 PRODUCTS**

2.01 ROOF CURBS

- A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
  - 1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.

2. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
  3. Sheet Metal Material:
    - a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
      - 1) Finish: Mill finish.
      - 2) Color: As selected by Architect from manufacturer's standard line of colors.
  4. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
    - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch clearance between curb and metal roof panel flange allowing water to properly flow past curb.
    - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
    - c. Maintain at least 12 inch clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
    - d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
- B. Roof Curb Caps: Square-type aluminum cap with weathertight seal when vent or equipment is not installed.

## 2.02 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
1. Activar Construction Products Group, Inc. - JL Industries; Diamond Series Roof Hatches, Model \_\_\_\_: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  2. Acudor Products Inc; Galvanized Steel Roof Hatch: [www.acudor.com/#sle](http://www.acudor.com/#sle).
  3. Babcock-Davis; Personnel: [www.babcockdavis.com/#sle](http://www.babcockdavis.com/#sle).
  4. Best Access Doors; Series BA-FRHTB - Fire-Rated Roof Hatch, Thermally Broken: [www.bestaccessdoors.com/#sle](http://www.bestaccessdoors.com/#sle).
  5. Bilco Company; Type TB (various types and special size): [www.bilco.com/#sle](http://www.bilco.com/#sle).
  6. Dur-Red Products; \_\_\_\_: [www.dur-red.com/#sle](http://www.dur-red.com/#sle).
  7. Elmdor; \_\_\_\_: [www.elmdor.com/#sle](http://www.elmdor.com/#sle).
  8. FAKRO America LLC; Flat Roof Access Hatch DRL: [www.fakrousa.com/#sle](http://www.fakrousa.com/#sle).
  9. LMCurbs; Roof Hatch: [www.lmcurbs.com/#sle](http://www.lmcurbs.com/#sle).
  10. Nystrom, Inc; \_\_\_\_: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  11. Precision Ladders, LLC; Model PH-A: [www.precisionladders.com/#sle](http://www.precisionladders.com/#sle).
  12. PS DOORS; Slidewise Roof Hatch: [www.psdoors.com/#sle](http://www.psdoors.com/#sle).
  13. Surespan Limited; SRHP75 Roof Hatch: [www.surespancovers.us/#sle](http://www.surespancovers.us/#sle).
  14. The Williams Brothers Corporation of America; \_\_\_\_: [www.wbdoors.com/#sle](http://www.wbdoors.com/#sle).
- B. Flat Roof Access Hatches with Ladder Manufacturers:
1. FAKRO America LLC; Flat Roof Access with DRL Hatch and LML Folding Ladder: [www.fakrousa.com/#sle](http://www.fakrousa.com/#sle).
  2. Precision Ladders, LLC; Roof Access Systems: [www.precisionladders.com/#sle](http://www.precisionladders.com/#sle).
- C. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
1. Style: Provide flat metal covers unless otherwise indicated.
  2. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
  3. Thermally Broken Hatches: Provide insulation within frame and cover.
  4. For Ladder Access: Single leaf; 30 by 36 inches.
  5. For Ships Ladder Access: Single leaf; 30 by 54 inches.
  6. For Stair Access: Single leaf; 30 by 96 inches.
  7. For Equipment Access: Double leaf; 48 by 48 inches.

- D. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
  - 1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
  - 2. Hinges: Heavy duty pintle type.
  - 3. Hold open arm with vinyl-coated handle for manual release.
  - 4. Latch: Upon closing, engage latch automatically and reset manual release.
  - 5. Manual Release: Pull handle on interior.
  - 6. Locking: Padlock hasp on interior.

## 2.03 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
  - 1. Design Loadings and Configurations: As required by applicable codes.
  - 2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
  - 3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  - 4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
  - 5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

## 2.04 ROOFTOP STAIRS

- A. Performance Requirements:
  - 1. Comply with ADA Standards.
  - 2. Uniform Load Capacity: 50 psf.
  - 3. Concentrated Load Capacity: 300 psf.
  - 4. Handrail and Guard Capacity: Support the following loads without exceeding the allowable working stress of the material:
    - a. Single Point Load: 200 lb.
    - b. Distributed Load: 50 pfl.
- B. Prefabricated Modular Metal Stairs: Standardized, modular stair components designed with manufacturer's standard stair angle and height charts. Field assemble with mechanical fasteners only.
  - 1. Material: Aluminum, ASTM B221; 6063 alloy, T52 temper for extrusions and 5052 alloy, H32 temper for sheets.
  - 2. Risers: Open.
    - a. Riser and Nosing Profile: Sloped riser with rounded nosing.
  - 3. Treads: Manufacturer's standard diamond plate.
  - 4. Landings:
    - a. Same construction as treads, supported and reinforced as recommended by manufacturer for design load capacity.
  - 5. Rails:
    - a. Guardrails: 42 inches high.
    - b. Handrails: 30 inches high.
    - c. Infill: Pickets.
    - d. Rail Finish: Hot-dipped galvanizing; comply with ASTM A153/A153M.
  - 6. Stair Finish: Manufacturer's standard hot-dipped galvanizing; comply with ASTM A153/A153M.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

#### **3.04 CLEANING**

- A. Clean installed work to like-new condition.

**SECTION 078100**  
**APPLIED FIRE PROTECTION**

**PART 2 PRODUCTS**

1.01 APPLIED FIRE PROTECTION ASSEMBLIES

1.02 MATERIALS

**END OF SECTION**

**SECTION 078400**  
**FIRESTOPPING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Firestopping systems.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2026.
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2024.
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.
- E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus; 2025b.
- F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.
- G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a, with Editorial Revision (2024).
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

## **PART 2 PRODUCTS**

### 2.01 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

### 2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
  - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
  - 2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  - 3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  - 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
  - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  - 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
- E. Acoustically Rated Firestopping: Provide system tested in accordance with ASTM E90 with STC rating of 50, minimum.

### 2.03 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
  - 1. Fire Ratings: See drawings for required systems and ratings.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

### 3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

### 3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

#### 3.04 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

#### 3.05 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

**END OF SECTION**



**SECTION 079200**  
**JOINT SEALANTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Spray-applied joint sealants.
- B. Nonsag gunnable joint sealants.
- C. Self-leveling pourable joint sealants.
- D. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2024.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- L. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- M. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Backing material recommended by sealant manufacturer.
  - 4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 5. Substrates the product should not be used on.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Executed warranty.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
  - 1. Adhesion Testing: In accordance with ASTM C794.
  - 2. Compatibility Testing: In accordance with ASTM C1087.
  - 3. Allow sufficient time for testing to avoid delaying the work.
  - 4. Deliver sufficient samples to manufacturer for testing.
  - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

#### 1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

### **PART 2 PRODUCTS**

#### 2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
  - 1. Exterior Joints:
    - a. Seal open joints except open joints indicated on drawings as not sealed.
  - 2. Interior Joints:
    - a. Seal open joints except specific open joints indicated on drawings as not sealed.
  - 3. Do Not Seal:
    - a. Intentional weep holes in masonry.
    - b. Joints indicated to be covered with expansion joint cover assemblies.
    - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
    - d. Joints where sealant installation is specified in other sections.
    - e. Joints between suspended ceilings and walls.

#### 2.02 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
- B. Colors: As indicated on drawings.

#### 2.03 SPRAY-APPLIED JOINT SEALANTS

- A. Spray-Applied Water-Based Acrylic Latex Sealant: For interior applications, spray-applied, fast-drying, premixed acrylic latex sealant, intended for air sealing penetrations and joints.

1. Surface Burning Characteristics: Smoke developed index of 450 or less, and flame spread index of 25 or less, Class A, when tested in accordance with ASTM E84.
2. Spray Equipment: Use rate of application and methods as recommended by manufacturer.

#### 2.04 NONSAG JOINT SEALANTS

- A. Type \_\_\_\_ - Silicone Sealant: ASTM C920, Grade NS, Uses M, A, G, and O; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
  3. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
  4. Color: To be selected by Architect from manufacturer's standard range.
  5. Service Temperature Range: Minus 65 to 180 degrees F.
- B. Type \_\_\_\_ - Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
  1. Color: selected from full range.
- C. Type \_\_\_\_ - Acrylic-Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
- D. Type \_\_\_\_ - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
  1. Color: To be selected by Architect from manufacturer's standard range.
  2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
- E. Type \_\_\_\_ - Acrylic Latex Sealant: ASTM C834; for use as acoustical sealant and in firestopping systems for expansion joints and through penetrations.
  1. Fire Rated System: Complies with UL 263 and ASTM E119 with UL fire resistance classifications.

#### 2.05 SELF-LEVELING JOINT SEALANTS

- A. Type \_\_\_\_ - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
  1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
  3. Color: To be selected by Architect from manufacturer's standard range.
- B. Type \_\_\_\_ - Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
  1. Composition: Multicomponent, 100 percent solids by weight.
  2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
  3. Joint Width, Minimum: 1/8 inch.
  4. Joint Width, Maximum: 1/4 inch.

#### 2.06 ACCESSORIES

- A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

#### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

#### **3.03 INSTALLATION**

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION**

**SECTION 079513**  
**EXPANSION JOINT COVER ASSEMBLIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Expansion joint cover assemblies for floor, wall, ceiling, and soffit surfaces.

1.02 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and \_\_\_\_\_.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and \_\_\_\_\_.
- D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
  - 1. Balco, Inc: [www.balcousa.com/#sle](http://www.balcousa.com/#sle).
  - 2. Construction Specialties, Inc: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
  - 3. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
  - 4. MM Systems Corp: [www.mmsystemscorp.com/#sle](http://www.mmsystemscorp.com/#sle).
  - 5. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement:
  - 1. Manufacturers:
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement:
  - 1. Manufacturers:
    - a. Balco, Inc; CMLP Low Profile Surface Mount: [www.balcousa.com/#sle](http://www.balcousa.com/#sle).
- C. Exterior Wall Joints Subject to Thermal Movement:
  - 1. Manufacturers:
    - a. Balco, Inc; CMX low profile: [www.balcousa.com/#sle](http://www.balcousa.com/#sle).

2.03 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.

1. Joint Dimensions and Configurations: As indicated on drawings.
2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Floor Joint Covers: Coordinate with indicated floor coverings.

#### 2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
1. Exposed Finish Outdoors: Natural anodized.
  2. Exposed Finish at Floors: Mill finish or natural anodized.
  3. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

#### 3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

#### 3.03 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.

### **END OF SECTION**

**SECTION 070150.19**  
**PREPARATION FOR RE-ROOFING**

**PART 2 PRODUCTS**

1.01 COMPONENTS

A. See the following sections for additional information on components relating to this work:

1.02 MATERIALS

**END OF SECTION**

**SECTION 080671**  
**DOOR HARDWARE SCHEDULE**

**PART 2 PRODUCTS**

1.01 FINISHES

- A. Finishes: Complying with BHMA A156.18.

**END OF SECTION**



**SECTION 081113**  
**HOLLOW METAL DOORS AND FRAMES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire-rated hollow metal doors and frames.
- C. Thermally insulated hollow metal doors with frames.
- D. Sound-rated hollow metal doors and frames.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SCIF: Sensitive Compartmented Information Facility.
- G. SDI: Steel Door Institute.
- H. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2026.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2026.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.
- H. ASTM C143/C143M - Standard Test Method for Slump of Concrete; 2026b.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- K. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. ITS (DIR) - Directory of Listed Products; Current Edition.

- O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.
- Q. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025, with Amendment (2024).
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- U. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2026.
- V. UL (DIR) - Online Certifications Directory; Current Edition.
- W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.
- E. Design Submittals: Manufacturer to submit anchor design analysis calculations for blast-resistant doors signed and sealed by specialty design engineer experienced in this type of work and licensed in the State in which the Project is located.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

## **PART 2 PRODUCTS**

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
  - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.

4. Door Edge Profile: Manufacturers standard for application indicated.
  5. Typical Door Face Sheets: Flush.
  6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
  7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

## 2.02 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty.
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
  2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inches, nominal.
- C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty.
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
  2. Door Thickness: 1-3/4 inches, nominal.
- D. \_\_\_\_\_, Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty.
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
  2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
  3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    - a. Attach fire rating label to each fire rated unit.
  4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
  5. Door Thickness: 1-3/4 inches, nominal.
- E. Sound-Rated Interior and Exterior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty.
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.

2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of rating as noted on drawings, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
3. Door Thickness: As required to meet acoustic requirements indicated.
4. Opening Force of Sound-Rated Doors, Non-Fire-Rated: 5 pounds, maximum, in compliance with ADA Standards.

## 2.03 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Exterior Door Frames: Full profile/continuously welded type.
  1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  2. Frame Finish: Factory primed and field finished.
  3. Weatherstripping: Separate, see Section 087100.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  2. Frame Finish: Factory primed and field finished.
- D. Door Frames, Fire-Rated: Full profile/continuously welded type.
  1. Fire Rating: Same as door, labeled.
  2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  3. Frame Finish: Factory primed and field finished.
- E. Sound-Rated Door Frames: Full profile/continuously welded type.
  1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  2. Frame Finish: Factory primed and field finished.

## 2.04 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities. Use at all doors installed in masonry.
  1. Fire-Rated Frames: Comply with fire rating requirements indicated.

## 2.05 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed.
  1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
- B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  1. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
  2. Glazing: 1/4 inch thick, tempered glass, in compliance with requirements of authorities having jurisdiction.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

#### **3.02 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

#### **3.03 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.

#### **3.04 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

#### **3.05 ADJUSTING**

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

### **END OF SECTION**

**SECTION 081116**  
**ALUMINUM DOORS AND FRAMES**

**PART 2 PRODUCTS**

1.01 DOORS AND FRAMES

- A. Dimensions and Shapes: As indicated on drawings; dimensions indicated are nominal.
  - 1. Provide the following clearances:
    - a. Hinge and Lock Stiles: 1/8 inch.
    - b. Between Meeting Stiles: 1/4 inch.
    - c. At Top Rail and Bottom Rail: 1/8 inch.

1.02 COMPONENTS

**END OF SECTION**

**SECTION 081416**  
**FLUSH WOOD DOORS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 2 by 2 inches in size illustrating wood grain, stain color, and sheen.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Warranty, executed in Owner's name.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
  - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

**PART 2 PRODUCTS**

2.01 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
  - 1. Quality Standard: Premium Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
  - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
  - 1. Provide solid core doors at each location.

2. Wood veneer facing with factory transparent finish as selected from full mfr. full range.

## 2.02 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

## 2.03 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: MAPLE, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
  1. Vertical Edges: Any option allowed by quality standard for grade.
  2. Transoms: Continuous match to doors.

## 2.04 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  1. Provide solid blocks at lock edge for hardware reinforcement.
  2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

## 2.05 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
  1. Transparent:
    - a. System - 1, Lacquer, Nitrocellulose.
    - b. Stain: As selected by Architect.
    - c. Sheen: Semigloss.
- B. Factory finish doors in accordance with approved sample.

## 2.06 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081113.
- B. Metal Louvers:
  1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
  2. Louver Blade: Inverted V blade, sight proof, light proof.
- C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  1. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
- D. Glazing: See Section 088000.
- E. Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.
- F. Astragals and Edges for Double Doors: Pairs of doors astragals, and door edge sealing and protection devices.
  1. UL listed products in compliance with requirements of authorities having jurisdiction.



- 2. Edge Type: Beveled edge
- 3. Material: Aluminum.

G. Door Hardware: See Section 087100.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

#### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

#### **3.03 TOLERANCES**

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

#### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

### **END OF SECTION**

**SECTION 083100**  
**ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware: Mortise cylinder and core hardware.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

**PART 2 PRODUCTS**

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
  - 1. Location: As indicated on drawings.
  - 2. Panel Material: Steel.
  - 3. Size: 16 by 16 inches.
  - 4. Door/Panel: Hinged, standard duty, with lockset and keyed - matching hardware in project.
  - 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
  - 6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
  - 7. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- B. Wall-Mounted Units in Wet Areas:
  - 1. Location: As indicated on drawings.
  - 2. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
  - 3. Size: 16 by 16 inches.
  - 4. Door/Panel: Hinged, standard duty, with lockset and keyed - matching hardware in project.
  - 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
  - 6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
  - 7. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- C. Fire-Rated Wall-Mounted Units:
  - 1. Location: As indicated on drawings.
  - 2. Wall Fire-Rating: As indicated on drawings.
  - 3. Panel Material: Steel.
  - 4. Size: 16 by 16 inches.
  - 5. Door/Panel: Insulated double-surface panel, with matching lockset and keyed .

- D. Ceiling-Mounted Units:
  - 1. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
  - 2. Size - Other Ceilings: 16 by 16 inches.
  - 3. Door/Panel: Hinged, standard duty, with lockset and keyed - match hardware on project

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

#### **3.03 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

### **END OF SECTION**

**SECTION 084313**  
**ALUMINUM-FRAMED STOREFRONTS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.

1.02 RELATED REQUIREMENTS

- A. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2025.
- B. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- E. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- M. FLA (PAD) - Florida Building Code Online - Product Approval Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples \_\_\_\_x\_\_\_\_ inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Specimen warranty.

#### 1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### 1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

#### 1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

### **PART 2 PRODUCTS**

#### 2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Front-Set Style, Wind-Borne-Debris Resistance Tested:
  - 1. Basis of Design: Kawneer 451T.
  - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
- B. Front-Set Style, Thermally-Broken (exterior locations):
  - 1. Basis of Design: Kawneer 451.
  - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
- C. Front-Set Style, Not Thermally-Broken (interior locations):
  - 1. Basis of Design: Kawneer 450.

2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

D. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:

1. Oldcastle BuildingEnvelope; [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
2. Tubelite, Inc: [www.tubeliteinc.com/#sle](http://www.tubeliteinc.com/#sle).
3. YKK AP America, Inc: [www.ykkap.com/commercial/#sle](http://www.ykkap.com/commercial/#sle).

## 2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

A. Front-Set Style, Structural Sealant Glazed Verticals:

1. Basis of Design: Kawneer 451.
2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:

1. Oldcastle BuildingEnvelope; [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
2. [ ]Tubelite, Inc: [www.tubeliteinc.com/#sle](http://www.tubeliteinc.com/#sle).
3. YKK AP America, Inc: [www.ykkap.com/commercial/#sle](http://www.ykkap.com/commercial/#sle).

## 2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Wind-Borne-Debris Resistance Tested:

1. Basis of Design: Kawneer 500T.
2. Thickness: 2-3/16 inch.

B. Wide Stile, Monolithic Glazing:

1. Basis of Design: Kawneer 500 Heavy Wall.
2. Thickness: 1-3/4 inches.

C. Wide Stile, Insulating Glazing, Thermally-Broken:

1. Basis of Design: Kawneer 500T.
2. Thickness: 2-1/4 inches.

D. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:as listed in approved manufacturers.

1. Oldcastle BuildingEnvelope; [www.oldcastlebe.com](http://www.oldcastlebe.com)
2. Tubelite, Inc: [www.tubeliteinc.com](http://www.tubeliteinc.com)
3. YKK AP America, Inc: [www.ykkap.com/commercial/#sle](http://www.ykkap.com/commercial/#sle).

## 2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Finish: Class I natural anodized.
  - a. Factory finish all surfaces that will be exposed in completed assemblies.
2. Finish Color: As indicated on drawings.If no specific indication, provide clear anodized color and finish.
3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
9. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
10. Preparation for Window Treatments: Provide reinforced interior horizontal head rail where window treatments are to be fastened to head.

B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - a. Design Wind Loads: Comply with requirements of ASCE 7.
  - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, having Florida Building Code FLA (PAD) approval for Large and Small Missile impact and pressure cycling at design wind pressure.
3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
4. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
5. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
6. Deflection limited to L/175 perpendicular to wall plane and L/360 or 1/8 inch whichever is greater parallel.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Glazing Stops: Flush.
- B. Glazing: See Section 088000.
- C. Infill Panels: Insulated, steel, with edges formed to fit glazing channel and sealed.
  1. Total Nominal Thickness: 1 inch.
  2. Core: Rigid expanded polystyrene insulation core
  3. Exterior Finish: Superior performing organic coatings.
  4. Interior Finish: Superior performing organic coatings.
- D. Swing Doors: Glazed aluminum.
  1. Thickness: 1-3/4 inches.
  2. Top Rail: 4 inches wide.
  3. Vertical Stiles: 4-1/2 inches wide.
  4. Bottom Rail: 10 inches wide.
  5. Glazing Stops: Square.
  6. Finish: Same as storefront.
- E. Interior Sliding Storefront Doors: Full glazed extruded aluminum frame and operable panels; manual operation; bottom rollers; flat or recessed sill.
  1. Configuration and Size: As indicated on drawings.
  2. Glazing Thickness: 1/4 inch.
  3. Stile Width: 2 inches.
  4. Frame Face Width: 1-1/2 inches.
  5. Provide deadlock keyed both sides on each operable panel.

## 2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- E. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch minimum thickness.
- F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- G. Sealant for Setting Thresholds: Non-curing butyl type.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

## 2.07 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

## 2.08 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: Storefront manufacturer's standard type to suit application.
  - 1. Finish on Hand-Contacted Items: Polished stainless steel.
  - 2. For each door, include butt hinges, pivots, push handle, and pull handle. Refer to hardware sets for hardware required for each door.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

## 3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install hardware using templates provided.



- K. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 088000.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### 3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### 3.04 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
  - 1. Perform a minimum of two tests in each designated area illustrating variance of conditions..
  - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- B. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

### 3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

### 3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

### 3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

## **END OF SECTION**

## **SECTION 087100**

### **DOOR HARDWARE**

#### **PART 1 GENERAL**

##### 1.01 SECTION INCLUDES

- A. Hardware for wood, aluminum, hollow metal, and \_\_\_\_\_ doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Thresholds.
- E. Weatherstripping and gasketing.
- F. Gate locks.

##### 1.02 RELATED REQUIREMENTS

- A. Section 062000 - Finish Carpentry: Wood door frames.
- B. Section 081113 - Hollow Metal Doors and Frames.
- C. Section 081416 - Flush Wood Doors.
- D. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- E. Section 084413 - Glazed Aluminum Curtain Walls: Door hardware, except cylinders.
- F. Section 281000 - Access Control: Electronic access control devices.

##### 1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA A156.1 - Standard for Butts and Hinges; 2025.
- C. BHMA A156.2 - Bored and Preamsembled Locks and Latches; 2022.
- D. BHMA A156.3 - Exit Devices; 2025.
- E. BHMA A156.4 - Door Closers and Pivots; 2024.
- F. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- G. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- H. BHMA A156.7 - Template Hinge Dimensions; 2022.
- I. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.
- J. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
- K. BHMA A156.17 - Self Closing Hinges & Pivots; 2025.
- L. BHMA A156.18 - Standard for Materials and Finishes; 2020.
- M. BHMA A156.21 - Thresholds; 2025.
- N. BHMA A156.22 - Standard for Gasketing; 2021.
- O. BHMA A156.23 - Electromagnetic Locks; 2022.
- P. BHMA A156.25 - Electrified Locking Devices; 2023.
- Q. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.
- R. BHMA A156.29 - American National Standard for Exit Locks, Exit Alarms, Alarms for Exit Devices; 2022 .
- S. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2024.
- T. BHMA A156.36 - Auxiliary Locks; 2020.

- U. DHI (KSN) - Keying Systems and Nomenclature; 2019.
- V. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- W. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- X. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025, with Amendment (2024).
- Y. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Z. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- AA. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- BB. UL (DIR) - Online Certifications Directory; Current Edition.
- CC. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on. Should requirements of this specification interfere or not coordinate with items specified in hardware set, the greatest quantity or quality shall apply. Contractor to note discrepancy on hardware submittal for review.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
  - 1. Architect.
  - 2. Installer's Architectural Hardware Consultant (AHC).
  - 3. Hardware Installer.
  - 4. Owner's Security Consultant.
  - 5. Owner's preferred keying contractor.
  - 6. Construction Manager
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying:
  - 1. Final keying will be done by Owner and Owner's keying contractors. Contractor to coordinate with Owner and Owner's Keying contractor (Oak Security)
  - 2. All construction keys, keying, cores, etc are to be provided by contractor. Contractor to remove all cores prior to Owner's keying Contractor installing final cores.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  - 2. Provide complete description for each door listed.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
  2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
  - E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
  - F. Manufacturer's qualification statement.
  - G. Installer's qualification statement.
  - H. Specimen warranty.
- 1.06 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
  - B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.
- 1.08 WARRANTY
- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
  - B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
    1. Closers: Five years, minimum.
    2. Exit Devices: Three years, minimum.
    3. Locksets and Cylinders: Three years, minimum.
    4. Other Hardware: Two years, minimum.

## **PART 2 PRODUCTS**

### **2.01 DESIGN AND PERFORMANCE CRITERIA**

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
  1. Applicable provisions of federal, state, and local codes.
  2. Accessibility: ADA Standards and ICC A117.1.
  3. Applicable provisions of NFPA 101.
  4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  5. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
  1. Refer to technology drawings for additional access control system requirements and refer to items being provided by others.

- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See drawings for the hardware schedule.
- F. Fasteners:
  - 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
    - a. Aluminum fasteners are not permitted.
    - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
  - 2. Fire-Rated Applications: Comply with NFPA 80.
    - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
    - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

## 2.02 HINGES

- A. Manufacturers:
  - 1. McKinney; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
- B. Hinges: Comply with BHMA A156.1, Grade 1.
  - 1. Self Closing Hinges: Comply with BHMA A156.17.
  - 2. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
    - a. Provide hinge width required to clear surrounding trim.
  - 3. Provide hinges on every swinging door.
  - 4. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
  - 5. Provide following quantity of butt hinges for each door:
    - a. Doors up to 60 inches High: Two hinges.
    - b. Doors From 60 inches High up to 90 inches High: Three hinges.
    - c. Doors 90 inches High up to 120 inches High: Four hinges.
    - d. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.
    - e. Dutch Doors: Two hinges each leaf.

## 2.03 PIVOTS

- A. Manufacturers:
  - 1. McKinney or Rixson; an Assa Abloy Group company; \_\_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. dormakaba; Architectural Hardware LM Series: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
  - 3. Ives, an Allegion brand; \_\_\_\_\_: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  - 4. BEST, dormakaba Group; \_\_\_\_\_: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
- B. Center-Hung and Offset Pivots: Comply with BHMA A156.4.
- C. Self-Closing Pivots: Comply with BHMA A156.17.
- D. Door Weight: Medium; standard openings with up to 650 lbs door weight.

## 2.04 FLUSH BOLTS

- A. Manufacturers:
  - 1. Adams Rite, an Assa Abloy Group company; \_\_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies; \_\_\_\_\_: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. Ives, an Allegion brand; \_\_\_\_\_: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
  - 1. Flush Bolt Throw: 3/4 inch, minimum.

2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
  - a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.
5. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.
6. Manufacturers:
  - a. Trimco
  - b. Rockwell
  - c. Ives

## 2.05 EXIT DEVICES

- A. Manufacturers: all shall be extra heavy duty grade
  1. Von Duprin, an Allegion brand: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
  1. Lever design to match lockset trim.
  2. Provide cylinder with cylinder dogging or locking trim.
  3. Provide exit devices properly sized for door width and height.
  4. Provide strike as recommended by manufacturer for application indicated.
  5. Provide less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes.
  6. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
  7. For electrical options, provide quick connect plug-in pre-wired connectors.

## 2.06 EXIT ALARMS

- A. Exit Alarms: Comply with BHMA A156.29.
  1. Include stand-alone and exit device integrated type(s), as indicated in Door Hardware Schedule.
  2. Arming and Disarming: By inside control key, allowing authorized entry or exit by means of an on-and-off key switch.
  3. Alarm: Manufacturer's standard piezo horn.
  4. Housing: Manufacturer's standard, weatherized for exterior or high-humidity environment applications.
  5. Cover Plate Color: As indicated on drawings.
  6. Mounting: As indicated on drawings.

## 2.07 ELECTRIC STRIKES

- A. Manufacturers:
  1. Adams Rite, HES, or Securitron; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. dormakaba; RCI 6 Series: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
  3. Pamex, Inc; Electric Strikes: [www.pamexinc.com/#sle](http://www.pamexinc.com/#sle).
- B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
  1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
  2. Provide non-handed voltage electric strike suitable for door frame material and scheduled lock configuration. Coordinate power requirements with technology drawings.
  3. Provide field selectable Fail Safe/Fail Secure modes.
  4. Provide transformer and rectifier as necessary for complete installation.
  5. Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

## 2.08 ELECTROMAGNETIC LOCKS

- A. Manufacturers:
  - 1. dormakaba; RCI 8310/8320 MultiMag Series: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
- B. Electromagnetic Locks: Comply with BHMA A156.23, Grade 1.
  - 1. Holding Force: 300 lbs, minimum.
  - 2. Voltage: coordinated with technology drawings, and provide power supplies by same manufacturer as locks.
  - 3. Mounting: Surface mounted to door and frame on secure side, with fasteners, brackets, and spacer bars as required for application.

## 2.09 LOCK CYLINDERS

- A. Manufacturers:
  - 1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
- B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
  - 1. Provide small format interchangeable core (SFIC) type cylinders, Grade 1, with seven-pin core in compliance with BHMA A156.5. CONFIRM owner existing locking system and match.
  - 2. Provide cylinders from same manufacturer as locking device.
  - 3. Provide cams and/or tailpieces as required for locking devices.

## 2.10 CYLINDRICAL LOCKS

- A. Manufacturers:
  - 1. Sargent; an Assa Abloy Group company; 10x line: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. BEST, dormakaba Group; 9K Series: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 3. Schlage, an Allegion brand; ND Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
  - 1. Bored Hole: 2-1/8 inch diameter.
  - 2. Latchbolt Throw: 1/2 inch, minimum.
  - 3. Backset: 2-3/4 inch unless otherwise indicated.
  - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
    - a. Finish: To match lock or latch.
  - 5. Provide a lock for each door, unless otherwise indicated that lock is not required.
  - 6. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.
  - 7. Trim: Lever style similar to BEST 16C
  - 8. Finish: Satin Nickel
  - 9. Rose: 3" mfr Standard

## 2.11 ELECTROMECHANICAL LOCKS

- A. Manufacturers:
  - 1. Sargent; an Assa Abloy Group company; \_\_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. BEST, dormakaba Group; 9KW Series: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 3. Schlage, an Allegion brand; ND Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  - 4. Match Manufacturer of standard locksets..
- B. Electromechanical Locks: Comply with BHMA A156.25, Grade 1, Security, 1000 Series
  - 1. Provide motor-driven or solenoid-driven locks, with strike that is applicable to frame.
  - 2. Type: Cylindrical (Bored).

## 2.12 AUXILIARY LOCKS (DEADLOCKS)

- A. Manufacturers:
  - 1. Match Lockset Manufacturer.
- B. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
  - 1. Type: Bored (cylindrical).

2. Application: Bored.
3. Backset: 2-3/4 inch, unless otherwise indicated.
4. Bolt Throw: 1/2 inch, with latch made of hardened steel.

## 2.13 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
  1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
- B. Door Pulls and Push Plates: Comply with BHMA A156.6.
  1. Pull Type: Offset, unless otherwise indicated.
  2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
    - a. Edges: Beveled, unless otherwise indicated.
  3. Material: Aluminum, unless otherwise indicated.
  4. On solid doors, provide matching door pull and push plate on opposite faces.
  5. At group restroom locations, provide foot pull in conjunction with door pull.

## 2.14 DOOR PULLS AND PUSH BARS

- A. Manufacturers:
  1. Rockwood; an Assa Abloy Group company; \_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. dormakaba; TG9335 Series: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
  3. Hager Companies; \_\_\_\_: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
- B. Door Pulls and Push Bars: Comply with BHMA A156.6.
  1. Bar Type: Bar set, unless otherwise indicated.
  2. Material: Aluminum, unless otherwise indicated.

## 2.15 COORDINATORS

- A. Manufacturers:
  1. Rockwood; an Assa Abloy Group company; \_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. dormakaba; TS93 GSR: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
  3. Ives, an Allegion brand; \_\_\_\_: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
  1. Type: Bar, unless otherwise indicated.
  2. Material: Aluminum, unless otherwise indicated.
  3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

## 2.16 CLOSERS

- A. Manufacturers; Surface Mounted:
  1. Norton; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. LCN, an Allegion brand: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Closers: Comply with BHMA A156.4, Grade 1.
  1. Type: Surface Mounted to door unless door arrangement or hardware set requires otherwise.
  2. Provide door closer on each exterior door.
  3. Provide door closer on each fire-rated and smoke-rated door.
    - a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
  4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
  5. At corridor entry doors, mount closer on room side of door.
  6. At outswinging exterior doors, mount closer on interior side of door.
  7. Unless specifically noted otherwise, all closers shall have overhead stop function.



## 2.17 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
  - 1. Sargent; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. dormakaba; Architectural Hardware 900 Series: [www.dormakaba.com/#sle](http://www.dormakaba.com/#sle).
- B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
  - 1. Provide stop for every swinging door, unless otherwise indicated.

## 2.18 PROTECTION PLATES

- A. Manufacturers:
  - 1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. Ives, an Allegion brand: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  - 4. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Protection Plates: Comply with BHMA A156.6.
- C. Metal Properties: Stainless steel material.
  - 1. Metal, Standard Duty: Thickness 0.050 inch, minimum.
- D. Edges: Beveled, on four sides unless otherwise indicated.
- E. Fasteners: Countersunk screw fasteners.

## 2.19 ARMOR PLATES

- A. Manufacturers:
  - 1. Same as Protection Plates
- B. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface.
  - 1. Size: 16 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.

## 2.20 KICK PLATES

- A. Manufacturers:
  - 1. Same as Protection Plates.
- B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
  - 1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

## 2.21 MOP PLATES

- A. Manufacturers:
  - 1. Same as Protection Plates.
- B. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.
  - 1. Size: 6 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.

## 2.22 DOOR HOLDERS

- A. Manufacturers:
  - 1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Door Holders: Comply with BHMA A156.16, Grade 1.
  - 1. Type: Lever, or kick down stop, with rubber bumper at bottom end.
  - 2. Material: Aluminum.

## 2.23 FLOOR STOPS

- A. Manufacturers:
  - 1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
  - 1. Type: Manual hold-open, with pencil floor stop.
  - 2. Material: Aluminum housing with rubber insert.

## 2.24 WALL STOPS

- A. Manufacturers:
  - 1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
  - 1. Type: Bumper, concave, wall stop.
  - 2. Material: Aluminum housing with rubber insert.

## 2.25 ASTRAGALS

- A. Manufacturers:
  - 1. Pemko; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 4. Standard Metal Hardware Manufacturing Ltd; Astragals: [www.smhardware.com/#sle](http://www.smhardware.com/#sle).
  - 5. Zero International, Inc: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).
- B. Astragals: Comply with BHMA A156.22.
  - 1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
  - 2. Type: Split, two parts, and with sealing gasket.
  - 3. Material: Steel, with neoprene weatherstripping.
  - 4. Provide non-corroding fasteners at exterior locations.

## 2.26 THRESHOLDS

- A. Manufacturers:
  - 1. Pemko; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Hager Companies: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 3. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 4. Zero International, Inc: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).
- B. Thresholds: Comply with BHMA A156.21.
  - 1. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.
  - 2. Provide threshold at each exterior door, unless otherwise indicated.
  - 3. Provide threshold with Sound Transmission Class (STC) of 35-40 at locations indicated.
  - 4. Type: Flat surface.
  - 5. Material: Aluminum.
  - 6. Threshold Surface: Fluted horizontal grooves across full width.
  - 7. Field cut threshold to profile of frame and width of door sill for tight fit.
  - 8. Provide non-corroding fasteners at exterior locations.

## 2.27 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:

1. Pemko; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Hager Companies; \_\_\_\_\_: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  3. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  4. Zero International, Inc: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
1. Head and Jamb Type: Adjustable.
  2. Door Sweep Type: Door shoe.
  3. Material: Aluminum, with rubber weatherstripping.
  4. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
  5. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
  6. Provide door bottom sweep on each exterior door, unless otherwise indicated.
  7. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

## 2.28 GATE LATCH

- A. Manufacturers:
1. Rockwood; an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
- B. Gate Latch: Provide to secure a gate used for traffic control to prevent pedestrian traffic into an area, located on inside of gate with turn piece.
1. Material: Steel.

## 2.29 SILENCERS

- A. Silencers: Provide at all locations without weatherstripping on door frame to mute sound of door's impact upon closing.
1. Single Door: Provide three on strike jamb of frame.
  2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
  3. Material: Rubber, gray color.

## 2.30 VERTICAL ROD COVERS

- A. Vertical Rod Covers: Provides protection from damage or tampering of surface mounted bottom vertical rod of exit device and to accommodate ADA Standards.
1. Length: 12 inch.
  2. Material: Stainless steel.

## 2.31 KEY CONTROL SYSTEMS

- A. Key Control Systems: Comply with guidelines of BHMA A156.28.
1. Contractor to include keying costs to utilize Owner's Keying Contractor Oak Security to execute all keying per University Standards. Coordination with the University is required. Oaks Security to work directly with University on keying standards. Contractor responsible for all costs associated with final keying arrangement of the proejct.
  2. Provide keying information in compliance with DHI (KSN) standards.
  3. Keying: Great grand master keyed.
  4. Supply keys in following quantities:
    - a. 4 each Master keys.
    - b. 1 each Grand Master keys.
    - c. 1 each Great Grand Master keys.
    - d. 6 each Construction Master keys.
    - e. 2 each Extra Cylinder cores.
  5. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.

6. Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.
7. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
8. Owner or Owner's agent install permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier. Contractor to include cost of Oak Security installing final cores and keying in their price.

#### 2.32 KEY CABINET

- A. Key Cabinet: Sheet steel construction, piano hinged door with key lock; BHMA A156.28.
  1. Mounting: Wall-mounted.
  2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
  3. Size key hooks to hold 6 keys each.
  4. Finish: Baked enamel, manufacturer's standard color.
  5. Key cabinet lock to building keying system.

#### 2.33 FIRE DEPARTMENT LOCK BOX

- A. Manufacturers:
  1. Knox Company; Knox-Box Rapid Entry System: [www.knoxbox.com/#sle](http://www.knoxbox.com/#sle).
- B. Fire Department Lock Box:
  1. Capacity: Holds 10 keys.
  2. Finish: Manufacturer's standard black.
  3. Coordinate final location with Fire Department, Owner, CM, and Architect.
  4. Provide (2) lock boxes

#### 2.34 FINISHES

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
  1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
  2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
    - a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

#### 3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- D. Use templates provided by hardware item manufacturer.
- E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-15-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
- G. Coordinate electrified hardware installation with Technology contractor. Coordinate all power supply items with Technology Contractor.
- H. Coordinate keying with Owner and Oak Security.

### 3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

### 3.04 ADJUSTING

- A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

### 3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

## **HARDWARE SCHEDULE**

### **HARDWARE SET NO. 1:**

SINGLE DOOR, CLASSROOM-48", ACCESS CONTROL.

DOORS: 601, 605, 606, 610, 611

|   |    |                                    |
|---|----|------------------------------------|
| 4 | EA | BB-BUTT HINGES                     |
| 1 | EA | MORTISE LOCKSET – STORAGE FUNCTION |
| 1 | EA | CYLINDER                           |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)   |
| 1 | EA | ELECTRIC STRIKE                    |
| 1 | EA | CLOSER WITH STOP ARM               |
| 1 | EA | WALL STOP                          |
| 2 | EA | KICKPLATE                          |
| 1 | EA | DOOR CONTACT                       |

CARD READER

POWER SUPPLY (REMOTE)

DOOR REMAINS LATCHED AND LOCKED UNLESS CREDENTIALS PRESENTED TO READER. PROPER CREDENTIAL ACTIVATES ELECTRIC STRIKE WHICH UNLATCHES THE DOOR. EXTERIOR LOCKSET REMAINS LOCKED. KEY ACCESS VIA EXTERIOR. FREE EGRESS AT ALL TIMES FROM THE INTERIOR. DOOR IS FAIL SECURE.

### **HARDWARE SET NO. 2:**

SINGLE DOOR, ACCESS CONTROL.

DOORS: 615, 616, 617, 619, 620, 602, 609, 613,

|   |    |                                    |
|---|----|------------------------------------|
| 3 | EA | BB-BUTT HINGES                     |
| 1 | EA | MORTISE LOCKSET – STORAGE FUNCTION |
| 1 | EA | CYLINDER                           |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)   |
| 1 | EA | ELECTRIC STRIKE                    |
| 1 | EA | CLOSER WITH STOP ARM               |
| 1 | EA | WALL STOP                          |
| 2 | EA | KICKPLATE                          |
| 1 | EA | DOOR CONTACT                       |

CARD READER

POWER SUPPLY (REMOTE)

DOOR REMAINS LATCHED AND LOCKED UNLESS CREDENTIALS PRESENTED TO READER. PROPER CREDENTIAL ACTIVATES ELECTRIC STRIKE WHICH UNLATCHES THE DOOR. EXTERIOR LOCKSET REMAINS LOCKED. KEY ACCESS VIA EXTERIOR. FREE EGRESS AT ALL TIMES FROM THE INTERIOR. DOOR IS FAIL SECURE.

**HARDWARE SET NO. 3:**

SINGLE DOOR, STORAGE FUNCTION.

DOORS: 618

|   |    |                                    |
|---|----|------------------------------------|
| 3 | EA | BB-BUTT HINGES                     |
| 1 | EA | MORTISE LOCKSET – STORAGE FUNCTION |
| 1 | EA | CYLINDER                           |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)   |
| 1 | EA | CLOSER WITH STOP ARM               |
| 1 | EA | WALL STOP                          |
| 2 | EA | KICKPLATE                          |

**HARDWARE SET NO. 4:**

SINGLE DOOR, CLASSROOM FUNCTION.

DOORS: 605A, 606A, 610A, 611A

|   |    |                                      |
|---|----|--------------------------------------|
| 3 | EA | BB-BUTT HINGES                       |
| 1 | EA | MORTISE LOCKSET – CLASSROOM FUNCTION |
| 1 | EA | CYLINDER                             |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)     |
| 1 | EA | CLOSER WITH STOP ARM                 |
| 1 | EA | WALL STOP                            |
| 2 | EA | KICKPLATE                            |

**HARDWARE SET NO. 5:**

SINGLE DOOR (RESTROOMS), STORAGE FUNCTION WITH INDICATOR.

DOORS: 603, 604, 606, 608

- |   |    |                                                    |
|---|----|----------------------------------------------------|
| 3 | EA | BB-BUTT HINGES                                     |
| 1 | EA | MORTISE LOCKSET – STORAGE WITH DB & OCC INDICATOR. |
| 1 | EA | CYLINDER                                           |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)                   |
| 1 | EA | ELECTRIC STRIKE                                    |
| 1 | EA | CLOSER WITH STOP ARM                               |
| 1 | EA | WALL STOP                                          |
| 2 | EA | KICKPLATE                                          |
| 1 | EA | DOOR CONTACT                                       |

CARD READER

POWER SUPPLY (REMOTE)

DOOR IS NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL PRESENTATION RELEASES ELECTRIC STRIKE FOR ENTRY. WHEN ROOM IS OCCUPIED, DEADBOLT IS THROWN BY INSIDE THUMBTURN DISALLOWING ENTRY, AND EXTERIOR INDICATOR DISPLAYS OCCUPIED STATUS. FREE EGRESS AT ALL TIMES. UPON LOSS OF POWER DOOR REMAINS LOCKED (FAIL-SECURE).

**HARDWARE SET NO. 6:**

DOUBLE DOOR, STORAGE FUNCTION.

DOORS: 600A, 600B

- |   |    |                                                 |
|---|----|-------------------------------------------------|
| 6 | EA | BB-BUTT HINGES                                  |
| 1 | EA | MORTISE LOCKSET – STORAGE FUNCTION              |
| 1 | EA | CYLINDER                                        |
| 1 | EA | SFIC CORE (VERIFY WITH EXISTING)                |
| 1 | EA | ASTRAGAL 550-NGP                                |
| 2 | EA | MANUAL FLUSH BOLTS 3913/3915 TRM TOP AND BOTTOM |
| 1 | EA | DUST PROOF STRIKE 3910 TRM                      |
| 2 | EA | OVERHEAD STOP WITH HOLD-OPEN OH902H ROC         |
| 4 | EA | KICKPLATE                                       |



**HARDWARE SET NO.7:**

DOUBLE ALUMINUM ENTRANCE, EXTERIOR.

DOOR: 614A

|                        |     |                                                       |
|------------------------|-----|-------------------------------------------------------|
| 1                      | EA  | CONTINUOUS HINGE                                      |
| 1                      | EA  | CONTINUOUS HINGE X EPT                                |
| 1                      | EA  | PANIC DEVICE WITH MOTORIZED LATCH RETRACTION, EXPOSED |
| VERTICAL RODS, LBR, LD |     |                                                       |
| 1                      | EA  | CYLINDER                                              |
| 1                      | EA  | SFIC CORE (VERIFY WITH EXISTING)                      |
| 1                      | EA  | PANIC DEVICE WITH EXPOSED VERTICAL RODS, LBR, LD, EO  |
| 2                      | EA  | TOP STRIKE                                            |
| 1                      | EA  | POWER TRANSFER EPT-12-C                               |
| 1                      | SET | DOOR PULLS BY MANUFACTURER                            |
| 1                      | EA  | ASTRAGAL BY DOOR MANUFACTURER                         |
| 1                      | EA  | DOOR SWEEP 200N                                       |
| 1                      | EA  | WEATHER STRIP KIT BY DOOR MANUFACTURER                |
| 1                      | EA  | CLOSER WITH STOP ARM                                  |
| 1                      | EA  | AUTOMATIC OPERATOR                                    |
| 2                      | EA  | PUSH PLATE-WALL SQUARE 8310-853T                      |
| 1                      | EA  | THRESHOLD - ADA                                       |
| 1                      | EA  | DOOR CONTACT                                          |

CARD READER

POWER SUPPLY

DOOR IS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL WILL UNLOCK THE DOOR AND ENABLE THE EXTERIOR WALL ACTUATOR. ACTIVATING THE EXTERIOR WALL ACTUATOR WHEN ENABLED WITHLL CAUSE THE AUTOMATIC OPERATOR TO OPEN (INTERIOR IS ALWAYS ENABLED). FREE EGRESS AT ALL TIMES.

**HARDWARE SET NO.8:**

DOUBLE ALUMINUM ENTRANCE, INTERIOR.

DOOR: 614A

|   |    |                                              |
|---|----|----------------------------------------------|
| 2 | EA | CONTINUOUS HINGE                             |
| 1 | EA | PUSH/PULL SET BY DOOR MANUFACTURER - PASSAGE |
| 1 | EA | ASTRAGAL BY DOOR MANUFACTURER                |
| 2 | EA | CLOSER WITH STOP ARM                         |
| 1 | EA | AUTOMATIC OPERATOR                           |
| 2 | EA | PUSH PLATE-WALL SQUARE 8310-853T             |
| 1 | EA | THRESHOLD - ADA                              |

**HARDWARE SET NO. 9:**

DOUBLE DOOR, STORAGE FUNCTION, ACOUSTICAL SEALS.

DOORS: 612

|   |     |                                                 |
|---|-----|-------------------------------------------------|
| 6 | EA  | BB-BUTT HINGES                                  |
| 1 | EA  | MORTISE LOCKSET – STORAGE FUNCTION              |
| 1 | EA  | CYLINDER                                        |
| 1 | EA  | SFIC CORE (VERIFY WITH EXISTING)                |
| 1 | EA  | ASTRAGAL 550-NGP                                |
| 1 | EA  | ASTRAGAL SOUND SEAL                             |
| 2 | EA  | ACOUSTICAL DOOR BOTTOM.                         |
| 1 | SET | ACOUSTICAL SEALS                                |
| 2 | EA  | MANUAL FLUSH BOLTS 3913/3915 TRM TOP AND BOTTOM |
| 1 | EA  | DUST PROOF STRIKE 3910 TRM                      |
| 2 | EA  | OVERHEAD STOP WITH HOLD-OPEN OH902H ROC         |
| 4 | EA  | KICKPLATE                                       |

**HARDWARE SET NO.10:**

DOUBLE DOOR, DOUBLE EGRESS, INTERIOR

DOOR: 600

|   |     |                                              |
|---|-----|----------------------------------------------|
| 2 | EA  | CONTINUOUS HINGE                             |
| 2 | EA  | PANIC DEVICE WITH EXPOSED VERTICAL RODS, LBR |
| 2 | EA  | TOP STRIKE                                   |
| 2 | EA  | CLOSER                                       |
| 1 | SET | DOOR PULLS BY MANUFACTURER                   |
| 1 | EA  | ASTRAGAL BY DOOR MANUFACTURER                |
| 2 | EA  | ELECTRIC MAGNETIC HOLD-OPEN, WALL MOUNTED.   |
| 4 | EA  | KICKPLATE                                    |

**END OF SECTION**

**SECTION 088000**  
**GLAZING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units, Standard Glazing.
- C. Plastic films.
- D. Glazing compounds.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2026.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2026).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024, with Editorial Revision (2025).
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- L. GANA (GM) - GANA Glazing Manual; 2022.
- M. GANA (SM) - GANA Sealant Manual; 2008.
- N. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2026.
- R. NGA (LGRM) - Laminated Glazing Reference Manual; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data on Insulating Glass Unit, Glazing Unit, and Plastic Film Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inch in size of glass units.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.06 QUALITY ASSURANCE

- A. Perform work in accordance with GANA (GM), GANA (SM), IGMA TM-3000, and NGA (LGRM) for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

#### 1.07 FIELD CONDITIONS

- A. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Glass Fabricators:
  - 1. GGI - General Glass International: [www.generalglass.com/#sle](http://www.generalglass.com/#sle).
  - 2. Trulite Glass & Aluminum Solutions, LLC: [www.trulite.com/#sle](http://www.trulite.com/#sle).
  - 3. Viracon, Inc: [www.viracon.com/#sle](http://www.viracon.com/#sle).
- B. Float Glass Manufacturers:
  - 1. Guardian Glass, LLC: [www.guardianglass.com/#sle](http://www.guardianglass.com/#sle).
  - 2. Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle).
  - 3. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
- C. Laminated Glass Manufacturers:
  - 1. Trulite Glass & Aluminum Solutions, LLC: [www.trulite.com/#sle](http://www.trulite.com/#sle).
  - 2. Viracon, Architectural Glass segment of Apogee Enterprises, Inc: [www.viracon.com/#sle](http://www.viracon.com/#sle).
- D. Spandrel Glass Manufacturers:
  - 1. match glazing unit manufacturer.
- E. Plastic Films Manufacturers: commercial decorative lines
  - 1. 3M Window Film; pattern: [solutions.3m.com/wps/portal/3M/en\\_US/Window\\_Film/Solutions/#sle](http://solutions.3m.com/wps/portal/3M/en_US/Window_Film/Solutions/#sle).
  - 2. Avery Dennison; Decorative Plastic Films: [www.averydennison.com/#sle](http://www.averydennison.com/#sle).
  - 3. Flexvue Films; patterns: [www.flexvuefilms.com/#sle](http://www.flexvuefilms.com/#sle).
  - 4. LLumar, an Eastman Chemical Company; LLumar: [www.llumar.com/#sle](http://www.llumar.com/#sle).

## 2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
  - 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  - 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
  - 3. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
  - 1. In conjunction with weather barrier related materials described in other sections, as follows:
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
  - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
  - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
  - 3. Solar Optical Properties: Comply with NFRC 300 test method.

## 2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
  - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
  - 2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
  - 3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  - 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

## 2.04 INSULATING GLASS UNITS

- A. Manufacturers:
  - 1. Glass: Any of the manufacturers specified for float glass.
- B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
- C. Insulating Glass Units: Types as indicated.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
  - 3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
  - 4. Spacer Color: Black.
  - 5. Edge Seal:
    - a. Color: Black.
  - 6. Purge interpane space with dry air, hermetically sealed.
- D. Type IG-1 - Insulating Glass Units: Vision glass, double glazed. basis of design is SOLARBAN 70 Insulated Glazing Unit. Intent is for CLEAR color.
  - 1. Applications: Exterior glazing unless otherwise indicated.
  - 2. Space between lites filled with air.
  - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.

- a. Tint: Clear.
  - b. Coating: Low-E (passive type), on #2 surface.
4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
  - a. Tint: Clear.
5. Total Thickness: 1 inch.
6. Thermal Transmittance (U-Value), Summer - Center of Glass: \_\_\_\_\_, nominal.
7. Visible Light Transmittance (VLT): \_\_\_\_\_ percent, nominal.
8. Solar Heat Gain Coefficient (SHGC): \_\_\_\_\_, nominal.

## 2.05 BASIS OF DESIGN - INSULATING GLASS UNITS

- A. Basis of Design - Insulating Glass Units: Vision glazing, with low-e coating. SOLA
  1. Applications: Exterior insulating glass glazing unless otherwise indicated.
  2. Space between lites filled with argon.
  3. Total Thickness: 1 inch.
  4. Thermal Transmittance (U-Value), Summer - Center of Glass: \_\_\_\_\_, nominal.
  5. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
  6. Spacer Color: Black.
  7. Edge Seal:
  8. Color: Black.
  9. Purge interpane space with dry air, hermetically sealed.
  10. Basis of Design - Vitro Architectural Glass (formerly PPG Glass):  
[www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
  11. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
    - a. Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 70 glass on #2 surface.
    - b. Glass: Clear.
  12. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
    - a. Glass: Clear.
    - b. provide spandrel film or paint on inboard lite where spandrel is called on drawings.

## 2.06 GLAZING UNITS

- A. Monolithic Interior Vision Glazing:
  1. Applications: Interior glazing unless otherwise indicated.
  2. Glass Type: Annealed float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.
- B. Monolithic Safety Glazing: Non-fire-rated.
  1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Sliding glass doors.
    - c. Shower and bathtub enclosures and doors.
    - d. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - e. Glazed view windows and panels in partitions enclosing athletic activity rooms, except in fire-rated walls and partitions.
    - f. Other locations required by applicable federal, state, and local codes and regulations.
    - g. Other locations indicated on drawings.
  2. Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.

## 2.07 PLASTIC FILMS

- A. Decorative Plastic Film: Polyvinyl butyral (PVB) type.

1. Application: Locations as indicated on drawings.
2. Color: and series to be selected from manufacturer's full range.
3. Thickness Without Liner: 0.002 inch.
4. Width: \_\_\_\_ inch.manfuacturer standard width cut and trimmed to fill entire glass panel.

#### 2.08 GLAZING COMPOUNDS

- A. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

#### 2.09 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

### **PART 3 EXECUTION**

#### 3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- C. Verify that sealing between joints of glass framing members has been completed effectively.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

#### 3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

#### 3.04 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

#### 3.05 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### 3.06 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

### **END OF SECTION**



**SECTION 090561**

**COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

**PART 2 PRODUCTS**

**PART 3 EXECUTION**

**END OF SECTION**

**SECTION 092116**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Resilient sound isolation clips.
- E. Acoustic insulation.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 092216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2024.
- B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
- C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2020.
- E. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- F. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- J. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2025.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- L. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- M. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- N. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- O. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2025.

- P. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
- Q. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- R. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
- S. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- T. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2025.
- U. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2025.
- V. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.
- W. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2024.
- X. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- Y. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- Z. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- AA. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- BB. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2025.
- CC. UL (FRD) - Fire Resistance Directory; Current Edition.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.
- B. Store metal products to prevent corrosion.

### **PART 2 PRODUCTS**

#### 2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
  - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
  - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.

2. Acoustic Attenuation: STC of as indicated in partition schedule calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
  1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: STC of as indicated in partition schedule calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
  1. Local authorities having jurisdiction.
- F. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
  1. ICC-ES Evaluation Report No. \_\_\_\_\_.
- G. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
  1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

## 2.02 METAL FRAMING MATERIALS

- A. Material and Product Requirements Criteria: AISI S201.
- B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
  1. Structural Grade: As required to meet design criteria.
  2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.
- C. Nonstructural Steel Framing for Application of Gypsum Board: See Section 092216.
- D. Structural Steel Framing for Application of Gypsum Board: See Section 054000.
- E. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
  1. Studs: C-shaped with knurled or embossed faces.
  2. Paired Studs for Sound-Rated Assemblies: Engineered single-piece assemblies comprised of paired studs coupled by sound isolators, designed to replace conventional side-by-side, parallel, double-wall partition framing.
    - a. Widths: As indicated on drawings.
  3. Runners: U shaped, sized to match studs.
  4. Ceiling Channels: C-shaped.
  5. Flexible Track: Flexible framing consisting of adjustable leg straps and pivoting, hinged track brackets designed to provide curved framing assemblies of varying radii.
  6. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
  7. Furring Members: Zee-shaped sections, minimum depth of 1 inch.
  8. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
  9. Sill Plate Isolation Pads: Acoustical separation between sole plate and subfloor.
- F. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
  2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
  3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
  4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
- H. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- I. Preformed Top Track Firestop Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
- J. Preformed Top of Wall Firestop Gasket:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
- K. Preformed Bottom of Wall Firestop Track Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated bottom of partition joint systems indicated on drawings.
- L. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
    - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
  3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

## 2.03 BOARD MATERIALS

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  2. Thickness:
    - a. Vertical Surfaces: 5/8 inch. TYPE X
    - b. Ceilings: 5/8 inch. TYPE X
- B. Abuse Resistant Wallboard:
1. Application: where indicated on drawings.
  2. Surface Abrasion: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
  3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
  4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
  5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  6. Type: Fire-resistance-rated Type X, UL or WH listed.
  7. Thickness: 5/8 inch.
  8. Edges: Tapered.
- C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in all areas
  2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    - a. Thickness: 5/8 inch.

- D. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
  - 2. Type X Thickness: 5/8 inch.
  - 3. Edges: Tapered.
- E. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.

#### 2.04 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
  - 1. Types: As detailed or required for finished appearance.
  - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- D. Decorative Metal Trim:
  - 1. Material: Extruded aluminum alloy 6063-T5 temper.
  - 2. Finish: Anodized, clear.
  - 3. Type: Profile as selected from manufacturer's standard range.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  - 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
  - 4. Joint Compound: Setting type, field-mixed.
- F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
- H. Exterior Soffit Vents: One piece, perforated, ASTM B221 6063 T5 alloy aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

#### 3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
  - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
  - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

### 3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Studs: Space studs at 16 inches on center.
  - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
  - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- G. Resilient Sound Isolation Clips: Install resilient sound isolation clips, and where applicable, associated furring sections and channels, in accordance with clip manufacturer's written instructions.

### 3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Place continuous bead at perimeter of each layer of gypsum board.

### 3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- E. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
- F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board.
- H. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
  - 1. Single-Layer Applications: Screw attachment.

2. Double-Layer Application: Install base layer using screws. Install face layer using screws.

I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

### 3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
  - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.
- E. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.

### 3.07 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
  - 5. Level 0: Temporary partitions.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

### 3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### 3.09 PROTECTION

- A. Protect installed gypsum board assemblies from subsequent construction operations.

## **END OF SECTION**



**SECTION 092216**  
**NON-STRUCTURAL METAL FRAMING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 072100 - Thermal Insulation: Acoustic insulation.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2024.
- B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2025.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
- H. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
  - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Manufacturer Reports: Include research reports indicating compliance with applicable building codes.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

## **PART 2 PRODUCTS**

### **2.01 FRAMING MATERIALS**

- A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. Firestopping: Materials meeting requirements necessary to maintain rating of penetrated assembly.
  - 1. Fire Ratings: See drawings for required systems and ratings.
- C. Loadbearing Studs: As specified in Section 054000.
- D. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220.
  - 1. Structural Grade: As required to meet design criteria.
- E. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
  - 1. Studs: C-shaped.
    - a. Products:
      - 1) CEMCO; CT Studs: [www.cemcosteel.com/#sle](http://www.cemcosteel.com/#sle).
      - 2) ClarkDietrich; ProSTUD: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
      - 3) MRI Steel Framing; MRI Traditional - Non-Structural: [www.mristeel framing.com/#sle](http://www.mristeel framing.com/#sle).
  - 2. Paired Studs for Sound-Rated Assemblies: Engineered single-piece assemblies comprised of paired studs coupled by sound isolators, designed to replace conventional side-by-side, parallel, double-wall partition framing.
  - 3. Runners: U-shaped, sized to match studs.
  - 4. Ceiling Channels: U-shaped.
  - 5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
  - 6. Furring: Z-shaped sections, minimum depth of 1 inch.
  - 7. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
  - 8. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attach to framing; improve noise isolation for areas between gypsum board assemblies and adjacent sources of noise.
- F. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code when evaluated in accordance with AISI S100.
  - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50.
- H. Preformed Top Track Firestop Seal:
  - 1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
- I. Non-Loadbearing Framing Accessories:
  - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
  - 3. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
  - 4. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
  - 5. Fasteners: ASTM C1002 self-piercing self-tapping screws.
  - 6. Anchorage Devices: Powder actuated.
  - 7. Acoustic Insulation: See Section 072100.

8. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

## 2.02 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

### 3.02 INSTALLATION OF STUD FRAMING

- A. Install structural members and connections in accordance with ASTM C1007.
- B. Extend partition framing to structure where indicated and to ceiling in other locations.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- E. Fire-Resistance-Rated Construction: Install framing and accessories in accordance with requirements of fire-resistance-rated assembly and to GA-600 requirements.
- F. Align and secure top and bottom runners at 24 inches on center.
- G. At partitions indicated with an acoustic rating:
  1. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.
- H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.
- K. Stud splicing is not permissible.
- L. Fabricate corners using a minimum of three studs.
- M. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- N. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- O. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
- P. Sound Isolation Clips: Mechanically attach to framing or structure with fasteners recommended by clip manufacturer. Install at spacing indicated on drawings.
- Q. Furring: Coordinate with sound isolation clip spacing and locations. Lap splices a minimum of 6 inches.

### 3.03 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.

- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

#### 3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.

### **END OF SECTION**

**SECTION 092236**

**LATH**

**PART 2 PRODUCTS**

1.01 LATH

**SECTION 092400**  
**CEMENT PLASTERING**

**PART 2 PRODUCTS**

1.01 CEMENT PLASTER APPLICATIONS

**END OF SECTION**

**SECTION 095100**  
**ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples \_\_\_\_ by \_\_\_\_ inch illustrating material and finish of acoustical units.
- E. Manufacturer's qualification statement.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Refer to drawings for product selections.
- B. Acoustic Tiles/Panels - wood, acoustic, and metal: Refer to drawings for basis of design. Approved manufacturers are as follows:
  - 1. Armstrong World Industries, Inc: [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).
  - 2. Certaineed Architectural: [www.certainteed.com/ceilings-and-walls/#sle](http://www.certainteed.com/ceilings-and-walls/#sle).
  - 3. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
- C. Suspension Systems:
  - 1. Same as for acoustical units.

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Class A in accordance with ASTM E84.
- B. Systems Located Outside Building Envelope:
  - 1. Accommodate wind and suction loads and wind uplift without damage in accordance with applicable code.
  - 2. Thermal Resistance R-value (RSI-value): \_\_\_\_\_ total, with insulation installed.

#### 2.03 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Refer to drawings for each ceiling type, location, and product schedule.

#### 2.04 SUSPENSION SYSTEMS

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold-down clips, stabilizer bars, clips, and splices as required.
  - 1. Materials:
    - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
    - b. Aluminum Grid: Aluminum sheet, ASTM B209/B209M.
    - c. Stainless Steel Grid: ASTM A666/A666M, Type 304.
- B. Exposed Suspension System: Hot-dip galvanized steel grid with steel cap.
  - 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
  - 2. Profile: Tee; 15/16 inch face width.
  - 3. Finish: Baked enamel.

#### 2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- E. Face sleeve.
- F. Wood Veneer Panel Safety Clips: Galvanized 1-9/16 by 5-1/2 inch bent sheet metal clips screw anchored to back of adjacent panels and spanning over top of suspended tee grid.
  - 1. Wire Ties: No. 12 galvanized wire.



- G. Wood Veneer Perimeter Trim: Field cut wood veneer panels to match acoustic ceiling panels.
- H. Perimeter Moldings: Same metal and finish as grid.
  - 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
  - 2. Shadow Molding: Shaped to create a perimeter reveal.
  - 3. Channel Molding: U-shaped, for hold-down type installations.
  - 4. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
- I. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
  - 1. Trim Height: 6 inches.
  - 2. Finish: Baked enamel.
  - 3. Color: White.
- J. Touch-up Paint: Type and color to match acoustical and grid units.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

#### **3.02 PREPARATION**

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

#### **3.03 INSTALLATION - SUSPENSION SYSTEM**

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
- D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

#### **3.04 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.

- F. Install hold-down clips on panels within 20 ft of an exterior door.
- G. Install safety clips on wood veneer panels 2 inches from outside edge of panel and at 24 inches on center.
- H. Install wood veneer trim using aluminum L angle to attach to suspended grid system as required for application.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

- A. Clean surfaces.
- B. Replace damaged or abraded components.

**END OF SECTION**

**SECTION 099113**  
**EXTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Non-metallic roofing and flashing.
  - 6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
  - 7. Marble, granite, slate, and other natural stones.
  - 8. Floors, unless specifically indicated.
  - 9. Ceramic and other types of tiles.
  - 10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
  - 11. Glass.
  - 12. Concealed pipes, ducts, and conduits.

**1.02 RELATED REQUIREMENTS**

**1.03 DEFINITIONS**

- A. Comply with ASTM D16 for interpretation of terms used in this section.

**1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020 (Reapproved 2025).
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  - C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
    1. Where sheen is specified, submit samples in only that sheen.
  - D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
    3. Label each container with color in addition to the manufacturer's label.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
  - B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
  - C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions. All paints shall be the highest commercial grade available from the manufacturer.
- B. Paints:
  1. Pittsburgh Paints: [www.pittsburghpaintsco.com/#sle](http://www.pittsburghpaintsco.com/#sle).
  2. Sherwin-Williams Company; \_\_\_\_: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
  3. Benjamin Moore.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
  1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  2. Supply each paint material in quantity required to complete entire project's work from a single production run.
  3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
  1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

- a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Colors: To be selected from manufacturer's full range of available colors.
  1. Selection to be made by Architect after award of contract.

## 2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint WE-OP-3L - Wood, Opaque, Latex, 3 Coat:
  1. One coat of latex primer sealer.
  2. Semi-gloss: Two coats of latex enamel; \_\_\_\_\_.
- B. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
  1. One coat of block filler.
  2. Semi-gloss: Two coats of latex enamel; \_\_\_\_\_.
- C. Paint GE-OP-3L - Exterior Gypsum Board and Exterior Plaster, Opaque, Latex, 3 Coat:
  1. One coat of latex primer sealer.
  2. Flat: Two coats of latex; \_\_\_\_\_.
- D. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
  1. One coat of alkyd primer.
  2. Semi-gloss: Two coats of alkyd enamel; \_\_\_\_\_.
- E. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
  1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  2. Semi-gloss: Two coats of alkyd enamel; \_\_\_\_\_.
- F. Paint E-Pav - Pavement Marking Paint:
  1. Yellow: One coat, with reflective particles; \_\_\_\_\_.
  2. White: One coat, with reflective particles; \_\_\_\_\_.

## 2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  1. Alkali-Resistant Water-Based Primer; MPI #3.
  2. Interior/Exterior Latex Block Filler; MPI #4.
  3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
  4. Stain Blocking Primer, Water-Based; MPI #137.

## 2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Exterior Plaster and Stucco: 12 percent.
2. Fiber Cement Siding: 12 percent.
3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors and Traffic Surfaces: 8 percent.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
  1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
- G. Masonry:
  1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  2. Prepare surface as recommended by top coat manufacturer.
- H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- I. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.
- J. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- K. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- L. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- M. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- N. Ferrous Metal:
  1. Solvent clean according to SSPC-SP 1.
  2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
  3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.
- O. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

- P. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.05 PROTECTION

- A. Touch-up damaged finishes after Substantial Completion.

## **END OF SECTION**

**SECTION 099123**  
**INTERIOR PAINTING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Prime surfaces to receive wall coverings.
  - 3. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically indicated.
  - 8. Ceramic and other tiles.
  - 9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
  - 10. Glass.
  - 11. Acoustical materials, unless specifically indicated.
  - 12. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020 (Reapproved 2025).
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.



#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
  - 2. MPI product number (e.g., MPI #47).
  - 3. Cross-reference to specified paint system products to be used in project; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
  - 3. Label each container with color in addition to the manufacturer's label.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

#### 1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc measured mid-height at substrate surface.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions. Products provided shall be the highest commercial grade product from manufacturer.
- B. Paints:
  - 1. Pittsburgh Paints: [www.pittsburghpaintsco.com/#sle](http://www.pittsburghpaintsco.com/#sle).
  - 2. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
  - 3. Benjamin Moore.
- C. Primer Sealers: Same manufacturer as top coats.

#### 2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  2. Supply each paint material in quantity required to complete entire project's work from a single production run.
  3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
  2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
  2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
- E. Approved Manufacturers:
1. Refer to drawings for colors and base manufacturer. Acceptable Manufacturers (if colors can be matched) are as follows:
    - a. Sherwin Williams
    - b. Benjamin Moore
    - c. PPG Commercial Paints

## 2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, galvanized piping, and \_\_\_\_\_.
1. Shop primer by others.
  2. One top coat \_\_\_\_\_.
  3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
  4. Top Coat Sheen:
    - a. Flat: MPI gloss level 1; use this sheen at all locations.
- B. Paint I-OP-FL - Concrete and Wood Floors to be Painted.
1. Two top coats and one coat primer.
  2. Top Coat(s): Latex Floor Paint, Low Gloss; MPI #60.
- C. Paint I-TR-C - Transparent Finish on Concrete Floors.
1. 1 coat stain.
  2. Stain: Semi-Transparent Stain for Concrete Floors; MPI #58.
  3. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
  4. Sealer Sheen:
    - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
- D. Paint I-OP-AF - Game Line Marking Paint for Wood Athletic Floors.
1. Water-Based Paint:
- E. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.
  2. Semi-gloss: Two coats of latex enamel; \_\_\_\_\_.

- F. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
  - 1. One coat of block filler.
  - 2. Eggshell: Two coats of latex enamel; \_\_\_\_.
- G. Paint MI-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
  - 1. One coat of alkyd primer.
  - 2. Semi-gloss: Two coats of alkyd enamel; \_\_\_\_.
- H. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
  - 1. Touch-up with alkyd primer.
  - 2. Semi-gloss: Two coats of alkyd enamel; \_\_\_\_.
- I. Paint CI-OP-3Af - Concrete/Masonry, Alkyd Floor Enamel, 3 Coat:
  - 1. One coat of alkali-resistant primer.
  - 2. Gloss: Two coats of alkyd floor enamel; \_\_\_\_.
- J. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
  - 1. One coat of alkyd primer sealer.
  - 2. Eggshell: Two coats of latex enamel; \_\_\_\_\_.

#### 2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  - 1. Alkali Resistant Water Based Primer; MPI #3.
  - 2. Interior/Exterior Latex Block Filler; MPI #4.
  - 3. Concrete Floor Primer, Waterborne.
  - 4. Interior Latex Primer Sealer; MPI #50.
  - 5. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
  - 6. Stain Blocking Primer, Water Based; MPI #137 or #172.

#### 2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.
  - 2. Plaster and Stucco: 12 percent.
  - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
  - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
  - 5. Concrete Floors and Traffic Surfaces: 8 percent.

#### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Acoustical Panel Ceilings:
  - 1. Pretreat ceiling water stains according to manufacturer's written instructions.
  - 2. Pretreat tiles saturated with grease or nicotine according to manufacturer's written instructions.
- H. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
- I. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  - 2. Prepare surface as recommended by top coat manufacturer.
- J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- K. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- L. Galvanized Surfaces:
- M. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.
- N. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

### 3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

#### 3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

#### 3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**

**SECTION 099300**

**STAINING AND TRANSPARENT FINISHING**

**PART 2 PRODUCTS**

1.01 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:

1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each finish material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

**END OF SECTION**

**SECTION 099600**  
**HIGH-PERFORMANCE COATINGS**

**PART 2 PRODUCTS**

1.01 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

**END OF SECTION**

**SECTION 101100**  
**VISUAL DISPLAY UNITS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Chalkboards.
- B. Porcelain enamel steel markerboards.
- C. Glass markerboards.
- D. Tackboards.
- E. Tackstrips.
- F. Tackable wall panels.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- C. ANSI A208.1 - American National Standard for Particleboard; 2022.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2026.
- E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2025.
- F. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024, with Editorial Revision (2025).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- H. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

**PART 2 PRODUCTS**

2.01 VISUAL DISPLAY UNITS

- A. Chalkboards: Porcelain enamel on steel, laminated to core.
  - 1. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch.
  - 2. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  - 3. Backing: Aluminum foil, laminated to core.
  - 4. Size: As indicated on drawings.



5. Frame: Extruded aluminum , with concealed fasteners.
  6. Frame Finish: Anodized, natural.
  7. Accessories: Provide chalk tray, map rail, and flag holder.
- B. Porcelain Enamel Steel Markerboards:
1. Manufacturers:
    - a. ASI Visual Display Products; \_\_\_\_: [www.asi-visualdisplayproducts.com/#sle](http://www.asi-visualdisplayproducts.com/#sle).
    - b. Claridge Products and Equipment, Inc; \_\_\_\_: [www.claridgeproducts.com/#sle](http://www.claridgeproducts.com/#sle).
    - c. Nelson Adams NACO: <https://www.nelsonadamsnaco.com/#sle>.
    - d. Specialty Glass Products, Inc: [www.specialtyglass.biz/#sle](http://www.specialtyglass.biz/#sle).
  2. Color: White.
  3. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch .
  4. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  5. Backing: Galvanized steel sheet, laminated to core.
  6. Size: As indicated on drawings.
  7. Frame: Same as for chalkboards.
  8. Frame Finish: Anodized, natural.
  9. Accessories: Provide marker tray, map rail, and flag holder.
- C. Magnetic Glass Markerboards:
1. Manufacturers:
    - a. Claridge Products and Equipment, Inc: [www.claridgeproducts.com/#sle](http://www.claridgeproducts.com/#sle).
    - b. GGI - General Glass International: [www.generalglass.com/#sle](http://www.generalglass.com/#sle).
    - c. Ghent, a GMI Company: [www.ghent.com/#sle](http://www.ghent.com/#sle).
    - d. MooreCo, Inc: [www.moorecoinc.com/#sle](http://www.moorecoinc.com/#sle).
    - e. Specialty Glass Products, Inc: [www.specialtyglass.biz/#sle](http://www.specialtyglass.biz/#sle).
  2. Glass: Laminated, low iron, 1/4 inch thick, with bevel edges and radiused corners, laminated to steel backing sheet for use with magnets. Coated or treated for use as dry erase board or projection surface.
  3. Steel Backing Sheet Thickness: 24 gauge, 0.0239 inch .
  4. Size: As indicated on drawings.
  5. Frame: No frame, with concealed fasteners.
  6. Mounting: Concealed Z clips.
  7. Accessories: Provide magnetic marker tray, magnetic marker holder, magnetic eraser, and magnets.
- D. Tackboards: Fabric laminated to cork.
1. Cork Thickness: 1/8 inch.
  2. Fabric: Vinyl-coated fabric.
  3. Color: As selected from manufacturer's full range.
  4. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
  5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
  6. Size: As indicated on drawings.
  7. Frame: Extruded aluminum , with concealed fasteners.
  8. Frame Profile: As indicated on drawings.
  9. Frame Finish: Anodized, natural.
  10. Accessories: Provide map rail.
- E. Tackstrips: Fine-grained, homogeneous natural cork.
1. Cork Thickness: 1/8 inch.
  2. Height: 2 inches.
  3. Length: As indicated on drawings.
  4. Frame and End Stops: Extruded aluminum, with concealed fasteners.
  5. Frame Profile: As indicated on drawings.

6. Frame Finish: Anodized, natural.

F. Combination Units and Units Made of More Than One Panel: Factory-assembled chalkboards, markerboards, and tackboards in a single frame, of materials specified above.

## 2.02 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Float Glass: Provide float-glass-based glazing unless otherwise indicated.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  - 1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
- D. Vinyl-Coated Fabric: ASTM F793 Category VI.
- E. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- F. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- G. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- H. Steel Sheet Backing: 28 gauge, 0.0149 inch, galvanized.

## 2.03 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.
- B. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.
- C. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.

# **PART 3 EXECUTION**

## 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

## 3.02 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

## 3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches above finished floor.
- C. Secure units level and plumb.
- D. Butt Joints: Install with tight hairline joints.
- E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

#### 3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Remove temporary protective cover at Date of Substantial Completion.

**END OF SECTION**

**SECTION 102123**  
**CUBICLE CURTAINS AND TRACK**

**PART 2 PRODUCTS**

**END OF SECTION**

**SECTION 102600**  
**WALL AND DOOR PROTECTION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Corner guards.
- B. Protective wall covering.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking for wall and corner guard anchors.
- B. Section 092116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2026.
- C. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Corner Guards:

1. Construction Specialties, Inc; Acrovyn Handrails: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
2. Inpro; \_\_\_\_\_: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
3. Koroseal Interior Products; \_\_\_\_\_: [www.koroseal.com/#sle](http://www.koroseal.com/#sle).
4. Wallprotex; wX3 Vinyl Corner Guards: [www.wallprotex.com/#sle](http://www.wallprotex.com/#sle).

B. Protective Wall Covering:

1. Construction Specialties, Inc; Acrovyn High-Impact Wall Covering: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
2. Inpro; \_\_\_\_\_: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
3. MDC Interior Solutions; MDC Wall Protection - Duratec: [www.mdcwall.com/#sle](http://www.mdcwall.com/#sle).
4. Pawling Corp; \_\_\_\_\_: [www.pawling.com/#sle](http://www.pawling.com/#sle).
5. Wallprotex; wX10 PETG (PVC Free) Wall Sheet : [www.wallprotex.com/#sle](http://www.wallprotex.com/#sle).

## 2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

## 2.03 PRODUCT TYPES

A. Corner Guards - Flush Mounted:

1. Material: High impact vinyl with full height extruded aluminum retainer.
2. Width of Wings: 2 inches.
3. Corner: Square.
4. Color: As selected from manufacturer's standard colors.
5. Length: One piece.

B. Protective Wall Panels:

1. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
2. Thickness: 0.075 inch.
3. Panel Size: 3 feet by 8 feet.
4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 55 or less, when tested in accordance with ASTM E84.
5. Color and Pattern: As selected from manufacturer's standard finishes.
6. Texture: As selected from manufacturer's standard textures.
7. Accessories: Provide manufacturer's standard PVC color-matched trim and moldings.
  - a. Top trim: Manufacturer's standard J-trim
8. Mounting: Adhesive.

## 2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

## **PART 3 EXECUTION**

### 3.01 INSTALLATION

- A. Position corner guard 4 inches above finished floor to \_\_\_\_ inches high.
- B. Position protective wall covering above finished floor to allow for floor level variation.
1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
  2. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.

3. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
4. At joints indicated to be caulked, allow for a minimum 1/16 inch wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project.
5. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

### 3.02 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

### 3.03 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

### 3.04 SCHEDULE

## **END OF SECTION**

**SECTION 102800**  
**TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 2 PRODUCTS**

**1.01 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666/A666M, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Zinc Alloy: Die cast, ASTM B86.
- F. Acrylic Plastic Sheet: ASTM D4802.
- G. PETG Plastic Sheet: ASTM D5047.
- H. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- I. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- J. Adhesive: Two component epoxy type, waterproof.
- K. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- L. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

**1.02 FINISHES**

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
- E. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- F. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- G. Back paint components where contact is made with building finishes to prevent electrolysis.

**1.03 COMMERCIAL TOILET ACCESSORIES**

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
  - 1. Attached Purse Shelf: 0.03 inch satin finished stainless steel, with rolled or formed edge at front.
- B. Paper Towel Dispenser: Manual, roll paper type.
  - 1. Material: Thermoplastic polymer.
  - 2. Paper Discharge: Manual dispense by lever operation.
  - 3. Capacity: 8-inch diameter roll.
  - 4. Mounting: Surface mounted.
  - 5. Refill Indicator: Transparent viewing slot.
- C. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.



- D. Grab Bars: Stainless steel, smooth surface.
  - 1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force, minimum.
    - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
    - c. Length and Configuration: As indicated on drawings.

#### 1.04 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:
  - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  - 2. Size: 36 by 72 inches, hemmed edges.
  - 3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
  - 4. Color: White.
  - 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
  - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of \_\_\_\_ color.
  - 2. Size: ADA Standards compliant.
- D. Towel Pin: Stainless steel, 3 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
- E. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

#### 1.05 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
  - 1. Operation: Automatic, sensor-operated on and off.
  - 2. Mounting: Wall-mounted - surface.
  - 3. Cover: Plastic.
    - a. Tamper-resistant screw attachment of cover to mounting plate.

#### 1.06 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
  - 1. Material: Polyethylene.
  - 2. Mounting: Surface.
  - 3. Minimum Rated Load: 250 pounds.

#### 1.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
  - 1. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
  - 2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
  - 3. Length: 36 inches.

### **PART 3 EXECUTION**

#### 2.01 EXAMINATION

- A. Verify existing conditions before starting work.

|                                                           |  |                                |
|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

## 2.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

## 2.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

## **END OF SECTION**

**SECTION 104400**  
**FIRE PROTECTION SPECIALTIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.

**PART 2 PRODUCTS**

2.01 FIRE EXTINGUISHERS

- A. General Requirements: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry-Chemical-Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  - 1. Class: A:B:C.
  - 2. Size: 5 lb.
  - 3. Finish: Baked polyester powder coat; color as selected by Architect.
  - 4. Temperature Range: Minus 65 to 120 degrees F.

2.02 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire-resistance rating of walls where cabinet installed.
- B. Cabinet Construction: Non-fire rated.
  - 1. Formed primed steel sheet; 20-gauge, 0.036-inch thick base metal.
- C. Fire-Rated Cabinet Construction: One-hour fire rated.
  - 1. Steel; double wall or outer and inner boxes with 5/8-inch thick fire barrier material.
- D. Cabinet Configuration: Semi-recessed type.
  - 1. Size to accommodate accessories.
  - 2. Trim: Flat square edge, with 2-inch wide face.
- E. Door: 20-gauge, 0.036-inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180-degree opening with two butt hinges.
- F. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- J. Finish of Cabinet Interior: White colored enamel.

2.03 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: FIRE EXTINGUISHER text on decal or self-adhesive vinyl, prespaced black lettering in accordance with authorities having jurisdiction.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and interfaces with other work.
- B. Verify substrate and site conditions for product installation are in accordance with manufacturer's written instructions.

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|-----------------------------------------------------------|--|--------------------------------|
| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- C. Verify rough openings for cabinet are sized and located in accordance with manufacturer's written instructions.
- D. Notify Architect in writing of conditions detrimental to completion of work. Do not proceed with installation until detrimental conditions are corrected.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets.

### **END OF SECTION**

**SECTION 105617**  
**WALL MOUNTED STANDARDS AND SHELVING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Steel shelf standards, brackets, and accessories.
- B. Steel shelf support brackets.
- C. Shelves.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

**PART 2 PRODUCTS**

2.01 COMPONENTS

- A. Steel Shelf Standards, Brackets, and Accessories:
  - 1. Extra-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch increments along entire length of standard, drilled and countersunk for screws.
    - a. Load Capacity: Recommended by manufacturer for loading of 300 to 680 pounds per pair of standards.
    - b. Finish: Electroplated, chrome-look.
    - c. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
    - d. Bracket Quantity: Provide one bracket for each 12 inches of standard length.
- B. Steel Shelf Support Brackets:
  - 1. Material: Steel, ASTM A36/A36M.
  - 2. Bracket Type: L-shaped, with predrilled mounting holes on vertical leg for attachment to wood stud or blocking.
  - 3. Finish: White powdercoat.
- C. Shelving:
  - 1. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
    - a. Edge Finish: Matching laminate, all four edges.
    - b. Substrate Thickness: 3/4 inch, nominal.
    - c. Laminate: NEMA LD 3 Type HGL.

d. Laminate Color and Pattern: As indicated on drawings.

- D. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards or brackets to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.

#### **3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

### **END OF SECTION**

**SECTION 122400**  
**WINDOW SHADES**

**PART 2 PRODUCTS**

**END OF SECTION**

**SECTION 123200**  
**MANUFACTURED WOOD CASEWORK**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Manufactured custom casework, with cabinet hardware.

1.02 RELATED REQUIREMENTS

- A. Section 123600 - Countertops: Additional requirements for countertops.

1.03 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.04 REFERENCE STANDARDS

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2026.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- D. AWI (QCP) - Quality Certification Program; Current Edition.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- G. BHMA A156.9 - Cabinet Hardware; 2020.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches.
  - 1. Plastic laminate samples, for color, texture, and finish selection.
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.



- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. This AWI (QCP) project is registered as project number \_\_\_\_\_.
  - 3. Provide designated labels on shop drawings as required by certification program.
  - 4. Provide designated labels on installed products as required by certification program.
  - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
  - 6. Replace, repair, or rework all work for which certification is refused.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
  - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
  - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

#### 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  - 1. Ruptured, cracked, or stained finish coating.
  - 2. Discoloration or lack of finish integrity.
  - 3. Cracking or peeling of finish.
  - 4. Failure of hardware.

### **PART 2 PRODUCTS**

#### 2.01 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom Grade.

#### 2.02 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Fixed panels at backs of open spaces between base cabinets.
  - 1. Provide cutouts for power receptacles where indicated on drawings.
- D. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

- E. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- F. Sloped tops for wall and floor cabinets: With closed ends, of matching construction and finish. Concealed anchorages for attachment to cabinet(s) below.
- G. Apron Frames: Construction similar to other cabinets, with modifications.

#### 2.03 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
  - 1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
  - 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
    - a. Base Cabinets: 24 inches.
    - b. Tall Cabinets: 22 inches.
    - c. Wall Cabinets: 16 inches.
  - 3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
    - a. Finish: Matte or suede, gloss rating of 5 to 20.
    - b. Surface Color and Pattern: As selected by Architect from manufacturer's full line.
    - c. Exposed Interior Surfaces: Thermally fused laminate.
      - 1) Color: White.
    - d. Cap exposed plastic laminate finish edges with material of same finish and pattern.

#### 2.04 COUNTERTOPS

- A. Countertops: See Section 123600.

#### 2.05 CABINET HARDWARE

- A. Comply with BHMA A156.9 requirements.
  - 1. Acceptable base materials for plated finishes include brass, bronze, and steel.
- B. Shelves in Cabinets:
  - 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- C. Swinging Doors: Hinges, pulls, and catches.
  - 1. Hinges: Visible, number as required by referenced standards for width, height, and weight of door.
    - a. Visible Hinges: Installed on framed cabinet face, and on door face, bright chromium plated over nickel on base material.
    - b. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
      - 1) European-Style Hinges for Overlay Doors: 110 degree opening angle.
  - 2. Pulls: Chrome bar pull, 4 inches wide.
  - 3. Catches: Magnetic.
- D. Drawers: Pulls and slides.
  - 1. Pulls: Chrome bar pull, 4 inches wide.
  - 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

#### 2.06 MATERIALS

- A. Wood-Based Materials:
  - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.

- B. Glass: Fully tempered float; ASTM C1036, Type 1, Quality Q3; ASTM C1048, tempered using horizontal tempering and complying with ANSI Z97.1; 3/16 inch thick minimum; exposed edges ground, and cut or drilled to receive hardware; clear.

## 2.07 ACCESSORIES

- A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- B. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
- C. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
- D. Sealant for Use in Casework Installation:
  - 1. Manufacturer's recommended type.

## **PART 3 EXECUTION**

### 3.01 PREPARATION

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

### 3.02 EXAMINATION

- A. Site Verification of Environmental Conditions:
  - 1. Do not deliver casework until the following conditions have been met:
    - a. Building has been enclosed (windows and doors sealed and weather-tight).
    - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
    - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
    - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
- D. Verify adequacy of support framing and anchors.
- E. Verify that service connections are correctly located and of proper characteristics.

### 3.03 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

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| Warren County Career Center -<br>Medical Academy Addition |  | Permit Documents<br>09-10-2026 |
|-----------------------------------------------------------|--|--------------------------------|

- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Install hardware uniformly and precisely.
- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Replace units that are damaged, including those that have damaged finishes.

#### 3.04 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

#### 3.05 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

### **END OF SECTION**

**SECTION 123600**  
**COUNTERTOPS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. PS 1 - Structural Plywood; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
  - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide designated labels on installed products as required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

### **PART 2 PRODUCTS**

#### 2.01 COUNTERTOPS

- A. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  - 1. Laminate Sheet, Type \_\_\_\_: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
    - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
    - b. Surface Color and Pattern: As indicated on drawings.
  - 2. Exposed Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch thick with raised radiused edge, integral coved backsplash with radiused top edge.
  - 3. Back and End Splashes: Same material, same construction.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
  - 1. Flat Sheet Thickness: 1/2 inch, minimum.
  - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - b. Color and Pattern: As indicated on drawings.
  - 3. Other Components Thickness: 1/2 inch, minimum.
  - 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

#### 2.02 MATERIALS

- A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.
- B. Wood-Based Components:
  - 1. Wood fabricated from old growth timber is not permitted.
- C. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- D. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

#### 2.03 ACCESSORIES

- A. Fixed Top-Mounted Countertop Support Brackets:
  - 1. Material: Steel.
  - 2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
  - 3. Color: Black.

#### 2.04 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.

2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.03 INSTALLATION**

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Seal joint between back/end splashes and vertical surfaces.

#### **3.04 TOLERANCES**

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

#### **3.05 CLEANING**

#### **3.06 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

### **END OF SECTION**

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## SECTION 21 0001 – BASIC FIRE SUPPRESSION REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements
2. Definitions
3. Scope of Work
4. Drawings and Specifications
5. Reference Standards
6. Allowances, Unit Prices and Alternates
7. Site Visit
8. Permits and Regulations
9. Project Management and Coordination
10. Workmanship
11. Protection
12. Painting
13. Cleaning
14. Equipment Selection
15. Shop Drawings
16. Final Inspection and Punch List
17. Operation and Maintenance Manuals
18. Record Drawings
19. Warranties
20. Project Closeout
21. Operation and Adjustment of Equipment
22. Operating Demonstration and Instruction

#### 1.2 GENERAL REQUIREMENTS

- A. All provisions of Division 00 Front End Documents and Division 01 General Requirements apply to work specified in this Division.
- B. Specification provisions of other relevant Divisions shall apply where applicable work is required to be performed under this Fire Suppression work.
- C. A complete and functional Fire Suppression system installation shall be provided under this Division. Should overlap of work among trades become evident, this shall be called to the attention of the architect. In such event, none of the trades or their suppliers shall assume that he relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

- D. The Fire Suppression, Plumbing, HVAC and Electrical drawings and specifications assign work (labor and/or materials) to be provided by the General, Fire Suppression, Plumbing, HVAC or Electrical Contractor or their sub-contractors. Understanding that the contractors for mechanical and electrical work are sub-contractors to the (General) Contractor, such assignments are not intended to restrict the General Contractor in assignment of work among the sub-contractor to accommodate trade agreements and practices or the normal conduct of the construction work.

### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

### 1.4 SCOPE OF WORK

- A. The scope of the Fire Suppression work includes furnishing, installing, testing and warranty of all Fire Suppression work shown on the Fire Suppression drawings and specified herein, including Division 00, division 01, Division 21 and applicable provisions of other relevant Divisions.

### 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "provided," as used, shall mean "furnish and install." If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Architect for approval before proceeding with the work.
- B. Make all necessary field measurements to ensure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Architect for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset

which may be necessary to complete the systems. Having pipe and fittings fabricated and delivered in advance of making actual measurements shall be sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.

- D. The Architect shall reserve the right to make minor adjustments in locations of system runs and components where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties.
- E. Equipment, or piping shall not be installed or run above electrical switchgear or panelboards, nor in or above the access space in the immediate vicinity of the electrical switchgear/panelboards, in accordance with NEC Article 384.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The Architect's decision shall be final in regard to the arrangement of ductwork, piping, etc., where conflict arises.
- G. Provides offsets in system runs, additional fittings, necessary drains and minor valves, traps, and devices required to complete the installation, or for the proper operation of the system. Each Contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

#### 1.6 REFERENCE STANDARDS

- A. Where standards (NFPA, NEC, ADTM, UL, etc.) are referenced in the specifications or on the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

#### 1.7 ALLOWANCES, UNIT PRICES AND ALTERNATES

- A. Refer to Sections 012100 Allowances, 012200 Unit Prices and 012300 Alternates.

#### 1.8 SITE VISIT

- A. Refer to Sections 017300 Execution.
- B. Each bidder shall visit the project site to understand the existing conditions and compare the conditions with information shown on the drawings. Report immediately to the Architect any

issues or discrepancies which are discovered that affect the bid. Changes to contract price will not be considered for site condition issues that are readily apparent from a thorough site review.

#### 1.9 PERMITS, REGULATIONS AND INSPECTION

- A. Work must conform to applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawing and specifications shall govern. Install no work contrary to minimum legal standards.
- B. The fire suppression contractor shall be responsible to prepare a permit set of documents to file for and obtain all required permits from the governing inspection agencies. Include payment of all permit and inspection fees applicable to the work in this Division.
- C. All work shall be subject to inspection and approval of Federal, State and local agencies as may be appropriate as well as the Architect and Engineer.
- D. Furnish for the Owner certificates of approval from the governing inspection agencies as a condition for final payment.

#### 1.10 PROJECT MANAGEMENT AND COORDINATION

- A. Refer to Section 013100 Project Management and Coordination.

#### 1.11 WORKMANSHIP

- A. Refer to Section 014000 Quality Requirements.
- B. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all respects, and the Architect shall have the right to stop the work if highest quality workmanship is not maintained.
- C. Fire suppression design and work shall be performed by licensed Fire Suppression Contractors in accordance with requirements of the jurisdiction.

#### 1.12 PROTECTION

- A. Each Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Architect.
- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide plastic sheeting, drop cloths or similar barriers where dust and debris is generated, to protect adjacent areas.

- C. Contractor shall protect all equipment and materials from detrimental effects of weather or construction activity. All items shall be stored and secured in a protected location away from the daily work area. Equipment or materials shall be placed on raised skids to protect from surface moisture. Where appropriate, provide plastic sheeting or similar vapor barrier underneath the stored products to reduce the effects of ground moisture or curing concrete on the local humidity levels. Where unfinished ferrous products or finished ferrous products with raw edges are stored, provide local, dry heat to maintain ambient relative humidity levels below 65% RH to prevent rust.
- D. All equipment shall retain the original packaging until required to be removed for installation or operation. Open ends of ducts, piping, conduit, etc. shall be capped or sealed and ventilation openings into equipment shall be wrapped and sealed in plastic sheeting to prevent dust or dirt entry both when stored and after installation but still open to the effects of construction activity. Stored items as well as installed equipment shall be covered with plastic sheeting at all times until placed in service or until dust generating activity in the area has ceased.

#### 1.13 PAINTING

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in Division 21:
  - 1. Ferrous metal which is not factory or shop painted or galvanized and which remains exposed to view in the finished areas of the building / building including finished areas, mechanical rooms, storage rooms, and other unfinished areas shall be given a prime coat of paint.
  - 2. Ferrous metal installed outside the building which is not factory or shop painted or galvanized shall be given a prime coat of paint.
  - 3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch-up.
- B. Paint, surface preparation and application shall conform to applicable portions of the Painting section of Division 09 Finishes. All rust must be removed before application of paint.
- C. Finish painting is included in the General Contract except where otherwise required under remodeling work.

#### 1.14 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the Owner is continuing to occupy or use; any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.
- B. The Owners dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall

be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.

- C. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain. The contractor shall also clean duct interiors and interior components of new or existing air handling system equipment if dirt, dust or debris have generated in the course of work have accumulated on these surfaces.

#### 1.15 EQUIPMENT SELECTION

- A. Materials and equipment furnished under this contract shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be of the same manufacturer. The selection of materials and equipment to be furnished under this contract shall be governed by the following:
  - 1. Where trade names, brands, or manufacturers of equipment or materials are listed in the specifications, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products shall be first quality line of manufacturer's listed.
  - 2. Where the words "or approved equal:" appear after a manufacturer's name, specific approval must be obtained from the Architect during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.
  - 3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval.
- B. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.
- C. Before bidding equipment, and again in the preparation of shop drawings the Contractor and his supplier shall verify that adequate space is available for entry and installation of the item of equipment, including associated piping and accessories. Also verify that adequate space is available for servicing of the equipment.
- D. If extensive changes in pipe, duct or equipment layout or electrical wiring and equipment are brought about by the use of equipment which is not compatible with the layout shown on the drawings, necessary changes shall be deemed to be included in the contract.

1.16 SHOP DRAWINGS

- A. Refer to Section 01600 Product Requirements.
- B. Shop drawings for equipment fixtures, devices and materials shall be **labeled and identified** same as on the Contract Documents. Failure to do so may be cause for rejection of shop drawings.
- C. The review of shop drawings by the Architect or Engineer shall not relieve the Contactor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.
- D. Shop drawings for the following Fire Suppression equipment and materials shall be submitted
  - 1. Pipe, fittings and joining methods for the various systems.
  - 2. Firestopping systems for pipe penetrations.
  - 3. Pipe hangers.
  - 4. Valves.
  - 5. Gauges.
  - 6. Sprinkler heads and accessories.
  - 7. Wet pipe components.
  - 8. Sprinkler system installation drawings per NFPA 13, applicable calculations and water supply flow curve.

1.17 FINAL INSPECTION AND PUNCH LIST

- A. Refer to Section 017700 Closeout Procedures.

1.18 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 017823 Operation and Maintenance Data.
- B. All shop drawing and installation, maintenance and operating instruction pamphlets or brochures, wiring diagrams, parts list and other information, along with warranties, shall be obtained from each manufacturer of the principal items of equipment. In addition, the Contractor shall prepare a chart listing all items of equipment which are furnished under his contract and indicating the nature of maintenance required, the recommended frequency of checking these points and the type of lubricating media or replacement material required.
- C. These shall be assembled into three-ring loose lead binders or other appropriate binding and also combined into a single electronic file in .PDF format. An index and tabbed sheets to separate the sections shall be included. These shall be submitted to the Architect or Engineer for review. Upon approval, manuals shall be turned over to the Owner.

1.19 RECORD DRAWINGS

- A. Refer to Section 017839 Project Record Drawings.
- B. Each Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawing shall be turned over to the Architect.

1.20 WARRANTIES

- A. Refer to Section 017700 Closeout Procedures.
- B. This Contractor shall warrant all workmanship, equipment and material entering into this contact for a period of one year of date of final acceptance or date of beneficial use, as agreed to between Contractor and Architect. Any materials or equipment proving to be defective during this warranty period shall be made good by this Contractor without expense to the Owner.
- C. This provision is intended specifically to cover deficiencies in contract completion or performance which are discovered after systems are placed in operation. Also included shall be supplementary assistance in balancing, adjusting or providing operating instructions as the need develops, and replacing overload heater elements in starters where necessary to keep systems in operation. Heater element sizes shall not exceed the motor manufacturer's recommendations.
- D. This provision shall not be construed to include maintenance items such as replacing filters, re-tightening or repacking glands, greasing, oiling belt tightening and cleaning strainers after these have been done for final close-out.
- E. Provisions of this warranty shall be considered supplementary to warranty provisions under General Conditions.

1.21 PROJECT CLOSEOUT

- A. Refer to Section 017700 Closeout Procedures.

1.22 OPERATIONS AND ADJUSTMENT OF EQUIPMENT

- A. As the fire suppression systems are placed in operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing air and water systems, adjusting fan speeds, belts, pulleys, tightening packing glands, and adjusting all operating equipment.
- B. Caution: Verify that all bearings are lubricated, all motors are operating in the right direction, and correct overload heater elements are provided on all motors. Do not depend wholly on the electrician's judgment in these matters. Follow specific instructions in regard to lubrication. Do not oil or grease presealed ball bearings unless upon manufacturer's specific instructions.
- C. Test relief valves, air vents and regulating valves to insure proper operation.



1.23 OPERATING DEMONSTRATION AND INSTRUCTIONS

- A. Refer to Section 017900 Demonstration and Training as well as individual Division 21 Sections for requirements.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION – NOT APPLICABLE

END OF SECTION 21 0001

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## SECTION 21 0002 – FIRE SUPPRESSION WORK IN EXISTING BUILDINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements for Work in the Existing Building
2. Inspection of Existing Building
3. Asbestos Material
4. Work Hours
5. Tobacco Products
6. Barriers and Signage
7. Storage of Tools and Materials
8. Protection of Existing Building and Equipment
9. Confined Spaces
10. Noise, Fumes and Dust Control
11. Soldering Welding and Cutting
12. Removals Disposal and Reuse
13. Draining, Flush and Refill of Piping Systems
14. Continuity of Systems
15. Cutting and Patching
16. Cleaning

#### 1.2 GENERAL REQUIREMENTS FOR WORK IN THE EXISTING BUILDING

- A. Refer to Article 1 Specification requirements and notes on the drawings where provided for requirements related to renovation work.
- B. Meet with the Owner and/or the Architect before demolition or construction begins to establish procedures for work effort in the existing building. Provide names and phone numbers and establish emergency contact information where work is performed. Provide security information to the Owner for all personnel who will be working on site. Educate all construction personnel regarding the project requirements and procedures.
- C. Coordinate effort with other contractors involved in the renovation project to minimize the disruption, system outages, phasing of work, share cleaning responsibilities, etc.

### 1.3 INSPECTION OF EXISTING BUILDING

- A. Each bidder shall inspect the project site and the existing building in the early time frame of the bidding period. Conditions shall be compared with information shown on the drawings. Report to the Architect/Engineer any significant discrepancies which may be discovered in a timely fashion so that direction may be provided in an addendum. After the contract is signed, no allowance will be made for failure to have made a thorough inspection.

### 1.4 ASBESTOS MATERIAL

- A. Abatement, removal or encapsulation of existing materials containing asbestos is not included in the Contract. Necessary work of this nature will be arranged by the Owner to be done outside of this construction and remodeling project by a company regularly engaged in asbestos abatement. Such work will be scheduled and performed in advance of work in the construction and remodeling project.
- B. If, in the performance of the fire suppression work, materials are observed which are suspected to contain asbestos, the Contractor shall immediately inform the Architect / Engineer who in turn will notify the Owner. Work that would expose workers to the inhalation of asbestos particles shall be terminated. Work may be resumed only after a determination has been made and unsafe materials have been removed or encapsulated and the area declared safe.

### 1.5 WORK HOURS

- A. Work hours for construction shall be as defined in Section 01150- Project Phasing or other specification sections or drawing notes.
- B. Where allowed, contractors may work normal hours except after hours is required for operations that are noisy, generate obnoxious fumes or dust, require shut down of ventilation systems, etc. The Owner reserves the right to stop normal hour work where the Owner deems the effort to be disruptive to their ongoing operations.
- C. Any work that creates hazards in or requires closure of corridors, exit pathways or stairwells work in corridors must be performed after hours when the building is not occupied.
- D. All occupied areas, corridors exit pathways and stairwells must be left clean, lighted (including emergency egress and exit signage) usable and safe at the end of each work shift.
- E. Access to the work area shall be coordinated with the Owner; follow all security protocols for parking, sign in, key control, etc. established by the Owner.

## 1.6 TOBACCO PRODUCTS

- A. Smoking or chewing tobacco products are expressly prohibited to be used within the building and on the premises except where specifically permitted by the Owner or in construction company trailers or vehicles where permitted by the construction company.

## PART 2 - PRODUCTS- NOT APPLICABLE

## PART 3 - EXECUTION

### 3.1 BARRIERS AND SIGNAGE

- A. Barriers and signage shall be provided as appropriate to identify work areas and to prevent unauthorized entry by non-construction personnel. Refer to appropriate Division 1 specification requirements and notes on the drawings where provided.
- B. All barriers and signs should be high visibility type and be maintained at all times.

### 3.2 STORAGE OF TOOLS AND MATERIALS

- A. Store all site material and tools in the active job site area, specific storage areas are not provided except where otherwise noted for material and tools. The contractor is responsible for security.
- B. Storage is specifically prohibited in means of egress paths and stairwells.

### 3.3 PROTECTION OF EXISTING BUILDING AND EQUIPMENT

- A. The Owners' property and the property of other contractors shall be respected at all times. Provide drop clothes, visqueen or other suitable barriers where dust and debris is generated. Tape ends of barriers for sealing purposes.
- B. Provide 55 gallon drums or smaller buckets as appropriate and use funnels, hoses, etc. where draining liquid systems.
- C. Provide plywood sheets for protection of walls, floors or Owner equipment or systems that are remaining in place near demolition or new installation work where there is possible damage from heavy material or equipment.

### 3.4 CONFINED SPACES

- A. Notify the Owner when performing work in confined spaces. Provide a written procedure for approval and obtain approval from the Owner when so requested.
- B. All work in confined spaces shall be done in accordance with OSHA regulations.

### 3.5 NOISE FUME AND DUST CONTROL

- A. Provide barriers and ventilation as required to limit the effect from construction generated noise fume and dust control on spaces that continue to be occupied by the Owner. Refer to protection of building and equipment paragraph above. In addition to the basic protection, provide additional visqueen barriers to limit airborne migration of dust and fumes. Provide supplemental portable fans to exhaust air to the outside of the building where appropriate. Use of the Owners' ventilation systems to induce positive or negative pressure is prohibited unless authorized by the Owner. Shut off ventilation systems serving the area where use of these systems can induce fumes or dust into return or exhaust ducts. Where systems need to remain operational for occupied areas, arrange to temporarily shutoff portions of the system in the work area. Provide taped visqueen covers on HVAC air supply and exhaust devices to limit migration. Coordinate all efforts requiring modification or shutdown of ventilation systems with the Owner. Contractor shut down of these systems is prohibited without Owner permission.
- B. Arrange with the Owner when required to shutoff fire alarm or smoke detectors to perform work. With the Owner's prior approval, cover smoke detectors where needed to prevent false alarms due to generated dust or fumes. Minimize outages and coordinate efforts to limit the effect due to false alarms.
- C. Where significant dust or fume generating work, welding or cutting operations are required for removal or new work, provide fume removal equipment with telescoping arms to locally capture the fumes. Fume exhaust shall be directed outside or adequately filtered and recirculated.
- D. Areas shall be thoroughly ventilated after completion of the work on a daily basis to remove residual odors and fumes before occupancy occurs the next day.
- E. Provide vacuum cleaners and other equipment to clean and restore conditions.

### 3.6 SOLDERING WELDING AND CUTTING

- A. For soldering, welding or cutting operations, provide insulated, fire rated barriers and blankets to isolate cover and protect remaining systems and materials, furniture, furnishings, floors, walls, ceilings, etc.
- B. Refer to noise, fume and dust control provisions in the previous paragraph.

- C. Obtain burn approval from the Owner before commencing any soldering or welding effort. Coordinate outages of fire alarm systems as noted in the previous paragraph.
- D. Provide a Fire Watch at each welding location. Fire Watch personnel shall be dedicated for the sole purpose of fire prevention during welding operations. All Fire Watch personnel shall be properly trained and equipped, including fire extinguisher, fire blanket and communication equipment for assistance request.
- E. Provide a fire extinguisher at every soldering or welding location.

### 3.7 REMOVALS DISPOSAL AND REUSE

- A. Refer to the drawings for the scope of remodeling in the existing building.
- B. Cooperate with the General Contractor regarding all removal and remodeling work. Each Contractor shall remove existing work which is associated with his trade and which will be superfluous when the new work is installed and made operational.
- C. Extraneous piping which is or becomes accessible shall be removed and stubs shall be capped at the first active duct or pipe encountered. Piping that is and remains inaccessible shall be abandoned. Ends of abandoned pipe shall be capped so as to be concealed by finished surfaces. Upon completion of the work no abandoned pipe, valve or stub shall extend thru finished floors, walls or ceilings.
- D. When it is necessary to reroute a section of active piping the rerouted section shall be installed before removing the existing in order to minimize system down time. Rerouted sections shall be insulated as required for new work. Patch insulation on existing piping which has been damaged or removed in this work.
- E. Where existing piping is removed and holes are left in existing walls, finished ceilings, floors, etc., these holes shall be patched using materials to match the existing construction to restore and maintain the integrity of the existing partition.
- F. Materials and equipment which are removed shall not be reused within the scope of this project unless specifically noted to be relocated or reused. Turn over to the Owner and place where directed on the premises all removed material and equipment so designated by the Owner. All material and equipment which the Owner does not wish to retain shall become the property of the Contractor responsible for removal and shall be removed from the premises and properly disposed.
- G. Disposal of materials regulated by EPA shall be done in strict accordance with latest requirements. Provide documentation to the Owner that disposal was properly executed.
- H. Remove, store and reinstall lay-in ceiling tile and grid as needed to perform work in areas where such removal and re-installation is not to be done by the General Contractor. Damaged tile and/or grid shall be replaced with new matching tile and/or grid.

- I. In areas of minor work where the space is not completely vacated, temporarily move portable equipment and furnishings within the space as required to complete the work. Coordinate this activity with Owner. Protect the Owner's property by providing dust covers and temporary plastic film barriers to contain dust. Remove barriers and return equipment and furniture upon completion of the work.
- J. Refinish any surface disturbed under this work match existing, except where refinishing of that surface is included under the General Contract.

### 3.8 DRAINING FLUSHING AND REFILL OF PIPING SYSTEMS

- A. Existing liquid systems shall be drained as required before removal or connection of new piping extensions.
- B. Draining of the system shall be the responsibility of the contractor. Provide threaded connections, etc. to direct fluids to drainage points. Water systems may be drained to sanitary systems or where permitted, to storm systems. Verify any chemical treatment, inhibitors or freeze protection additives in the existing systems and obtain a permit from the local sewer authority before disposing.
- C. Provide drums or containers to accept other than water drainage and remove from the premises and properly dispose. Provide visqueen to protect Owners' property when opening pipes, even where piping has been drained to prevent damage from residual liquid that remains in the pipe.

### 3.9 CONTINUITY OF SYSTEMS

- A. Work shall be so planned and executed as to provide reasonably continuous services of existing systems throughout the construction period. Where necessary to disrupt services for short periods of time for connection, alteration or switch-over, the Owner shall be notified in advance and outages scheduled at the Owner's reasonable convenience.
- B. Submit, on request, a written step-by-step sequence of operations proposed to accomplish the work. The outline must include tentative dates, times of day for disruption, downtime and restoration services. Submit the outline sufficiently in advance of the proposed work to allow the Architect or Engineer to review the information with the Owner. Upon approval, final planning and the work shall be done in close coordination with the Owner.
- C. Shutdown of system and work undertaken during shutdowns shall be bid as being done during normal working hours. If the Owner should require such work be performed outside of normal working hours, reimbursement shall be made for premium time expenses only.



### 3.10 CUTTING AND PATCHING

- A. Refer to Division 1 – General Requirements for information regarding cutting and patching.
- B. Plan the work well ahead of the general construction. Where pipes are to pass thru new walls, partitions, floors, roof or ceilings, place sleeves in these elements or arrange with the General Contractor to provide openings where sleeves are not practical. Where sleeves or openings have not been installed, cut holes and patch as required for the installation of this work, or pay other trades for doing this work when so directed by the Architect. Any damage caused to the building shall be repaired or rectified.
- C. Where pipes are to pass thru, above or behind existing walls, partitions, floors, roof or ceiling, cutting, patching and refinishing of same shall be included in this contract. Core drilling and saw cutting shall be utilized.
- D. All material, methods and procedures used in patching and refinishing shall be in accordance with applicable provisions of specifications governing the various trades. The final appearance and integrity of the patched and refinished areas must meet the approval of the Architect. Wall, floor and ceiling refinishing must extend to logical termination lines (entire ceiling of the room repainted, for instance), if an acceptable appearance cannot be attained by finishing a partial area.
- E. Provide steel angle or channel lintels to span openings which are cut in existing jointed masonry wall where the opening span exceeds 16 inches. Provide framing around roof openings for required support of the roof deck.

### 3.11 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the Owner is continuing to occupy or use. Any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.
- B. The Owners dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.
- C. Cleaning responsibility remains with the contractor creating the dust or debris unless noted otherwise in Division 1 specifications. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain.
- D. The contractor shall also clean duct interiors and interior components of new or existing air handling system equipment if dirt, dust or debris have generated in the course of work have accumulated on these surfaces.

Warren County Career Center  
Medical Academy Addition  
263306.00

Bid / Permit Documents  
9/15/2026

END OF SECTION 21 0002

## SECTION 21 0004 – FIRESTOPPING FOR FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Firestopping assemblies shall be tested and rated in accordance with ASTM E814 (ANSI/UL 1479) Fire Tests of Through-Penetration Fire Stops (minimum positive pressure of .01 inches of water column) and E119 (ANSI/UL 263) Fire Tests of Building Construction and Materials Time-Temperature Curve. Firestopping shall provide an “F” fire rating equal to that of the construction being penetrated. Firestop systems shall meet all requirements of the Ohio Building Code.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view or above ceilings in air return plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Firestopping materials shall be manufactured and/or supplied by:
1. Hilti, Inc.
  2. Specified Technologies Inc.
  3. 3M; Fire Protection Products Division.

### 2.2 FIRESTOPPING

- A. Materials shall be in the form of caulk, putty, sealant, intumescent material, wrap strip, fire blocking, ceramic wool and other materials required for the UL listed assemblies. These shall be installed in conjunction with sleeves and materials for fill and damming.

## PART 3 - EXECUTION

### 3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Installation of all materials and assemblies shall be in accordance with UL assembly drawings and the manufacturer's instructions.
- B. Installation shall be done by an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary training and experience.
- C. Provide firestop system for every pipe at penetration of all fire resistance rated walls and horizontal assemblies.
- D. Provide rigid supports for pipes on both sides of the fire resistance rated wall or assembly where required as part of the fire stop assembly.
- E. Coordinate opening size and additional framing requirements with the General Contractor for each opening to meet the firestop installation requirements.
- F. Annular space of penetrations of non-fire-resistant-rated floor, floor/ceiling assemblies, or the ceiling membrane of a non-fire-resistant rated roof/ceiling assembly shall be filled with an approved firestopping material to resist the free passage of flame and products of combustion.
- G. Smoke Barriers:
1. Penetrations shall be sealed with a firestopping system to prevent the passage of smoke.
- H. Smoke Partitions:
1. Penetrations shall be sealed with a caulking material to prevent the passage of smoke. Non-rated smoke partitions do not require a fire stopping system.

3.2 BUILDING STRUCTURE FIRE STOPPING

- A. Where building structural members have a fire stopping system installed and portions of this fire stopping system are removed to install new systems hangers, the F.C. shall provide new fire stopping system onto portions of the building structure and hanger where fire stopping was removed. The fire stopping system shall be equal to the existing system and be 2-hour rated.

END OF SECTION 21 0004

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## SECTION 21 0519 - GAUGES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Gauges.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PRESSURE GAUGES

- A. Pressure gauges, including compound gauges and vacuum gauges, shall be Bourdon tube type with 4-1/2" dial and cast aluminum case, equal to Terrice 600C Series. Accuracy shall be 1% at mid-range.
- B. Pressure gauges for low pressure application, calibrated in inches of water gauge, ounces per sq. in. or 0-5 psi, as appropriate, shall be equal to Terrice 860.
- C. Pressure gauges at pumps shall be liquid filled Bourdon tube type with 4" dial and stainless-steel case and internals, equal to Terrice 700 Series.
- D. A brass cock or bronze ball valve and a pressure snubber shall be furnished with each pressure gauge.
- E. Ranges of pressure gauges shall be selected to be consistent with anticipated pressures. Range shall be approximately twice the normal system working pressure at the gauge location.

#### 2.2 TEST PLUGS

- A. Pressure-temperature test plugs for insertion of pressure gauge or thermometer shall be a brass fitting with neoprene or Nordel self-sealing insert and knurled brass cap with plastic capture tab. Fittings shall be equal to Peterson "PT". Furnish two thermometers and two pressure gauges with integral insertion stem appropriate for use with the test plugs.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Pressure gauges shall be installed where shown on the drawings, where required by applicable codes and also at:
- B. Gauges shall be positioned to be read with unobstructed view from the floor. Pressure-temperature test plugs shall be installed where shown, located in a position to be most readable.

END OF SECTION 21 0519



## SECTION 21 0529 – PIPE HANGERS AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Hanger Rods and Attachments.
  - 4. Pipe Riser Supports

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.

### PART 2 - PRODUCTS

#### 2.1 STEEL PIPE HANGERS

- A. Hangers and supports for piping shall be equal to the Anvil catalog numbers as follows:
  - 1. Pear shaped band hanger with adjustable swivel ring type per NFPA standards, lock nut and rod attachment, carbon steel with galvanized finish, Anvil fig. 69.

#### 2.2 HANGER RODS AND ATTACHMENTS

- A. Hanger rods shall be solid steel, threaded end or all-thread rod, of diameter listed below. A hanger attachment device (for attachment to the structure) and locking nut at the hanger attachment shall be provided on each hanger.

| <u>Pipe Size</u> | <u>Min. Rod Dia.</u> |
|------------------|----------------------|
| 4" and smaller   | 3/8"                 |
| 5" to 6"         | 1/2"                 |
| 8"               | 5/8"                 |

B. Hanger rod attachment devices for attachment to the structure shall be:

1. Beam clamps for steel construction equal to Anvil Fig. 92, 93, or 94. Utilize swivel type in sloped steel construction to provide vertical support of pipe without bending hanger rods.
2. Channel support system equal to Unistrut or Hilti.

### 2.3 PIPE RISER SUPPORTS

A. Riser clamps shall be:

1. Carbon steel, epoxy coated or galvanized finish- Anvil Fig. 261.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Spacing of hangers shall be as follows:

1. Steel pipe - Vertical:
  - a. At the base and 15 ft. maximum spacing unless otherwise shown.
2. Steel pipe - Horizontal:
  - a. 2" size and smaller – 8 ft. intervals
  - b. 2-1/2" thru 6" – 10 ft. intervals
  - c. 8" and larger – 12 ft.. intervals.

B. In piping systems with rolled or cut groove end pipe and mechanical joint couplings, pipe hangers shall be provided on horizontal piping at normal specified intervals and, in addition, so that no pipe shall be left unsupported between any two couplings nor left unsupported whenever a change in direction takes place. Added supports may be omitted on "rigid" couplings such as Victaulic Style 07 Zero-Flex. Vertical piping shall be supported at normal specified intervals or every other pipe length, which ever is more frequent. The base of the riser or base fitting shall be supported.

C. Attachment of pipe hangers to the structure shall be with:

1. Provide anchoring where steel beam clamps are attached to sloping surfaces of beam flanges and where otherwise required to insure permanent attachment.

2. Attachment to steel deck is prohibited. Span from steel structural members with supplementary steel shapes where direct attachment to structural members is not practical.
- D. Attachment to manufactured trusses and other engineered structural members and supports shall be done in strict accordance with the structural manufacturer's recommendations. Refer to the architectural and structural drawings for type of engineered structural systems being used. Connections to these structural members shall be made with connection devices and methods approved by the structural manufacturer. Provide additional supports with supplemental steel shapes when spacing between structural members exceeds specified distances.
- E. Pipe hangers shall be adjusted to proper elevation and all hanger rods set in a vertical position.
- F. Extended legs of pipe riser clamps shall be shortened as needed to maintain concealment of the clamp within finished spaces. Insure that adequate support is still maintained.

END OF SECTION 21 0529

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## SECTION 21 0553 - IDENTIFICATION FOR FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipe labels.
2. Valve Tags

#### 1.2 SUBMITTAL

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

#### 1.3 QUALITY ASSURANCE

- A. Labels, tags and markers shall comply with ANSI A13.1 for lettering size, colors and length of color field.

### PART 2 - PRODUCTS

#### 2.1 PIPE LABELS

- A. Pipe markings shall be applied to all piping.
- B. Labeling shall be:
1. Plastic semi-rigid snap-on type, manufacturer's standard pre-printed color coded pipe markers extending fully around the pipe and insulation or pressure-sensitive vinyl pipe markers similar to above.

#### 2.2 VALVE TAGS

- A. Each shutoff valve, other than at equipment, shall be identified with a stamped tag. Valves and tagging shall be scheduled, typewritten on 8-1/2" x 11" paper, tabulating valve number, piping system, abbreviation, location of valve (room or area) and service (e.g. – south wing reheat boxes).
- B. Valve tags shall be engraved plastic laminate with solid brass S hook. Tags shall be engraved with "F" for Fire Suppression and the designated number.

## 2.3 ACCEPTABLE MANUFACTURERS

- A. Labels, markings and tags shall be manufactured by W.H. Brady, Seton, Allen or Industrial Safety Supply.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification marking and tagging shall be applied after painting has been completed.
- B. Coordinate names, abbreviations and other designations used with corresponding designations shown, specified or scheduled on drawings. Verify with Owners' desired identification marking system.
- C. The Plumbing, Fire Suppression and HVAC Contractors shall coordinate labeling, marking and tagging to attain coordinated and consistent systems of identification.
- D. Equipment labeling shall consist of unit designation as shown on the drawings.
- E. Pipe markers shall be placed at 25 ft. centers in mechanical rooms and concealed spaces and at 50 ft. centers in other exposed locations.
- F. Refer to appropriate sections of this specification for installation of underground line marker tape.
- G. Valve tags shall be placed on each valve except those intended for isolation of individual items of equipment. Valve tag schedules shall be prepared as specified above.

END OF SECTION 21 0553

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.

- B. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible devices. Hose connections are included if indicated.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Design sprinkler system(s), by a State certified designer, using performance requirements and design criteria indicated.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- C. System shall conform to the requirements of NFPA 13 and OBC chapter 9 and other requirements of the authority having jurisdiction.
- D. Sprinkler system design shall be approved by authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Approved Sprinkler Piping Drawings and Calculations: Working plans and hydraulic calculations, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Welding certificates.

- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- E. Field quality-control reports.
- F. Operation and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Design Responsibility: Preparation of working plans, calculations, and field test reports by a certified sprinkler designer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Refer to piping schedule on the Drawings for piping material and applications.

#### 2.2 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be listed as UL or FM approved.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Acceptable Manufacturers: Subject to compliance with requirements:
    - a. Anvil International, Inc.
    - b. Kennedy Valve; a division of McWane, Inc.



- c. Stockholm Valve and Fittings.
- d. Tyco Fire & Building Products LP.
- e. Victaulic Company.
- f. Watts Water Technologies, Inc.

B. Check Valves 2" and smaller:

- 1. Standard: UL 312.
- 2. Type: Swing check.
- 3. Body Material: Bronze.
- 4. Disc Material: Composition faced
- 5. End Connections: Threaded.

C. OS&Y Gate Valves 2" and smaller:

- 1. Standard: UL 262.
- 2. Body Material: Bronze.
- 3. End Connections: Threaded.

D. OS&Y Gate Valves: 2 1/2" and larger

- 1. Standard: UL 262.
- 2. Body Material: Cast or ductile iron.
- 3. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

- 1. Standard: UL 1091.
- 2. Pressure Rating: 175 psig minimum.
- 3. Valves 2" and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
- 4. Valves 2-1/2" and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
- 5. Valve Operation: Integral electrical, 115-V AC, pre-wired, single-circuit, supervisory switch indicating device.

F. Trim and Drain Ball Valves:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Body Material: Bronze.
- 3. End Connections: Threaded.

## 2.3 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.
8. Acceptable Manufacturers:
  - a. Elkhart Brass Mfg. Company, Inc.
  - b. Fire-End & Croker Corporation.
  - c. Potter Roemer.

### B. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.
6. Acceptable Manufacturers:
  - a. Tyco Fire & Building Products LP.
  - b. Victaulic Company.
  - c. Viking Corporation.

## 2.4 SPRINKLERS

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Acceptable Manufacturers:
  - a. Globe Fire Sprinkler Corporation.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.

### B. Automatic Sprinklers:

1. Non-Residential Applications: UL 199.
2. Characteristics: Quick-response type with nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Sprinkler Finishes:

1. Chrome plated.
2. Painted.

D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications.

1. Exposed Pendent Sprinklers: Chrome-plated steel, one piece, flat.
2. Concealed Recessed Sprinklers: White -plated steel, two piece, with 1-inch vertical adjustment and a flat cover plate.
3. Sidewall Mounting: Chrome-plated steel one piece, flat.

E. Dry Sprinklers – In spaces subject to freezing use dry sidewall sprinklers.

F. Spare Sprinklers – Furnish spare sprinklers and sprinkler wrench in accordance with the requirements of NFPA 25. Spare sprinklers shall include each type and temperature rating in a proportional amount equal of those installed. Provide a wall mounted cabinet for sprinklers and wrench.

## 2.5 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.
7. Manufacturers:
  - a. ADT Security Services, Inc.
  - b. McDonnell & Miller; ITT Industries.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Viking Corporation.
  - f. Victaulic Company.

C. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.

- 5. Manufacturers:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.

## 2.6 PIPE ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with setscrews.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. Split-Casting Floor Plates: Cast brass with concealed hinge.

## 2.7 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Locate sprinkler piping in areas protected from freezing.
- C. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- E. Install unions adjacent to each valve in pipes 2" and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having 2-1/2" and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install alarm devices in piping systems.
- J. Install hangers and piping supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gages on riser or feed main, and at each sprinkler test connection. Include pressure gages with connection not less than 1/4" and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Fill sprinkler system piping with water.

### 3.2 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated.
- G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
  1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

### 3.4 SPRINKLER INSTALLATION

- A. Refer to the drawing for the locations of various types of sprinklers.
- B. Install sprinklers in suspended ceilings in center of acoustical ceiling panels or at the quarter points along the long axis for rectangular panels.
- C. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

### 3.5 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, and walls.
- B. Sleeves are not required for core-drilled holes in cast walls or floors.
- C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

- D. Install sleeves in new partitions, slabs, and walls as they are built.
- E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

### 3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Coordinate with fire-alarm tests. Operate as required.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Turn spare sprinklers, wrench and cabinet over to owner

### 3.8 CLEANING

- A. Clean dirt and debris from sprinklers.

- B. Remove and replace sprinklers with paint other than factory finish.

### 3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Dry sidewall sprinklers

- B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted flat white cover plate.
2. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313



## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.

- B. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible devices. Hose connections are included if indicated.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Design sprinkler system(s), by a State certified designer, using performance requirements and design criteria indicated.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- C. System shall conform to the requirements of NFPA 13 and OBC chapter 9 and other requirements of the authority having jurisdiction.
- D. Sprinkler system design shall be approved by authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Approved Sprinkler Piping Drawings and Calculations: Working plans and hydraulic calculations, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Welding certificates.

- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- E. Field quality-control reports.
- F. Operation and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Design Responsibility: Preparation of working plans, calculations, and field test reports by a certified sprinkler designer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Refer to piping schedule on the Drawings for piping material and applications.

#### 2.2 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be listed as UL or FM approved.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Acceptable Manufacturers: Subject to compliance with requirements:
    - a. Anvil International, Inc.
    - b. Kennedy Valve; a division of McWane, Inc.

- c. Stockholm Valve and Fittings.
- d. Tyco Fire & Building Products LP.
- e. Victaulic Company.
- f. Watts Water Technologies, Inc.

B. Check Valves 2" and smaller:

- 1. Standard: UL 312.
- 2. Type: Swing check.
- 3. Body Material: Bronze.
- 4. Disc Material: Composition faced
- 5. End Connections: Threaded.

C. OS&Y Gate Valves 2" and smaller:

- 1. Standard: UL 262.
- 2. Body Material: Bronze.
- 3. End Connections: Threaded.

D. OS&Y Gate Valves: 2 1/2" and larger

- 1. Standard: UL 262.
- 2. Body Material: Cast or ductile iron.
- 3. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

- 1. Standard: UL 1091.
- 2. Pressure Rating: 175 psig minimum.
- 3. Valves 2" and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
- 4. Valves 2-1/2" and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
- 5. Valve Operation: Integral electrical, 115-V AC, pre-wired, single-circuit, supervisory switch indicating device.

F. Trim and Drain Ball Valves:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Body Material: Bronze.
- 3. End Connections: Threaded.

## 2.3 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.
8. Acceptable Manufacturers:
  - a. Elkhart Brass Mfg. Company, Inc.
  - b. Fire-End & Croker Corporation.
  - c. Potter Roemer.

### B. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.
6. Acceptable Manufacturers:
  - a. Tyco Fire & Building Products LP.
  - b. Victaulic Company.
  - c. Viking Corporation.

## 2.4 SPRINKLERS

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Acceptable Manufacturers:
  - a. Globe Fire Sprinkler Corporation.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.

### B. Automatic Sprinklers:

1. Non-Residential Applications: UL 199.
2. Characteristics: Quick-response type with nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Sprinkler Finishes:

1. Chrome plated.
2. Painted.

D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications.

1. Exposed Pendent Sprinklers: Chrome-plated steel, one piece, flat.
2. Concealed Recessed Sprinklers: White -plated steel, two piece, with 1-inch vertical adjustment and a flat cover plate.
3. Sidewall Mounting: Chrome-plated steel one piece, flat.

E. Dry Sprinklers – In spaces subject to freezing use dry sidewall sprinklers.

F. Spare Sprinklers – Furnish spare sprinklers and sprinkler wrench in accordance with the requirements of NFPA 25. Spare sprinklers shall include each type and temperature rating in a proportional amount equal of those installed. Provide a wall mounted cabinet for sprinklers and wrench.

## 2.5 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.
7. Manufacturers:
  - a. ADT Security Services, Inc.
  - b. McDonnell & Miller; ITT Industries.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Viking Corporation.
  - f. Victaulic Company.

C. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.

5. Manufacturers:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.

## 2.6 PIPE ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with setscrews.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. Split-Casting Floor Plates: Cast brass with concealed hinge.

## 2.7 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Locate sprinkler piping in areas protected from freezing.
- C. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- E. Install unions adjacent to each valve in pipes 2" and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having 2-1/2" and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install alarm devices in piping systems.
- J. Install hangers and piping supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gages on riser or feed main, and at each sprinkler test connection. Include pressure gages with connection not less than 1/4" and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Fill sprinkler system piping with water.

### 3.2 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated.

- G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

### 3.4 SPRINKLER INSTALLATION

- A. Refer to the drawing for the locations of various types of sprinklers.
- B. Install sprinklers in suspended ceilings in center of acoustical ceiling panels or at the quarter points along the long axis for rectangular panels.
- C. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

### 3.5 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, and walls.
- B. Sleeves are not required for core-drilled holes in cast walls or floors.
- C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.



- D. Install sleeves in new partitions, slabs, and walls as they are built.
- E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

### 3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Coordinate with fire-alarm tests. Operate as required.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Turn spare sprinklers, wrench and cabinet over to owner

### 3.8 CLEANING

- A. Clean dirt and debris from sprinklers.

- B. Remove and replace sprinklers with paint other than factory finish.

### 3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Concealed sprinklers.
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Spaces Subject to Freezing: Dry sidewall sprinklers
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted flat white cover plate.
  - 2. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

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## SECTION 22 0001 – BASIC PLUMBING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements
2. Definitions
3. Scope of Work
4. Drawings and Specifications
5. Reference Standards
6. Allowances, Unit Prices and Alternates
7. Site Visit
8. Permits, Regulations and Inspections
9. Project Management and Coordination
10. Temporary Utilities
11. Workmanship
12. Protection
13. Painting
14. Cleaning
15. Miscellaneous Equipment Connections
16. Equipment Selection
17. Shop Drawings
18. Final Inspection and Punch List
19. Operation and Maintenance Manuals
20. Record Drawings
21. Warranties
22. Project Closeout
23. Operation and Adjustment of Equipment
24. Operating Demonstration and Instruction

#### 1.2 GENERAL REQUIREMENTS

- A. All provisions of Division 00 Front End Documents and Division 01 General Requirements apply to work specified in this Division.
- B. Specification provisions of other relevant Divisions shall apply where applicable work is required to be performed under this Plumbing work.
- C. A complete and functional Plumbing system installation shall be provided under this Division. Should overlap of work among trades become evident, this shall be called to the attention of the architect. In such event, none of the trades or their suppliers shall assume that he relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

- D. The Mechanical and Electrical drawings and specifications assign work (labor and/or materials) to be provided by the General, Plumbing, Fire Suppression, HVAC or Electrical Contractor or their sub-contractors. Understanding that the contractors for mechanical and electrical work are sub-contractors to the (General) Contractor, such assignments are not intended to restrict the Contractor in assignment of work among the sub-contractor to accommodate trade agreements and practices or the normal conduct of the construction work.

### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

### 1.4 SCOPE OF WORK

- A. The scope of the Plumbing work includes furnishing, installing, testing and warranty of all Plumbing work shown on the Plumbing drawings and specified herein, including Division 00, Division 01, Division 22 and applicable provisions of other relevant Divisions..

### 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "provide," as used, shall mean "furnish and install." If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Architect for approval before proceeding with the work.
- B. Make all necessary field measurements to ensure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Architect for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Having pipe and fittings fabricated and

delivered in advance of making actual measurements shall be sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.

- D. The Architect shall reserve the right to make minor adjustments in locations of system runs and components where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties.
- E. Equipment or piping shall not be installed or run above electrical switchgear or panelboards, nor in or above the access space in the immediate vicinity of the electrical switchgear/panelboards, in accordance with NEC Article 384.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The Architect's decision shall be final in regard to the arrangement of ductwork, piping, etc., where conflict arises.
- G. Provides offsets in system runs, additional fittings, necessary drains and minor valves, traps, and devices required to complete the installation, or for the proper operation of the system. Each Contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

#### 1.6 REFERENCE STANDARDS

- A. Where standards (NFPA, NEC, ADTM, UL, ASPE, etc.) are referenced in the specifications or on the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

#### 1.7 ALLOWANCES, UNIT PRICES AND ALTERNATES

- A. Refer to Sections 01200 Allowances, 012200 Unit Prices and 012300 Alternates.

#### 1.8 SITE VISIT

- A. Refer to Section 017300 Execution.
- B. Each bidder shall visit the project site to understand the existing conditions and compare the conditions with information shown on the drawings. Report immediately to the Architect any issues or discrepancies which are discovered that affect the bid. Changes to contract price will not be considered for site condition issues that are readily apparent from a thorough site review.

1.9 PERMITS, REGULATIONS AND INSPECTION

- A. Work must conform to applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawing and specifications shall govern. Install no work contrary to minimum legal standards.
- B. Except where the permit application is made by the Architect or the Engineer, the Plumbing contractor shall be responsible to file for and obtain all required permits from the governing inspection agencies for the plumbing work. Where the Architect or Engineer is the Architect or Engineer of record, they will furnish sealed and signed drawings and specifications required by the permit authorities.
- C. Include payment of all permit and inspection fees applicable to the work in this Division.
- D. All work shall be subject to inspection and approval of Federal, State and local agencies as may be appropriate as well as the Architect and Engineer.
- E. Furnish for the Owner certificates of approval from the governing inspection agencies as a condition for final payment.

1.10 PROJECT MANAGEMENT AND COORDINATION

- A. Refer to Section 013100 Project Management and Coordination.

1.11 TEMPORARY UTILITIES

- A. Refer to Section 015000 – Temporary Facilities and Controls for division of responsibilities for temporary utilities.
- B. Each Contractor requiring water for construction purposes shall connect to wall hydrants or other connection points within the existing building.
- C. Cost of water use for construction is not included in Division 22.

1.12 WORKMANSHIP

- A. Refer to Section 014000 Quality Requirements.
- B. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all respects, and the Architect shall have the right to stop the work if highest quality workmanship is not maintained.
- C. Plumbing work shall be performed by licensed Plumbing Contractors in accordance with requirements of the jurisdiction.

1.13 PROTECTION

- A. Each Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Architect.
- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide plastic sheeting, drop cloths or similar barriers where dust and debris is generated, to protect adjacent areas.
- C. Contractor shall protect all equipment and materials from detrimental effects of weather or construction activity. All items shall be stored and secured in a protected location away from the daily work area. Equipment or materials shall be placed on raised skids to protect from surface moisture. Where appropriate, provide plastic sheeting or similar vapor barrier underneath the stored products to reduce the effects of ground moisture or curing concrete on the local humidity levels. Where unfinished ferrous products or finished ferrous products with raw edges are stored, provide local, dry heat to maintain ambient relative humidity levels below 65% RH to prevent rust.
- D. All equipment shall retain the original packaging until required to be removed for installation or operation. Open ends of piping, conduit, etc. shall be capped or sealed and ventilation openings into equipment shall be wrapped and sealed in plastic sheeting to prevent dust or dirt entry both when stored and after installation but still open to the effects of construction activity. Stored items as well as installed equipment shall be covered with plastic sheeting at all times until placed in service or until dust generating activity in the area has ceased.

1.14 PAINTING

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in Division 22:
  - 1. Ferrous metal which is not factory or shop painted or galvanized and which remains exposed to view in the finished areas of the building / building including finished areas, mechanical rooms, storage rooms, and other unfinished areas shall be given a prime coat of paint.
  - 2. Ferrous metal installed outside the building which is not factory or shop painted or galvanized shall be given a prime coat of paint.
  - 3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch-up.
- B. Paint, surface preparation and application shall conform to applicable portions of the Painting section of Division 9 of the Specifications. All rust must be removed before application of paint.



- C. Finish painting is included in the General Contract except where otherwise required under remodeling work. Refer to the Cutting and Patching paragraph in this Section for finishing requirements

#### 1.15 RECORD DRAWINGS

- A. Refer to Section 017839 Project Record drawings.
- B. Each Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawing shall be turned over to the Architect.

#### 1.16 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the Owner is continuing to occupy or use; any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.
- B. The Owners dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.
- C. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain.

#### 1.17 MISCELLANEOUS EQUIPMENT CONNETIONS

- A. Certain categories of fixtures and equipment, including dental equipment, require piping connections as shown on the drawings. Equipment will be furnished and set in places by the equipment supplier.
- B. Make all final connections to these fixture and equipment, as indicated and in accordance with the manufacturer's recommendations. All piping connections shall be valved and final connections made with unions.
- C. Fixtures and equipment, unless otherwise noted, will be furnished complete with the basic plumbing supply and waste trim. The trim will generally be furnished "loose" and shall be installed under this work. Countertop sinks furnished "loose" shall also be installed by the Plumbing Contractor.
- D. Provide supplies, supply stops, traps, shut-off valves, fixture drains, continuous wastes and indirect wastes. Provide a water-hammer arrestor on the system side of each automatic (quick-closing) valve on water supply lines. Items not specifically described elsewhere in these specifications shall be of the same manufacturer as similar items specified in conjunction with the plumbing fixtures.

- E. Supply piping and devices connecting to fixtures or equipment, where exposed to view in the finished space, shall be chrome plated and insulation shall be omitted.
- F. Roughing-in drawings shall be obtained for the various fixtures and items of equipment as the time approaches when such information is required; allow a reasonable period, from the time of notice to obtain this information.
- G. Connections to equipment shall be in accordance with manufacturers' installation guidelines. Any additional accessories recommended by the manufacturer such as gauges, shut-off valves, unions at connection points, etc., shall be provided by this Contractor.

#### 1.18 EQUIPMENT SELECTION

- A. Materials and equipment furnished under this contract shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be of the same manufacturer.
- B. The selection of materials and equipment to be furnished under this contract shall be governed by the following:
  - 1. Where trade names, brands, or manufacturers of equipment or materials are listed in the specifications, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products shall be first quality line of manufacturers listed.
  - 2. Where the words "or approved equal: appear after a manufacturer's name, specific approval must be obtained from the Architect during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.
  - 3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval.
- C. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.
- D. Before bidding equipment, and again in the preparation of shop drawings the Contractor and his supplier shall verify that adequate space is available for entry and installation of the item of equipment, including associated piping and accessories. Also verify that adequate space is available for servicing of the equipment.
- E. If extensive changes in pipe, or equipment layout or electrical wiring and equipment are brought about by the use of equipment which is not compatible with the layout shown on the drawings, necessary changes shall be deemed to be included in the contract.

#### 1.19 SHOP DRAWINGS

- A. Refer to Section 016000 Product Requirements.
- B. Shop drawings for equipment fixtures, devices and materials shall be **labeled and identified** same as on the Contract Documents. Failure to do so may be cause for rejection of shop drawings.
- C. The review of shop drawings by the Architect or Engineer shall not relieve the Contactor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.
- D. Shop drawings for the following Plumbing equipment and materials shall be submitted:
  - 1. Pipe, fittings and joining methods for the various systems.
  - 2. Firestopping systems for pipe penetrations.
  - 3. Pipe hangers and saddles.
  - 4. Valves.
  - 5. Gauges.
  - 6. Pipe insulation
  - 7. Supply system specialties.
  - 8. Drainage system specialties
  - 9. Plumbing fixtures and trim
  - 10. Water heating equipment
  - 11. Dental Air compressor and accessories.

#### 1.20 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 017823 Operation and Maintenance Data.
- B. All shop drawing and installation, maintenance and operating instruction pamphlets or brochures, wiring diagrams, parts list and other information, along with warranties, shall be obtained from each manufacturer of the principal items of equipment. In addition, the Contractor shall prepare a chart listing all items of equipment which are furnished under his contract and indicating the nature of maintenance required, the recommended frequency of checking these points and the type of lubricating media or replacement material required.
- C. These shall be assembled into three-ring loose lead binders or other appropriate binding and also combined into a single electronic file in .PDF format. An index and tabbed sheets to separate the sections shall be included. These shall be submitted to the Architect or Engineer for review. Upon approval, manuals shall be turned over to the Owner.

#### 1.21 RECORD DRAWINGS

- A. Refer to Section 017839 Project Record Drawings.

- B. Each Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawing shall be turned over to the Architect.

#### 1.22 WARRANTIES

- A. This Contractor shall warrant all workmanship, equipment and material entering into this contract for a period of one year of date of final acceptance or date of beneficial use, as agreed to between Contractor and Architect. Any materials or equipment proving to be defective during this warranty period shall be made good by this Contractor without expense to the Owner.
- B. This provision is intended specifically to cover deficiencies in contract completion or performance which are discovered after systems are placed in operation. Also included shall be supplementary assistance in balancing, adjusting or providing operating instructions as the need develops, and replacing overload heater elements in starters where necessary to keep systems in operation. Heater element sizes shall not exceed the motor manufacturer's recommendations.
- C. This provision shall not be construed to include maintenance items such as replacing filters, and cleaning strainers after these have been done for final close-out.
- D. Provisions of this warranty shall be considered supplementary to warranty provisions under General Conditions.

#### 1.23 PROJECT CLOSEOUT

- A. Refer to Section 017700 Closeout Procedures.

#### 1.24 OPERATIONS AND ADJUSTMENT OF EQUIPMENT

- A. As each piping system is put into operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing the domestic hot water return system,
- B. Caution: Verify that all bearings are lubricated, all motors are operating in the right direction, and correct overload heater elements are provided on all motors. Do not depend wholly on the electrician's judgment in these matters. Follow specific instructions in regard to lubrication. Do not oil or grease pre-sealed ball bearings unless upon manufacturer's specific instructions.
- C. Test relief valves, air vents and regulating valves to ensure proper operation.

#### 1.25 OPERATING DEMONSTRATION AND INSTRUCTIONS

- A. Refer to Section 017900 Demonstration and Training as well as individual Division 22 Sections for requirements.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION– NOT APPLICABLE

END OF SECTION 22 0001

## SECTION 22 0002 – PLUMBING WORK IN EXISTING BUILDINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements for Work in Existing Building
2. Inspection of Existing Building
3. Asbestos Material
4. Work Hours
5. Tobacco Products
6. Barriers and Signage
7. Storage of Tools and Materials
8. Protection of Existing Building and Equipment
9. Confined Spaces
10. Noise, Fumes and Dust Control
11. Soldering Welding and Cutting
12. Removals Disposal and Reuse
13. Draining, Flush and Refill of Piping Systems
14. Continuity of Systems
15. Cutting and Patching
16. Cleaning

#### 1.2 GENERAL REQUIREMENTS FOR WORK IN EXISTING BUILDING

- A. Refer to Article 1 Specification requirements and notes on the drawings where provided for requirements related to renovation work.
- B. Meet with the Owner and Architect before demolition or construction begins to establish procedures for work effort in the existing building. Provide names and phone numbers and establish emergency contact information where work is performed. Provide security information requested by the Owner for all personnel who will be working on site. Educate all construction personnel in regard to the project requirements and procedures.
- C. Coordinate effort with other contractors involved in the renovation project to minimize the disruption, phasing of work, share cleaning responsibilities, etc.

### 1.3 INSPECTION OF EXISTING BUILDING

- A. Each bidder shall inspect the project site and the existing building in the early time frame of the bidding period. Conditions shall be compared with information shown on the drawings. Report to the Architect/Engineer any significant discrepancies which may be discovered in a timely fashion so that direction may be provided in an addendum. After the contract is signed, no allowance will be made for failure to have made a thorough inspection.

### 1.4 ASBESTOS MATERIAL

- A. Abatement, removal or encapsulation of existing materials containing asbestos is not included in the Contract. Necessary work of this nature will be arranged by the Owner to be done outside of this construction and remodeling project by a company regularly engaged in asbestos abatement. Such work will be scheduled and performed in advance of work in the construction and remodeling project.
- B. If, in the performance of the mechanical work, materials are observed which are suspected to contain asbestos, the Contractor shall immediately inform the Architect / Engineer who in turn will notify the Owner. Work that would expose workers to the inhalation of asbestos particles shall be terminated. Work may be resumed only after a determination has been made and unsafe materials have been removed or encapsulated and the area declared safe.

### 1.5 WORK HOURS

- A. Work hours for construction shall be as defined in Section 01150- Project Phasing or other specification sections or drawing notes.
- B. Where allowed, contractors may work normal hours except after hours is required for operations that are noisy, generate obnoxious fumes or dust, require shut down of ventilation systems, etc. The Owner reserves the right to stop normal hour work where the Owner deems the effort to be disruptive to their ongoing operations.
- C. Any work that creates hazards in or requires closure of corridors, exit pathways or stairwells work in corridors must be performed after hours when the building is not occupied.
- D. All occupied areas, corridors, exit pathways, and stairwells must be left clean, lighted (including emergency egress and exit signage) usable, and safe at the end of each work shift.
- E. Access to the work area shall be coordinated with the Owner; follow all security protocols for parking, sign in, key control, etc. established by the Owner.

1.6 TOBACCO PRODUCTS

- A. Smoking or chewing tobacco products are expressly prohibited to be used within the building and on the premises except where specifically permitted by the Owner or in construction company trailers or vehicles where permitted by the construction company.

PART 2 - PRODUCTS- NOT APPLICABLE

PART 3 - EXECUTION

3.1 BARRIERS AND SIGNAGE

- A. Barriers and signage shall be provided as appropriate to identify work areas and to prevent unauthorized entry by non-construction personnel. Refer to appropriate Division 1 specification requirements and notes on the drawings where provided.
- B. All barriers and signs should be high visibility type and be maintained at all times.

3.2 STORAGE OF TOOLS AND MATERIALS

- A. Store all site material and tools in the active job site area, specific storage areas are not provided except where otherwise noted for material and tools. The contractor is responsible for security.
- B. Storage is specifically prohibited in means of egress paths and stairwells.

3.3 PROTECTION OF EXISTING BUILDING AND EQUIPMENT

- A. The Owners' property and the property of other contractors shall be respected at all times. Provide drop clothes, visqueen or other suitable barriers where dust and debris is generated. Tape ends of barriers for sealing purposes.
- B. Provide 55 gallon drums or smaller buckets as appropriate and use funnels where draining liquid systems.
- C. Provide plywood sheets for protection of walls, floors or Owner equipment or systems that are remaining in place near demolition or new installation work where there is possible damage from heavy material or equipment.



### 3.4 CONFINED SPACES

- A. Notify the Owner when performing work in confined spaces. Provide a written procedure for approval and obtain approval from the Owner when so requested.
- B. All work in confined spaces shall be done in accordance with OSHA regulations.

### 3.5 NOISE, FUME, AND DUST CONTROL

- A. Provide barriers and ventilation as required to limit the effect from construction generated noise fume and dust control on spaces that continue to be occupied by the Owner. Refer to protection of building and equipment paragraph above. In addition to the basic protection, provide additional visqueen barriers to limit airborne migration of dust and fumes. Provide supplemental portable fans to exhaust air to the outside of the building where appropriate. Use of the Owners' ventilation systems to induce positive or negative pressure is prohibited unless authorized by the Owner. Shut off ventilation systems serving the area where use of these systems can induce fumes or dust into return or exhaust ducts. Where systems need to remain operational for occupied areas, arrange to temporarily shutoff portions of the system in the work area. Provide taped visqueen covers on HVAC air supply and exhaust devices to limit migration. Coordinate all efforts requiring modification or shutdown of ventilation systems with the Owner. Contractor shut down of these systems is prohibited without Owner permission.
- B. Arrange with the Owner when required to shutoff fire alarm or smoke detectors to perform work. With the Owners' prior approval. Cover smoke detectors where needed to prevent false alarms due to work generated dust or fumes. Minimize outages and coordinate efforts to limit the effect due to false alarms.
- C. Where significant dust or fume generating work, welding or cutting operations are required for removal or new work, provide fume removal equipment with telescoping arms to locally capture the fumes. Fume exhaust shall be directed outside or adequately filtered and recirculated.
- D. Areas shall be thoroughly ventilated after completion of the work on a daily basis to remove residual odors and fumes before occupancy occurs the next day.
- E. Provide vacuum cleaners and other equipment to clean and restore conditions.

### 3.6 SOLDERING WELDING AND CUTTING

- A. For soldering, welding or cutting operations, provide insulated, fire rated barriers and blankets to isolate cover and protect remaining systems and materials, furniture, furnishings, floors, walls, ceilings, etc.
- B. Refer to noise, fume and dust control provisions in the previous paragraph.

- C. Obtain burn approval from the Owner before commencing any soldering or welding effort. Coordinate outages of fire alarm systems as noted in the previous paragraph.
- D. Provide a Fire Watch at each welding location. Fire Watch personnel shall be dedicated for the sole purpose of fire prevention during welding operations. All Fire Watch personnel shall be properly trained and equipped, including fire extinguisher, fire blanket and communication equipment for assistance request.
- E. Provide a fire extinguisher at every soldering or welding location.

### 3.7 REMOVALS, DISPOSAL, AND REUSE

- A. Refer to the drawings for the scope of remodeling in the existing building.
- B. Cooperate with the General Contractor regarding all removal and remodeling work. Each Contractor shall remove existing work which is associated with his trade and which will be superfluous when the new work is installed and made operational.
- C. Extraneous piping which is or becomes accessible shall be removed and stubs shall be capped at the first active pipe encountered. Piping that is and remains inaccessible shall be abandoned. Ends of abandoned pipe shall be capped so as to be concealed by finished surfaces. Upon completion of the work no abandoned duct. Pipe, valve or stub shall extend thru finished floors, walls or ceilings.
- D. When it is necessary to reroute a section of active piping the rerouted section shall be installed before removing the existing in order to minimize system down time. Rerouted sections shall be insulated as required for new work. Patch insulation on existing piping which has been damaged or removed in this work.
- E. Where existing piping is removed and holes are left in existing walls, finished ceilings, floors, etc., these holes shall be patched using materials to match the existing construction to restore and maintain the integrity of the existing partition.
- F. Materials and equipment which are removed shall not be reused within the scope of this project unless specifically noted to be relocated or reused. Turn over to the Owner and place where directed on the premises all removed material and equipment so designated by the Owner. All material and equipment which the Owner does not wish to retain shall become the property of the Contractor responsible for removal and shall be removed from the premises and properly disposed.
- G. Disposal of materials regulated by EPA shall be done in strict accordance with latest requirements. Provide documentation to the Owner that disposal was properly executed.
- H. Remove, store and reinstall lay-in ceiling tile and grid as needed to perform work in areas where such removal and re-installation is not to be done by the General Contractor. Damaged tile and/or grid shall be replaced with new matching tile and/or grid.

- I. In areas of minor work where the space is not completely vacated, temporarily move portable equipment and furnishings within the space as required to complete the work. Coordinate this activity with Owner. Protect the Owner's property by providing dust covers and temporary plastic film barriers to contain dust. Remove barriers and return equipment and furniture upon completion of the work.
- J. Refinish any surface disturbed under this work match existing, except where refinishing of that surface is included under the General Contract.

### 3.8 DRAINING, FLUSHING, AND REFILL OF PIPING SYSTEMS

- A. Existing liquid systems shall be drained as required before removal or connection of new piping extensions.
- B. Draining of the system shall be the responsibility of the contractor. Provide threaded connections, etc. to direct fluids to drainage points. Water systems may be drained to sanitary systems or where permitted, to storm systems. Verify any chemical treatment, inhibitors or freeze protection additives in the existing systems and obtain a permit from the local sewer authority before disposing.
- C. Provide drums or containers to accept other than water drainage and remove from the premises and properly dispose. Provide visqueen to protect Owners' property when opening pipes, even where piping has been drained to prevent damage from residual liquid that remains in the pipe.
- D. After new piping is connected and tested, flush clean and disinfect all existing piping that has been drained and new piping as specified in Section 22001, Basic Plumbing Requirements. Provide full port, 0.75" ball valves with hose connectors as described to facilitate flushing operations.

### 3.9 CONTINUITY OF SYSTEMS

- A. Work shall be so planned and executed as to provide reasonably continuous services of existing systems throughout the construction period. Where necessary to disrupt services for short periods of time for connection, alteration or switch-over, the Owner shall be notified in advance and outages scheduled at the Owner's reasonable convenience.
- B. Submit, on request, a written step-by-step sequence of operations proposed to accomplish the work. The outline must include tentative dates, times of day for disruption, downtime and restoration services. Submit the outline sufficiently in advance of the proposed work to allow the Architect or Engineer to review the information with the Owner. Upon approval, final planning and the work shall be done in close coordination with the Owner.
- C. Shutdown of systems and work undertaken during shutdown shall be bid as being done outside of normal working hours.

### 3.10 CUTTING AND PATCHING

- A. Refer to Division 1 – General Requirements for information regarding cutting and patching.
- B. Plan the work well ahead of the general construction. Where pipes are to pass thru new walls, partitions, floors, roof or ceilings, place sleeves in these elements or arrange with the General Contractor to provide openings where sleeves are not practical. Where sleeves or openings have not been installed, cut holes and patch as required for the installation of this work, or pay other trades for doing this work when so directed by the Architect. Any damage caused to the building shall be repaired or rectified.
- C. Where pipes are to pass through, above, or behind existing walls, partitions, floors, roof or ceiling, cutting, patching and refinishing of same shall be included in this contract. Core drilling and saw cutting shall be utilized.
- D. All material, methods and procedures used in patching and refinishing shall be in accordance with applicable provisions of specifications governing the various trades. The final appearance and integrity of the patched and refinished areas must meet the approval of the Architect. Wall, floor and ceiling refinishing must extend to logical termination lines (entire ceiling of the room repainted, for instance), if an acceptable appearance cannot be attained by finishing a partial area.
- E. Provide steel angle or channel lintels to span openings which are cut in existing jointed masonry wall where the opening span exceeds 16 inches. Provide framing around roof openings for required support of the roof deck.

### 3.11 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the Owner is continuing to occupy or use; any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.
- B. The Owner's dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.
- C. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain. The contractor shall also clean duct interiors and interior components of new or existing air handling system equipment if dirt, dust or debris have generated in the course of work have accumulated on these surfaces.

END OF SECTION 22 0002

Warren County Career Center  
Medical Academy Addition  
263306.00

Bid / Permit Documents  
9/15/2026

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## SECTION 22 0004 – FIRESTOPPING FOR PLUMBING SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes through-penetration firestopping systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Firestopping assemblies shall be tested and rated in accordance with ASTM E814 (ANSI/UL 1479) Fire Tests of Through-Penetration Fire Stops (minimum positive pressure of .01 inches of water column) and E119 (ANSI/UL 263) Fire Tests of Building Construction and Materials Time-Temperature Curve. Firestopping shall provide an “F” fire rating equal to that of the construction being penetrated. Firestop systems shall meet all requirements of the Ohio Building Code.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
  - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view or above ceilings in air return plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

#### 1.3 SUBMITTALS

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

- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Firestopping materials shall be manufactured and/or supplied by:
  - 1. Hilti, Inc.
  - 2. Specified Technologies Inc.
  - 3. 3M; Fire Protection Products Division.

### 2.2 FIRESTOPPING

- A. Materials shall be in the form of caulk, putty, sealant, intumescent material, wrap strip, fire blocking, ceramic wool and other materials required for the UL listed assemblies. These shall be installed in conjunction with sleeves and materials for fill and damming.

## PART 3 - EXECUTION

### 3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Installation of all materials and assemblies shall be in accordance with UL assembly drawings and the manufacturer's instructions.
- B. Installation shall be done by an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary training and experience.
- C. Provide firestop system for every pipe at penetration of all fire resistance rated walls and horizontal assemblies.
- D. Coordinate opening size and additional framing requirements with the General Contractor for each opening to meet the firestop installation requirements.
- E. Annular space of penetrations of non-fire-resistant-rated floor, floor/ceiling assemblies, or the ceiling membrane of a non-fire-resistant rated roof/ceiling assembly shall be filled with an approved firestopping material to resist the free passage of flame and products of combustion.
- F. Smoke Barriers:
  - 1. Penetrations shall be sealed with a firestopping system to prevent the passage of smoke.

G. Smoke Partitions:

1. Penetrations shall be sealed with a caulking material to prevent the passage of smoke.  
Non-rated smoke partitions do not require a fire stopping system.

3.2 BUILDING STRUCTURE FIRE STOPPING

- A. Where building structural members have a fire stopping system installed and portions of this fire stopping system are removed to install new systems hangers, the P.C. shall provide new fire stopping system onto portions of the building structure and hanger where fire stopping was removed. The fire stopping system shall be equal to the existing system and be 2-hour rated.
- 1.

END OF SECTION 22 0004



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## SECTION 22 0005 – EXCAVATION, BACKFILL AND SURFACE RESTORATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:

1. Excavating and backfilling for utility trenches.

#### 1.2 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

- E. Fill: Soil materials used to raise existing grades.

- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below topsoil materials.

- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

### 1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

### 1.4 GENERAL

- A. Excavate for all in-grade, under-floor piping, underground, exterior piping, and incidental work which are included in the Plumbing contract. Backfill to finish grade or to levels consistent with the General Contractor's and Site Contractor's activities. Cut existing street, drive and parking lot paving, walks, curbs and other permanent hard surfaces which are to be encountered. Repair or restore exterior surfaces to original condition where such are not affected by Division 2 – Site Work. Cut existing floor slabs and replace slabs in conformance to 22 0002.
- B. Excavation and trench wall supporting, cribbing, sloping and stepping of excavations required for safety shall be done in accordance with OSHA and local requirements. Pumping of water from excavations and trenches which may be required during construction shall be included in this contract.
- C. Contact the Ohio Utilities Protection Service (1-800-362-2764) well in advance of the start of any excavation to determine if any of the utility companies or departments have underground utilities in or near the project area.
- D. Contact local water and sewer departments, gas company, electric company, telephone company, etc., regarding the possibility of encountering existing utilities. The integrity of all existing utilities shall be respected.
- E. Existing utilities encountered during excavation work shall be protected in a manner acceptable to the utility owner. Any utilities that are damaged shall be repaired or replaced by the Contractor to the full satisfaction of the utility owner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Bedding Course: Naturally or artificially graded natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

### PART 3 - EXECUTION

#### 3.1 EXCAVATION FOR UTILITY TRENCHES

- A. Trenches for interior and exterior piping shall be over-excavated and the pipe shall be laid on 6" minimum depth sand bed.
- B. Backfilling of excavations and trenches inside the building and outside under paved or other hard surfaced areas, shall be with graded pea gravel, graded coarse sand or compacted, crushed limestone, 3/4" maximum size, to prevent undue settlement. Backfill material for plastic piping shall be pea gravel or sand. Other excavations and trenches shall be backfilled with similar materials up to 18" above the top of the piping. The remainder shall be with similar materials or with excavated material having no large clods, stones or rocks.
- C. Maintain in place adequate barricades, guards, planking, plating signage, warning lights, etc., at and around excavations.
- D. Backfill shall be mechanically compacted in layers not over 6" deep. Water settling will not be permitted. Where excavations have not been properly filled or where settlement occurs, they shall be refilled, compacted, smoothed off, and finally made to conform to the initial requirements. Excess excavated materials shall be removed from the site or disposed of as directed by the General Contractor. Refer to Division 31 Earthwork for compaction requirements.
- E. Concrete floor slabs, paving, sidewalks, curbs sodded and other finished surfaces which have been damaged or removed in order to install the underground work shall be replaced but this Contractor equal to original conditions. **Refer to Division 32 for Surface Restoration requirements.** This requirement is not applicable in areas where the General Contractor or the Site Contractor is obligated to provide new surfaces.
- F. Excavation, backfill, surface repair and traffic control within the public right-of-way shall be in accordance with governing agency rules and regulations. Any fee for activity in the roadways shall be included in this contract so that no additional cost will accrue to the Owner.
- G. All exterior underground piping shall be protected against future excavation damage by placing a plastic tape warning marker in each trench during backfill. Tape shall be 6' wide with black letters identifying the piping service. Tape shall be equal to that manufactured by Seton. Install tape full length of the trench approximately 18' above and on the centerline of the pipe.

END OF SECTION 22 0005

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## SECTION 22 0519 - METERS AND GAUGES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Thermometers.
  - 2. Gauges.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 THERMOMETERS

- A. Thermometers shall be 5" diameter dial face bi—metallic type with adjustable angle hinge, stainless steel insertion stem and recalibration feature, equal to Terice B85604.
- B. Provide a separable socket insertion thermowell shall be furnished with each thermometer. An extension neck, with appropriate increase in thermometer stem length, shall also be furnished where insulation thickness exceeds 2".
- C. Ranges of thermometers shall be selected from standard Fahrenheit scales to be consistent with anticipated temperatures, typically 0 deg.F.- 160 deg.F.

#### 2.2 PRESSURE GAUGES

- A. Pressure gauges, including compound gauges and vacuum gauges, shall be Bourdon tube type with 4-1/2" dial and cast aluminum case, equal to Terice 600C Series. Accuracy shall be 1% at mid-range.
- B. Pressure gauges for low pressure application, calibrated in inches of water gauge, ounces per sq. in. or 0-5 psi, as appropriate, shall be equal to Terice 860.
- C. Pressure gauges at pumps shall be liquid filled Bourdon tube type with 4" dial and stainless steel case and internals, equal to Terice 700 Series.

- D. A brass cock or bronze ball valve and a pressure snubber shall be furnished with each pressure gauge.
- E. Ranges of pressure gauges shall be selected to be consistent with anticipated pressures. Range shall be approximately twice the normal system working pressure at the gauge location.

## 2.3 TEST PLUGS

- A. Pressure-temperature test plugs for insertion of pressure gauge or thermometer shall be a brass fitting with neoprene or Nordel self-sealing insert and knurled brass cap with plastic capture tab. Fittings shall be equal to Peterson "PT". Furnish two thermometers and two pressure gauges with integral insertion stem appropriate for use with the test plugs.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Thermometers shall be installed where shown on the drawings and also at:
- B. Pressure gauges shall be installed where shown on the drawings, where required by applicable codes and also at:
- C. Thermometers and gauges shall be positioned to be read with unobstructed view from the floor. Pressure-temperature test plugs shall be installed where shown, located in a position to be most readable.
- D. Install thermometer wells in piping tees in the vertical position. Fill the well with oil or graphite and secure the thermometer in position

END OF SECTION 22 0519

## SECTION 22 0523 – GENERAL DUTY VALVES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Valves
- B. Related Sections:
  - 1. Division 22 Plumbing piping Sections for specialty valves applicable to those Sections only. Section 22 0553 "Identification for Plumbing Systems" for valve tags and schedules.
  - 2. Valves for natural gas are specified in the system specification. See appropriate Division 22 specifications.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. These shall be **labeled and identified** same as on the Contract Documents.

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- C. Press-Fit and sweat end valves of equal construction and features are acceptable in lieu of those specified with screwed ends. Grooved pipe fittings are not acceptable.
- D. Ball valves in piping which is to be insulated shall have extended shaft necks to accommodate the insulation.
- E. All valve for Domestic potable water systems (cold, hot hot return, etc.) shall be “lead free” in accordance with the Federal Safe Water Act (S3874) definition and NSF/ANSI-61 approved.
- F. Working pressures shall exceed those imposed by the service applied.



## PART 2 - PRODUCTS

2.1 Refer to valve schedule on the Drawings for piping material and applications.

### 2.2 MANUFACTURERS

A. Valves shall be as specified above, or of equal construction manufactured by:

1. Apollo
2. Crane/Stockham
3. Watts
4. Flowserve
5. Bell & Gossett
6. Griswold
7. Flow Design
8. Nibco
9. Milwaukee
10. Conbraco
11. Armstrong
12. Stockham

2.3 Piping Systems with mechanical joints shall be provided with valves with the same fitting type, i.e., valves with pro-press ends shall be provided in piping systems with pro-press joints.

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

- A. Drain valves shall be the same as for the shut-off service. Provide a 3/4" hose thread adapter on the outlet of each drain valve that is not piped to a drainage point. Hose thread adapters on drain valves of potable water piping shall be fitted with a non-removable vacuum breaker.
- B. Internals shall be removed and the remaining elements of sweat end valves shall be protected against heat damage during soldering or brazing
- C. Valves shall be installed with the stem at or above the centerline of the pipe. Valves shall be located to be accessible for operation, servicing and/or removal.
- D. Packing glands shall be tightened before placing the valves in service.
- E. Valves which are insulation shall have extended shafts.

END OF SECTION 22 0523

## SECTION 22 0529 – PIPE HANGERS, SUPPORTS, AND PENETRATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Steel Pipe Hangers
  - 2. Trapeze Pipe Hangers
  - 3. Hanger Rods and Attachments
  - 4. Pipe Riser Supports
  - 5. Roof Supports
  - 6. Pipe Sleeves, Openings, Penetrations, Escutcheons, and Curb
- B. Related Sections
  - 1. 22 0004 Fire Stopping for Plumbing Systems

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal hanger shield inserts.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 STEEL PIPE HANGERS

- A. Hangers and supports for piping shall be equal to the Anvil catalog numbers as follows:
1. General Service – Clevis type - Fig. 260.
  2. Uninsulated Copper Tubing – Copper plated clevis type - Fig. CT-65 (or plastic-coated clevis, or fiberglass construction).
  3. Where the length of the hanger rod between the top of the hanger and the attachment is 3" or less, clevis type hangers with rollers, Fig. 181, shall be used to allow for expansion travel.
- B. Hangers on insulated horizontal piping shall be oversized to surround the pipe insulation. To protect the insulation from damage or inordinate compression due to concentrated weight, the following shall be provided at each hanger:
1. Pipe 2" and smaller – Anvil Fig. 168 18 ga. sheet metal rib-lock shield with belled ends, 12" long.
  2. Pipe 2-1/2" and larger – Factory fabricated assembly equal to Pipe Shields, Inc. A1000.

### 2.2 TRAPEZE PIPE HANGERS

- A. Trapeze hangers for numerous pipes run in parallel may be utilized. Horizontal support members shall be Unistrut type section with pipe rollers (to allow for expansion travel) and spring and nut connectors, suspended with hanger rods and attachments similar to individual pipe hanger suspension.

### 2.3 HANGER RODS AND ATTACHMENTS

- A. Hanger rods shall be solid steel, threaded end or all-thread rod, of diameter listed below or matching manufacturer's provisions. A hanger attachment device (for attachment to the structure) and locking nuts at the hanger attachment shall be provided on each hanger. Locking nuts shall be provided at each clevis hanger.

| <u>Pipe Size</u> | <u>Min. Rod Dia.</u> |
|------------------|----------------------|
| 1" and smaller   | 1/4"                 |
| 1-1/4" to 3"     | 3/8"                 |
| 4" to 6"         | 1/2"                 |
| 8"               | 5/8"                 |
| 10"              | 3/4"                 |
| 12" and larger   | 7/8"                 |

B. Construction Type – Hanger rod attachment devices for attachment to the structure shall be:

1. Steel Construction – Beam clamps for steel construction equal to Anvil Fig. 92, 93, or 94. Utilize swivel type in sloped steel construction to provide vertical support of pipe without bending hanger rods.

2.4 PIPE RISER SUPPORTS

A. Riser clamps on cold service insulated piping shall be:

1. Insulated Pipe size 1-1/2" and smaller shall be factory (Pipe Shields E1000) or shop fabricated assembly Fig. 261 with high density calcium silicate insulation and galvanized steel jacket.
2. Insulated Pipe size 2" and greater shall be factory fabricated assembly Pipe Shields, Inc. E1000 or approved equal.
3. Un-insulated copper tubing – Anvil Fig CT-121 or CT-121C
4. Un-insulated steel piping – Anvil Fig. 261.

2.5 ROOF SUPPORTS

- A. Roof Pipe Support, Non-Anchored – Pipe supports for pipe running across the roof shall be manufactured by Nvent Caddy Pyramid RL series or approved equal, requiring no penetration of the roofing membrane. The support system shall consist of round injection molded polypropylene bases, 12-gauge hot dipped galvanized Unistrut framing and adjustable hot dipped galvanized or cadmium plated hangers and cadmium plated hanger rods as detailed. Furnish protective slip sheets of roofing membrane for installation under the bases.

2.6 PIPE SLEEVES, OPENINGS, PENETRATIONS, ESCUTCHEONS AND CURBS

A. Piping Wall and Floor Sleeves – Non-Fire Rated Assemblies:

1. New Piping – New or Existing Walls and Floors
  - a. Poured Concrete - Schedule 40 black steel pipe or 18-gauge galvanized steel
  - b. Assemblies other than poured concrete – Schedule 40 black steel pipe or 26-gauge galvanized sheet.
2. Existing Piping – New Walls and Floors
  - a. Poured Concrete Floors – 18-gauge Galvanized sheet metal
  - b. New walls and partitions – 26-gauge Galvanized sheet metal

B. Piping Wall and Floor Sleeves – Rated Assemblies

1. Refer to specification 22 0004 for requirements.

C. Exterior, Concrete Walls Below Grade

1. New Construction Penetrations – Cast iron pipe or Schedule 40 galvanized steel pipe in exterior walls below grade, with intermediate wall stop and anchor collar set in place before concrete pouring. Sleeves shall be a part of the sealing assembly.
2. Existing Construction, Core Drilled Penetrations – When the wall opening is core-drilled, the wall sleeve may be omitted. A mechanically compressed rubber sealing assembly equal to Thunderline Corp. “Link-Seal” shall be placed in the annular space between pipe and sleeve or core drilling.

D. Roof Deck Penetrations

1. Waterproof Floor/Roof Membrane Sleeve – Provide sleeve J.R. Smith 1720, or equal, riser sleeve with clamping ring and auxiliary pipe sleeve extending 4” above finished floor or 8” above finished roof. Waterproofing membrane for roof and floor construction shall be secured by the flashing clamping ring. These are to be used in areas having special membrane waterproofing in or on the floor slab and at roof decks.
2. Concrete Curbs – Concrete curbs may be formed and poured around multiple pipe risers in rooms with waterproofing floor membrane, in lieu of the Smith 1720 riser sleeve and clamping ring. Curbs shall be 4” wide x 4” high with chamfered corners. Membrane and curbing shall be arranged to maintain the integrity of the membrane. Pipe sleeves shall be as described for normal areas or extended to the top level of the curb where the concrete is full depth throughout the curbed area.
3. Roof Penetrations – Piping and conduits extending through the roof may be fitted with a manufactured pipe curb weatherproofing assembly equal to Sigrist Pipe Chase Housing or approved equal as an alternative to riser sleeves with clamping rings specified above. Provide 14” roof curb and all required piping exit seals.

E. Escutcheon Plates

1. Construction – Escutcheon plates shall be split-ring chromium plated pressed steel. Plates shall be sized to cover the surface penetration and sleeve.
2. Locations – Plates shall be installed on exposed piping in finished rooms and areas where pipes penetrate walls, floors, ceilings or overhead structure.

F. Grout

1. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - a. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - b. Design Mix: 5000-psi, 28-day compressive strength.
  - c. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hanger Spacing – Spacing of hangers shall be as follows:

1. Steel pipe - Vertical:
  - a. At the base and 15 ft. maximum spacing unless otherwise shown.

2. Steel pipe - Horizontal:
    - a. 2" size and smaller – 8 ft. intervals
    - b. 2-1/2" thru 6" – 10 ft. intervals
    - c. 8" and larger – 12 ft. intervals.
  3. Cast iron pipe - Vertical
    - a. At the base and 15 ft. maximum spacing unless otherwise shown.
  4. Cast iron pipe – Horizontal
    - a. At 10 ft. intervals.
    - b. Support each length of pipe not more than 18" from the joint.
    - c. Support terminal ends of horizontal runs and branches and each change in direction.
    - d. 5" and larger provide bracing to prevent horizontal movement in accordance with CISPI "Soil Pipe and Fittings Handbook"
  5. Copper Tubing - Vertical
    - a. At the base and 10 ft. maximum spacing unless otherwise shown.
  6. Copper Tubing – Horizontal
    - a. 1-1/4" size and smaller – 6 ft. intervals
    - b. 1-1/2" thru 2" – 8 ft. intervals
    - c. 2-1/2" and larger – 10 ft. intervals
- B. Installation Details – Refer to hanger installation details on drawings for installation information supplemental to this specification section.
- C. Mechanical Joint Piping System Supports – In piping systems with mechanical joint couplings, pipe hangers shall be provided on horizontal piping at normal specified intervals and, in addition, so that no pipe shall be left unsupported between any two couplings nor left unsupported whenever a change in direction takes place. Vertical piping shall be supported at normal specified intervals or every other pipe length, whichever is more frequent. The base of the riser or base fitting shall be supported.
- D. Structural Attachments – Attachment of pipe hangers to the following structure types:
1. Steel Beam Construction – Provide anchoring where steel beam clamps are attached to sloping surfaces of beam flanges and where otherwise required to insure permanent attachment.
  2. Trapeze Supports – Unistrut channels with spring and nut rod connection may be utilized where several pipes are run in parallel. Channel shall be attached to the structure with inserts or clamps.
  3. Steel Decks – Attachment to steel deck is prohibited. Span from steel structural members with supplementary steel shapes where direct attachment to structural members is not practical. This does not apply to steel deck with concrete slab poured deck. Refer to 1 and 2 above.
  4. Manufactured Truss Attachment – Attachment to manufactured trusses and other engineered structural members and supports shall be done in strict accordance with the structural manufacturer's recommendations. Refer to the architectural and structural drawings for types of engineered structural systems being used. Connections to these structural members shall be made with connection devices and methods approved by the

structural manufacturer. Provide additional support with supplemental steel shapes when pipe spacing between structural members exceeds specified distances.

- E. Adjustment –
  - 1. Hanger Adjustment – Pipe hangers shall be adjusted to proper elevation and all hanger rods set in a vertical position before pipe insulation is installed.
  - 2. Pipe Riser Clamps – Extended legs of pipe riser clamps shall be shortened as needed to maintain concealment of the clamp within the pipe chase. Ensure that adequate support is still maintained.
- F. Painting – Hanger assemblies which will remain exposed to public view upon completion of the project shall be painted prior to pipe installation.
- G. Pipe Roof Supports –
  - 1. Non-Anchored Type – Pipe supports manufactured by Advanced Support Products for pipe running across the roof shall be installed in accordance with the manufacturer's instructions and as detailed. Install protective slip sheets of roofing membrane under the bases to satisfy requirements of both the roofing manufacturer and the support system manufacturer.
  - 2. Roof Curb Type – Pipe supports manufactured by Pate or the approved equal shall be installed per the manufacturer's instructions and anchored and flashed into place by a certified roofing contractor.

### 3.2 PIPE SLEEVES

- A. General – Pipe sleeves, floor and wall openings, water protective curbing and escutcheon plates shall be provided as described below. Pipe sleeves shall be placed in all above grade floor slabs, poured concrete roof decks, walls and partitions, except as noted below, to allow new piping to pass through and allow for expansion, contraction and normal movement of the pipe. Sleeves are also required for all existing piping related to the various trades in new walls, partitions, floors and roof slabs, same as for new piping.
- B. Sleeve Coordination – Pipe sleeves shall be placed in the initial stages of construction before concrete, masonry and other general construction activity. Means shall be taken to ensure that the sleeve will not move during or after construction. Beams, columns and other structural members shall not be sleeved except upon approval of the Architect and/or Structural Engineer.
- C. Sleeve Exceptions – Pipe sleeves are not required in the following instances:
  - 1. In floor slabs on grade.
  - 2. In stud and gypsum board or plaster walls and partitions which are not fire rated.
  - 3. For uninsulated pipe passing through masonry walls and partitions and stud and gypsum board or plaster walls and partitions not anticipated to be subject to thermal expansion, such as compressed air, medical gas or natural gas piping.
  - 4. In core drilled openings in solid concrete not requiring water protection. Sleeves are required, however, at core drilling through hollow pre-cast slabs and concrete block walls, to facilitate containment of required firestopping material.

- D. Sleeve Sizing – Length of wall sleeves shall be such that the sleeve ends are substantially flush with both sides of the wall or partition. Floor sleeves shall be flush with the bottom and top of the floor slab except, in mechanical rooms and other areas which might have water on the floor, sleeves shall project a minimum of 1” above finished floor. Pipe sleeves shall be sized to allow insulation to pass through the sleeve, for insulation requiring continuous vapor barrier (domestic cold water, chilled water refrigerant, etc.). Where vapor barrier continuity is not needed, the sleeve may be sized to pass the pipe only or the insulation as well. Refer to the following paragraph for qualification and exceptions relating to firestopping.
- E. Fire-Rated and Non-Rated Assemblies –
  - 1. Pipe sleeves which are part of firestopping assemblies shall conform to the requirements of the assembly with particular emphasis regarding size, annular space, length, passage or non-passage of insulation and the installation of the sleeves.
  - 2. Where firestopping is not required per this section and specification 23 0004, the annular space between the sleeve, core drilling or opening and the pipe or pipe insulation shall be closed with caulking to retard the passage of smoke.
  - 3. Where uninsulated pipes requiring no pipe sleeves pass through non-fire wall or partition, the annular space shall be closed with material and methods compatible with the wall or partition material (Type M masonry grout, drywall joint compound, plaster, etc.).

### 3.3 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 22 0529



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## SECTION 22 0530- EQUIPMENT BASES AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:

1. Equipment Bases

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE BASES

- A. Concrete bases and pads with anchor bolts cast-in-place. Bases shall be formed on all sides and hand troweled to a smooth, dense finish with neatly chamfered corners. Large concrete pads on grade shall be constructed with reinforcing steel or reinforcing roadway mesh.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Concrete bases for plumbing equipment are included in the Plumbing Contract. The Plumbing Contractor shall provide exact dimensions, locations and other details for the specific equipment provided. The Plumbing Contractor shall set anchor bolts as required for the equipment.

END OF SECTION 22 0530

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## SECTION 22 0553 - IDENTIFICATION FOR PLUMBING SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipe labels.
2. Warning markers.
3. Valve tags.

#### 1.2 SUBMITTAL

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

#### 1.3 QUALITY ASSURANCE

A. Labels, tags and markers shall comply with ANSI A13.1 for lettering size, colors and length of color field.

### PART 2 - PRODUCTS

#### 2.1 PIPE LABELS

A. Pipe markings shall be applied to all piping.

B. Labeling shall be:

1. Snap-On Type – Plastic, semi-rigid snap-on type, manufacturer's standard pre-printed pipe markers or pressure-sensitive vinyl pipe markers.
2. Adhesive Type – Strip-type markers fastened to the bare pipe or insulation with laminated or bonded application or plastic tape not less than 1-1/2" wide. On piping and insulation 6" and greater diameter provide full band.
3. Lettering heights shall be as specified by manufacturer for indicated pipe/pipe plus insulation size.
4. Markers shall extend fully around pipe and insulation or full circle at both ends of the marker.
5. Markers shall be color coded for service.

6. Flow direction arrows provided integral with the pipe marker or separate at each marker.
7. Service pressure for compressed air and natural gas piping systems.
8. In areas where exposure to water or high humidity is anticipated, provide washdown, fade-resistant style labels.

## 2.2 WARNING MARKERS

- A. Underground line marker tape shall be permanent, bright-colored, plastic with continuous identification lettering. Tape over service lines that cannot be detected by a metal detector shall be multi-ply with an aluminum foil core.

## 2.3 VALVE TAGS

- A. Each shutoff valve, other than at equipment, shall be identified with a stamped tag. Valves and tagging shall be scheduled, typewritten on 8-1/2" x 11" paper, tabulating valve number, piping system, abbreviation, location of valve (room or area) and service (e.g. – south wing reheat boxes).
- B. Valve tags shall be polished brass or plastic laminate with solid brass S hook. Tags shall be engraved with "P" for Plumbing and the designated number.

## 2.4 ACCEPTABLE MANUFACTURERS

- A. Labels, markings and tags shall be manufactured by:
  1. W.H. Brady
  2. Seton
  3. Allen
  4. Industrial Safety Supply
  5. McMaster-Carr

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification marking and tagging shall be applied after insulation and painting has been completed.
- B. Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified, or scheduled on drawings.
- C. The Plumbing, Fire Suppression and HVAC Contractors shall coordinate labeling, marking and tagging to attain coordinated and consistent systems of identification.

- D. Pipe markers shall be placed at 25 ft. centers in mechanical rooms and concealed spaces and at 50 ft. centers in other exposed locations.
- E. Refer to appropriate sections of this specification for installation of underground line marker tape.
- F. Service pressure markings to be placed upstream and downstream of regulators at each pipe service label.
- G. Valve tags shall be placed on each valve except those intended for isolation of individual items of equipment. Valve tag schedules shall be prepared as specified above.

END OF SECTION 22 0553

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## SECTION 22 0719 - PIPE INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Insulation Materials:
  - a. Fiberglass.
  - b. Flexible Elastomeric.
2. Protective Jacketing

#### 1.2 SUBMITTALS

##### A. Product Data:

1. For each type of product indicated.
2. Thickness and covering table.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

- B. Thicknesses shall be in compliance with ASHRAE 90.1.

### PART 2 - PRODUCTS

#### 2.1 INSULATION GENERAL

- A. Refer to insulation schedule on the Drawings for piping material and applications.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be done by tradesmen specializing in insulation work in strict accordance with the manufacturer's recommendations.
- B. Overlap and seal all longitudinal joints. Staples and adhesive may be used as stated above. Tape and seal cross joints. Vapor barrier shall be continuous on insulation of all cold services. Vapor barrier type mastic shall be used where needed to maintain a vapor seal.
- C. Where insulation is terminated, insulation shall be beveled at 45 degrees and the beveled surface sealed with vapor barrier mastic. PVC caps over straight cut ends which have been vapor sealed may be used in lieu of beveling.
- D. Mechanical joint fittings and couplings shall be considered as a part of the pipe line and shall be insulated. Bidders on the insulation work are cautioned to verify during the bidding period the extent of this work.
- E. Insulation on cold service piping shall be run through floor and wall sleeves to maintain vapor barrier continuity. Insulation on other services may likewise be run continuous when sleeve size permits. Refer to Section 22 0529 for non-compressible insulation material and sheet metal saddles required at pipe hangers. Coordinate with the contractor on the furnishing, installation and detailed requirements of these. Provide insulation and vapor barrier on and around supports for pipe risers of services which require vapor seal so as to prevent sweating.
- F. Re-insulate piping where existing insulation has been damaged or removed in the performance of work in this project.
- G. Verify that piping has been tested before applying insulation materials and that piping surfaces are clean and dry, with foreign material removed.
- H. Fittings, valves, flanges and other devices, both exposed and concealed, requiring insulation shall be covered same thickness as pipe insulation with:
  - 1. Factory molded fitting insulation cover with PVC one-piece fitting cover.
  - 2. Miter-cut segments of pipe insulation, held in place with adhesive and/or wire, filled with insulating cement smoothed to shape and covered with PVC one-piece fitting cover.
  - 3. Fiberglass blanket insulation, held in place and covered with PVC one-piece fitting cover.
  - 4. Oversized pipe insulation, where applicable, finished same as straight run pipe insulation.
- I. Storm drainage insulation includes interior horizontal above ground piping including underside of roof drain sumps and outlet piping. Secondary (emergency) roof drainage system piping does not require insulation but roof drain sumps and the first 10 feet of piping shall be insulated.

- J. Underfloor direct buried domestic hot water and domestic hot water recirculating pipe and fittings shall be insulated with 1" flexible elastomeric insulation.

END OF SECTION 22 0719

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## SECTION 22 800 – PLUMBING COMMISSIONING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The Owner has contracted separately with a Commissioning Agent independent from the Architect, Engineer and Contractors. The Commissioning Agent shall be responsible solely to the Owner and shall act as an agent to the Owner in reviewing the quality of the project. The Commissioning Agent shall, through the Owner, have the authority to direct the Contractors to perform corrective work until final acceptance of the project by the Owner.
- B. The purpose of the commissioning is to verify that the building systems have been designed and installed to meet the Owner's requirements and operate per the design intent. Commissioning does not eliminate or reduce the contractor's responsibility to provide a complete and functional systems.
- C. The Plumbing contractor shall participate in the commissioning process and provide adequate personnel to do so.

#### 1.2 RELATED DOCUMENTS

- A. Section 01 9113 – General Commissioning Requirements

#### 1.3 PLUMBING SYSTEMS / EQUIPMENT INCLUDED IN THE COMMISSIONING PROCESS

- A. The following Plumbing Systems shall be commissioned.
  - 1. Water Heating
  - 2. Mixing Valve

### PART 2 - COMMISSIONING PLAN

#### 2.1 PRE-FUNCTIONAL TESTING / START UP

- A. The Commissioning Agent will provide pre-functional checklists. The installing contractor will complete the pre-functional checklist and the Manufacturer's start-up checklist for each piece of equipment prior to functional testing.
- B. Startup of major Plumbing equipment will be witnessed by the Commissioning Agent. The contractor shall provide a minimum of 72 hours' notice to the Commissioning Agent prior to equipment start up. The appropriate contractors and or manufacturer's representative will be required to be on site to perform start up.

## 2.2 FUNCTIONAL TESTING

- A. The Commissioning Agent will perform or witness the installing contractor or manufacturer's representative performing functional testing.

## 2.3 ISSUE LOG

- A. All deficiencies noted during the commissioning process will be documented in the master issues log.
- B. Contractors shall be responsible for correcting deficiencies and providing written responses to the Commissioning Agent listing the date and resolution. If a deficiency is not corrected the contractor shall provide an explanation as to why it was not corrected.
- C. Participation in the commissioning process is the contractor's responsibility. Unresolved issues or failure to provide responses to the Issue Log may be considered during the pay application approval process.
- D. The status of all items on the issue log will be updated and tracked by the Commissioning Agent.
- E. The Commissioning Agent will perform limited rechecks of items on the issues log after the contractor has provided written confirmation that corrections are complete. The cost of subsequent rechecks, if necessary, will be charged directly to the appropriate contractor at the hourly rate of the Commissioning Agent.

## 2.4 WARRANTY REVIEW

- A. The Commissioning Agent will return to the site approximately one month prior to the end of the warranty period to review outstanding issues and review system operation. The Commissioning Agent will assist the facility staff in developing reports and requests for services to remedy outstanding problems.

## PART 3 - EXECUTION

### 3.1 RESPONSIBILITY OF THE PLUMBING CONTRACTOR

- A. The contractor shall provide the Commissioning Agent assistance as necessary to gain access to the construction site for the purpose of verifying the installation of equipment and materials is performed in accordance with the contract documents. This shall include the use of keys, ladders, power lifts and other specialized equipment where needed.
- B. Assure participation of major equipment manufacturers in appropriate start up, training, and testing activities.
- C. Participate in commissioning meetings scheduled by the Commissioning Agent or the Construction Manager.

- D. Complete pre-functional checklists for review by the Commissioning Agent.
- E. Assist the Commissioning Agent as needed during the functional testing.
- F. Participate in seasonal testing as required.
- G. Provide owner training per the project specifications
- H. The contractor shall submit to the Commissioning Agent the following information for all facility equipment and materials. This information will be used to create the facility maintenance plan.
  - 1. Manufacturer
  - 2. Supplier
  - 3. Model
  - 4. Serial Number
  - 5. Replacement Cost
  - 6. Warranty Start Date
  - 7. Warranty Duration
  - 8. Belt Sizes and Quantities (if applicable)
  - 9. Filter Sizes and Quantities (if applicable)
- I. It is the responsibility of each contractor to complete all equipment setup, testing, calibration, loop tuning, and related functions prior to commissioning. The contractor shall complete all the required checklists and certify in writing that these tasks have been accomplished on the systems are ready for commissioning.

END OF SECTION 22 0800

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## SECTION 22 1116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Under-building slab and above ground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Unions and Flanges.
3. Dielectric Connectors.

B. Related Sections:

1. 22 0004 Fire Stopping for Plumbing Systems
2. 22 0523 General Duty Valves
3. 22 0529 Pipe Hangers, Supports, and Penetrations
4. 22 1119 Domestic Water Piping Specialties
5. 22 1123 Domestic Water Pumps

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product used. These shall be **labeled and identified** same as on the Contract Documents.

#### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Welders shall be qualified and fully certified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- F. Welding procedures and testing shall comply with ANSI Standard B31.1.0 Standard Code for Pressure Piping, Power piping and The American Welding Society Welding Handbook.



- G. All pressure piping systems regulated by the Ohio Pressure Piping Systems Code, Chapter 4101:8 shall conform to applicable requirements of the Code. Welders shall carry a current State of Ohio, Pressure Piping Board Certification. Each welder shall submit a copy of their signed performance qualification record to the Engineer for approval prior to beginning work on any pressure piping system.
- H. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIAL

- A. Refer to piping schedules on the Drawings for piping materials and applications.

### 2.2 UNIONS AND FLANGES

- A. Unions
  1. Unions on copper tubing, all bronze construction 150 lb., solder ends.
  2. Unions on steel pipe 2" and smaller, malleable iron with ground seat, bronze to steel, 300 lbs., screwed ends.
- B. Flanges
  1. Flanges on steel pipe with welded or screwed joints, 2-1/2" and larger.
  2. Gaskets shall be 1/16" thickness full face compressed sheet suitable for temperature and pressure ranges of the application.
  3. Mechanical joints associated with grooved end pipe are not acceptable in lieu of unions and flanges.

### 2.3 DIELECTRIC FITTINGS

- A. A dielectric connector shall be incorporated at each connection between ferrous and copper piping. Connectors shall be:
  1. Dielectric coupling with non-conductive polymer liner, Lochinvar Corp. "V-line" Dielectric fitting on services 180 degrees and less.
  2. Dielectric flange with non-metallic bolt hole grommets and gasket.
  3. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Pipe and tubing shall be cut and fabricated to field measurements and run parallel to normal building lines. Pipe ends shall be cut square and ends reamed to remove burrs. The pipe interior shall be cleaned of foreign matter before erection of the pipe.
- C. Piping shall be installed consistent with good piping practice and installed in concealed locations, unless otherwise indicated, and except in equipment rooms and service areas. Coordinate with other trades to attain a workmanlike installation.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Piping shall be pitched for drainage. The low points shall be fitted with a  $\frac{3}{4}$ " drain valve (with hose thread adapter if not piped to a floor drain) except that on piping 1-1/4" and smaller where a drain valve is not shown, a drain plug is acceptable. Hose thread adapters on drain valves of potable water piping shall be fitted with non-removable vacuum breaker.
- F. Piping shall be supported as specified in Section 22 0529 Pipe Hangers, Supports and Penetrations. Piping with mechanical joints for grooved end steel pipe shall be supported in accordance with the manufacturer's recommendations. Pipe alignment in both the horizontal and vertical must be tightly maintained. Misalignment must be corrected to the satisfaction of the Engineer before insulation is applied and the system accepted.
- G. Inform the Insulation sub-contractor during the bid period as to the extent of use of mechanical joints so that sub-contractor can price the work accurately.
- H. Internals of sweat end valves shall be removed when damage or warping could occur due to applied heat of soldering. Where silver brazing is specified, solder connection of valves shall be used to reduce the danger of damage. Close open ends of piping during installation to keep interior of the pipe clean.
- I. Install strainers as indicated on the drawings. Provide a nipple and ball valve in the blow down connection of each strainer 2" and larger.
- J. Close open ends of piping during installation to keep interior of pipe clean.
- K. Piping shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment, in accordance with N.E.C. Article 384.

- L. Unions and flanges shall be installed at pipe connections to fixtures and equipment and as required for erection purposed.
- M. Provide dielectric fitting between copper and ferrous piping.
- N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- O. Install piping to permit valve servicing.
- P. Install piping adjacent to equipment and specialties to permit servicing and maintenance.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install piping to allow application of insulation.
- T. Select system components with pressure rating equal to or greater than system operating pressure.
- U. Install escutcheons for penetrations of walls, ceilings, and floors.
- V. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- W. Annular space around piping through all wall penetrations shall be sealed off with a fire stopping system (rated walls) or permanent pliable caulking (non-rated walls).

### 3.2 FIELD QUALITY CONTROL

- A. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Domestic water piping – hydrostatic at 125 psig for 6 hours at the low point of the system. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

C. Domestic water piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 TESTING

- A. Piping shall be air tested at 125 psi for a minimum of 6 hours at the low point in the system before flushing.

3.4 PIPE CLEANING

- A. Before placing each water piping system in operation, the piping system shall be thoroughly flushed out with clean water.

3.5 DISINFECTION OF PIPING

- A. All new domestic water piping shall be disinfected by a company or personnel regularly engaged in the performance of this service.
- B. Disinfection shall be performed in accordance with AWWA C651- 86 Standards. Disinfection shall be means of a chlorine solution injected into the water system near the source. Outlets throughout the system shall be tested to prove presence of minimum chlorine concentration. Flush out the system with clean water until the residual chlorine content is not greater than .2 parts per million or until approved by the Health Department.
- C. Disinfection procedures shall be witnessed by the Architect, Engineer or other qualified representative.

3.6 DOMESTIC HOT WATER RETURN SYSTEM BALANCING

- A. The domestic hot water return shall be adjusted to provide proper operation or function in accordance with the drawings, specifications and manufacturer's recommendations.

END OF SECTION 22 1116

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Temperature-actuated water mixing valves.
3. Strainers.
4. Hose bibbs.
5. Wall hydrants.
6. Drain valves.
7. Water hammer arresters.

#### 1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. NSF Compliance:
  1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## PART 2 - PRODUCTS

### 2.1 VACUUM BREAKERS

#### A. Hose-Connection Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. FEBCO; SPX Valves & Controls.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated/Rough bronze.

### 2.2 TEMPERATURE-ACTUATED WATER MIXING VALVES

#### A. Digital Hot Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Caleffi Hydronic Solutions "Legiomix.
  - b. Armstrong International Inc.
  - c. Leonard Valve Company.
  - d. Powers; a Watts Industries Co.
2. Valve shall be digital of lead-free stainless steel/polymer construction.
3. Valve shall have all of the following operational capabilities:
  - a. +/- 2F water temperature control
  - b. 2F minimum inlet to outlet water temperature differential
  - c. Automatic shutoff of hot water flow upon cold water inlet supply failure.
  - d. Automatic shutoff of hot water flow in the event of a power failure
  - e. Programmable set point range of 81-158°F (27-70°C)
  - f. Programmable thermal disinfection mode
  - g. Programmable 1st level hi/lo temp alarm display
  - h. Programmable temperature error level for safety shutdown
4. Valve shall have all of the following connectivity capabilities:
  - a. SPCO relay outputs which are energized during operation.
  - b. LCD display which indicates: set point, delivered temperature, error codes and alarm conditions.
  - c. MODBUS 485 port for remote set point adjustment and remote operating temperature visibility.

- d. RS485 Serial Port for connection to a performance matched hot water monitoring system.
- e. BACnet protocol card.
- 5. Valve shall be compliant with ASSE Standard 1017 and CSA B125 and so certified and identified.
- 6. Valve shall be UL listed and identified.

B. Emergency Fixture Thermostatic Mixing Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Guardian Equipment.
  - b. Bradley Corporation
  - c. Lawler Manufacturing Company, Inc.
  - d. Leonard Valve Company.
  - e. Powers; a Watts Industries Co.
  - f. Symmons Industries, Inc.
- 2. Standard: ASSE 1071.
- 3. Pressure Rating: 125 psig.
- 4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Union inlets and outlet.
- 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, thermometer on outlet, temperature-control handle.
- 8. Tempered-Water Setting: 85 deg F .
- 9. Tempered-Water Design Flow Rate: 4gpm(eyewash).
- 10. Valve Finish: Rough bronze.
- 11. Piping Finish: Copper.

C. Point of Use Thermostatic Mixing Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bradley Corporation
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.
- 2. Standard: ASSE 1070.
- 3. Pressure Rating: 125 psig.
- 4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Union inlets and outlet.
- 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, thermometer on outlet, temperature-control handle.
- 8. Tempered-Water Setting: 105 deg F .



9. Tempered-Water Design Flow Rate: 0.5 gpm minimum.
10. Valve Finish: Chrome plated
11. Piping Finish: Chrome plated.

## 2.3 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers.

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for 2" and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for 2-1/2" and larger.
3. End Connections: Threaded for 1/2" and smaller; flanged for 2-1/2" and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
  - a. Strainers 2" and Smaller: 0.020 inch.
  - b. Strainers 2-1/2" to 4": 0.045 inch.
6. Drain: Pipe plug.

## 2.4 HOSE BIBBS

### A. Interior Exposed Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: 3/4" threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze/chrome/ or nickel plated.
9. Finish for Service Areas: Chrome.
10. Operation for Equipment Rooms: Wheel handle.

## 2.5 WALL HYDRANTS

### A. Non-freeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.

- e. Watts Drainage Products Inc.
  - f. Woodford Manufacturing Company.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
  - 3. Pressure Rating: 125 psig.
  - 4. Operation: Loose key.
  - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  - 6. Inlet: 3/4".
  - 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 8. Box: Deep, flush mounting with cover.
  - 9. Box and Cover Finish: Polished nickel bronze.
  - 10. Include operating key with each key operated hose bibb

## 2.6 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves.

- 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
- 2. Pressure Rating: 400-psig minimum CWP.
- 3. Size: 3/4".
- 4. Body: Copper alloy.
- 5. Ball: Chrome-plated brass.
- 6. Seats and Seals: Replaceable.
- 7. Handle: Vinyl-covered steel.
- 8. Inlet: Threaded or solder joint.
- 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.7 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Metal bellows/Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
- D. Install Y-pattern strainers for water on supply side of each control valve, solenoid valve, and pump.
- E. Install water hammer arresters on each quick closing valve in water piping according to PDI-WH 201.
- F. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

#### 3.2 FIELD QUALITY CONTROL

- A. Remove and replace malfunctioning domestic water piping specialties.

#### 3.3 ADJUSTING

- A. Set field-adjustable temperature setting of thermal balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

## SECTION 221123 - DOMESTIC WATER PUMPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic hot-water recirculation:
  - 1. Close-coupled, in-line, seal less centrifugal pumps.
- B. See Division 22 Section "Domestic-Water Packaged Booster Pumps" for booster systems.

#### 1.2 SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Operation and maintenance data.

#### 1.3 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

### PART 2 - PRODUCTS

#### 2.1 CLOSE-COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
  - 2. Casing: Bronze, with threaded companion-flange connections.
  - 3. Impeller: Corrosion-resistant material.

4. Motor: synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.

B. Capacities and Characteristics:

1. Capacity: Refer to Drawings.r
2. Total Dynamic Head: Refer to Drawing for
3. Maximum Operating Pressure: 125 psig.
4. Maximum Continuous Operating Temperature: 220 deg F .
5. Inlet and Outlet Size: Refer to Drawings
6. Motor Horsepower: Refer to Drawings
7. Electrical Characteristics: Refer to Drawings

C. Acceptable Manufacturers:

1. Bell & Gossett Domestic Pump; ITT Industries.
2. Armstrong Pumps Inc
3. Grundfos Pumps Corp.
4. Taco, Inc.

## 2.2 CONTROLS

- A. Thermostatic Control: Thermostatic control of pump shall be thru the digital mixing valve controller.
- B. Time Clock Control: 7 day time clock shall be provided thru the Building Automation System

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Install piping adjacent to pumps to allow service and maintenance.
- F. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."

1. Install test plugs for pressure gage at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and test plugs.
  2. Install thermometer at suction of pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometer.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 221123

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## SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
- B. Pipe, tube, and fittings.
- C. Special pipe fittings.

#### 1.2 Related Sections:

- A. 22 0004 Fire Stopping For Plumbing Systems.
- B. 22 0529 Pipe Hangers, Supports and Penetrations
- C. 22 1319 Sanitary Waste Piping Specialties

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
- B. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product used. These shall be **labeled and identified** same as on the Contract Documents.

#### 1.5 QUALITY ASSURANCE

- A. All piping shall conform to the requirements of the current version of the Ohio Building Codes.
- B. Comply with ASME B31.9 "Building Services Piping".
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Cast iron pipe, fittings, and standard duty no-hub couplings shall be listed by NSF International and marked with "NSF" demonstrating certification.



- E. Plastic piping and components shall comply with NSF 14, "Plastics Piping Systems Components and Related Materials,". Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Refer to "BUILDING DRAIN SYSTEMS SCHEDULE STORM, SANITARY, & VENT" on drawings for pipe materials.

### 2.2 PLENUMS

- A. PVC piping shall not be used in return air plenums.

## PART 3 - EXECUTION

### 3.1 Piping Installations

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Pipe and tubing shall be cut and fabricated to field measurements and run parallel to normal building lines. Pipe ends shall be cut square and ends reamed to remove burrs. The pipe interior shall be cleaned of foreign matter before erection of the pipe.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends and long-sweep bends. Sanitary tees and short-sweep  $\frac{1}{4}$  bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
- F. Piping shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment, in accordance with N.E.C. Article 384.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Install piping adjacent to equipment and specialties to permit servicing and maintenance.

- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Verify final equipment locations for roughing-in.
- O. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- P. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Pipe Hangers, Supports and Penetrations".
- Q. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- R. Piping suspended 18" or more shall be provided with sway bracing as required by CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- S. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- T. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- U. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping smaller than 3" and; 1 percent downward in direction of flow for piping 3" and larger.
  - 2. Vent Piping: slope down toward vertical fixture vent or toward vent stack.
- V. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

- W. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- X. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- Y. Annular space around piping through all wall penetrations shall be sealed off with a fire stopping system (rated walls) or permanent pliable caulking (non-rated walls).
- Z. Refer to Division 22 Section "Pipe Hangers, Supports, and Penetrations" for hanger, escutcheon, and sleeve requirements.
- AA. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for equipment and piping labeling requirements.

### 3.2 JOINT CONSTRUCTION

- A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- B. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
- C. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- E. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

### 3.3 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code or indicated on the drawings.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2" and larger.

### 3.4 FIELD QUALITY CONTROL

- A. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction. All pipe openings shall be covered through construction to prevent debris from entering the sanitary system.
- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
- C. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
- D. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- E. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- F. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- G. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
- H. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- I. Prepare reports for tests and required corrective action.

### 3.5 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Plugs the ends of uncompleted piping at end of day and when work stops.

### 3.6 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 22 1316

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## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

1. Floor Drains
2. Cleanouts.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

#### 1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 FLOOR DRAINS

- A. Floor drains shall be as indicated on the drawings:

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - g. Wade Manufacturing Company Division of Tyler Pipe

## 2.2 CLEANOUTS

### A. Exposed Cast-Iron Cleanouts:

1. Manufacturer shall be same as floor drains.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### B. Cast-Iron Floor Cleanouts:

1. Manufacturer shall be same as floor drains.
2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Plastic plug.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

### C. Cast-Iron Wall Cleanouts

1. Manufacturer shall be same as floor drains.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.3 ROOF FLASHING ASSEMBLIES

### A. Roof Flashing Assemblies:

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; Elmdor/Stoneman Div.

- b. Thaler Metal Industries Ltd.
- c. Approved equal.

- B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-] thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

- 1. Open-Top Vent Cap: Without cap.

## 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Floor-Drain, Trap-Seal Maintenance Device:

- 1. Description: Device inserted into the drain body or adjustable strainer that opens to allow water to pass through and closes to prevent sewer gases from entering the room from the drainage system.
- 2. Must conform to ASSE 1072.
- 3. Size: Same as floor drain outlet.

- B. Stack Flashing Fittings <Insert drawing designation if any>:

- 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- 2. Size: Same as connected stack vent or vent stack.

## 2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

- 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
- 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
- 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

- B. Fasteners: Metal compatible with material and substrate being fastened.

- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

- D. Solder: ASTM B 32, lead-free alloy.

- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Cleanouts
  - 1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
    - a. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
    - b. Locate at each change in direction of piping greater than 45 degrees.
    - c. Locate at minimum intervals of 100 feet.
    - d. Locate at base of each vertical soil and waste stack.
  - 2. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
  - 3. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. Floor Drains
  - 1. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
    - a. Position floor drains for easy access and maintenance.
    - b. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      - 1) Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
  - 2. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- D. Roof Flashing Assemblies – Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- E. Miscellaneous Sanitary Drainage Piping Specialties.
  - 1. Install floor-drain, trap-seal maintenance devices on inlet to floor drains as noted on drawings.
    - a. Size: Same as floor drain inlet.
- F. Flashing Materials – Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through in roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

### 3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

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## SECTION 221416 - INTERIOR STORM DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following storm drainage piping inside the building.

1. Pipe, tube, and fittings.
2. Special pipe fittings.

- B. Related Sections:

1. 22 0004 Fire Stopping for Plumbing Systems.
2. 22 0529 Pipe Hangers, Supports, and Penetrations.
3. 22 1423 Storm Drainage Piping Specialties

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product used.
- B. Field quality-control inspection and test reports.

#### 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Refer to piping schedule on the Drawings for piping material and applications.

## 2.2 PLENUMS

- A. PVC piping shall not be used in return air plenums.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Pipe and tubing shall be cut and fabricated to field measurements and run parallel to normal building lines. Pipe ends shall be cut square and ends reamed to remove burrs. The pipe interior shall be cleaned of foreign matter before erection of the pipe.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Piping shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment, in accordance with N.E.C. Article 384.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to equipment and specialties to permit servicing and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- L. Verify final equipment locations for roughing-in.
- M. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- N. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to

make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Pipe Hangers, Supports and Penetrations."

- O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- P. On piping 5" and larger provide bracing at every branch opening or change in direction as required by CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- Q. Piping suspended 18" or more shall be provided with sway bracing as required by CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- R. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- S. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- T. Install storm drainage piping at the following minimum slopes, 1/8" per linear foot downward in direction of flow for piping 3" and larger.
- U. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- V. Install PVC storm drainage piping according to ASTM D 2665.
- W. Install underground PVC storm drainage piping according to ASTM D 2321.
- X. Annular space around piping through all wall penetrations shall be sealed off with a fire stopping system (rated walls) or permanent pliable caulking (non-rated walls).
- Y. Refer to Division 22 Section "Pipe Hangers, Supports, and Penetrations" for sleeve requirements.
- Z. Refer to Division 22 Section "Pipe Hangers and Supports" for basic hanger and support requirements.
- AA. Refer to Division 22 Section "Pipe Hangers, Supports, and Penetrations" for escutcheon requirements.
- BB. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for equipment and piping labeling requirements.

- CC. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.2 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.3 CONNECTIONS

- A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect storm drainage piping to roof drains and storm drainage specialties.

### 3.4 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  - 1. Test storm drainage piping according to procedures of authorities having jurisdiction. Maintain record of tests.

### 3.5 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Plugs the ends of uncompleted piping at end of day and when work stops.

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### 3.6 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 22 1416



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## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
  - 1. Cleanouts.
  - 2. Roof drains.
  - 3. Miscellaneous storm drainage piping specialties.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. These shall be **labeled and identified** same as on the Contract Documents.

#### 1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 ROOF DRAINS

- A. Cast-Iron Roof Drains:
  - 1. Standard: ASME A112.21.2M.
  - 2. Pattern: Roof drain.
  - 3. Body Material: Cast iron.
  - 4. Combination Flashing Ring and Gravel Stop: Required.
  - 5. Outlet: Bottom.
  - 6. Dome Material: Cast iron.
  - 7. Top Set Deck plate: Required
  - 8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Zurn Plumbing Products Group; Specification Drainage Operation
    - b. Josam Company; Josam Div.
    - c. MIFAB, Inc.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. Watts Drainage Products Inc.

## 2.2 CLEANOUTS

### A. Exposed Cast-Iron Cleanouts:

1. Manufacturer shall be same as roof drains.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, brass plug.
6. Closure Plug Size: Same as cleanout size.

### B. Floor Cleanouts:

1. Manufacturer shall be same as floor drains.
2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: PVC.
6. Outlet Connection: Threaded.
7. Closure: Plastic plug.
8. Adjustable Housing Material: PVC with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: round.
11. Top Loading Classification: Extra Heavy Duty.
12. Riser: Same as DWV piping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to 4". Use 4" for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 100 feet.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

E. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

F. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1423

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## SECTION 22 1613 – NATURAL GAS HOUSE PIPING

### PART 1 - GENERAL

#### A. SUMMARY

1. Section Includes:
  - a. Piping, Tubes, and Fittings Materials
  - b. Piping Specialties
    - 1) Gas Pressure Regulators
    - 2) Transition Fittings
    - 3) Transition Service-Line Risers
  - c. Valves
  - d. Dielectric Fittings

#### B. Related Sections

1. 22 0004 Fire Stopping for Plumbing Systems
2. 22 0529 Pipe Hangers, Supports, and Penetrations

### 1.2 PERFORMANCE REQUIREMENTS

#### A. Minimum Operating-Pressure Ratings –

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators –100 psig minimum unless otherwise indicated.

#### B. Compliance – All gas piping work shall be in accordance with NFPA 54/the International Fuel Gas Code (IFGC) and the Gas Company requirements. Verify materials selected and installation methods are in conformance before installation.

#### C. House Pressure – Intermediate natural gas piping shall run across the roof at an intermediate pressure of 2 psi. At the at locations indicated on the drawings the pressure shall be regulated down to as noted. which shall enter the building and be distributed to each item needing natural gas or connected to roof top equipment.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. These shall be **labeled and identified** same as on the Contract Documents
- B. Welding certificates.
- C. Operation and maintenance data.

### 1.4 QUALITY ASSURANCE

- A. Materials and installation shall conform to standards and requirements of the Gas Company and the Ohio Building Code including the referenced International Fuel Gas Code.

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIAL

- A. Refer to piping schedule on the Drawings for piping material and applications.

### 2.2 PIPING SPECIALTIES

- A. Gas Pressure Regulators:
  - 1. Construction – Gas pressure regulator shall be self-operating spring-loaded type. Valve body shall be cast iron, 125 psi construction with screwed or flanged connections. Spring and diaphragm casings shall be aluminum. Regulator should have an internal relief valve assembly, tapped vent connection with removable screen on the spring casing and an external pilot operator to afford a 5% maximum droop. Over-pressure protection shall be ten times the inlet pressure (or higher as may be required by the gas company).
  - 2. Performance – Refer to the drawings for capacity, inlet and outlet pressures and installation detail.
  - 3. Manufacturers – Sensus or equal by Fisher, Sprague or Equimeter.

### 2.3 VALVES

- A. General
  - 1. Exterior valve shall comply with ASME B16.33.
  - 2. Interior valves shall comply with ASME B16.44.
  - 3. Refer to schedule on drawings for valve information.

### 2.4 DIELECTRIC FITTINGS

- A. A dielectric connector shall be incorporated at each connection between ferrous and copper piping. Connectors shall be:
  - 1. Dielectric flange with non-metallic bolt hole grommets and gasket.
  - 2. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. General – Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Prohibited Locations – Refer to the International Fuel Gas Code (IFGC) for additional information on prohibited or restricted locations for piping and piping accessories.
- C. Workmanship – Pipe and tubing shall be cut and fabricated to field measurements and run parallel to normal building lines. Pipe ends shall be cut square and ends reamed to remove burs. The pipe interior shall be cleaned of foreign matter before erection of the pipe.
- D. Pipe Routing & Location Requirements –
  - 1. Install piping in concealed locations, unless otherwise indicated, except in equipment rooms and service areas.
  - 2. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
  - 3. Electrical Coordination – Piping shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment, in accordance with N.E.C. Article 384.
  - 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
  - 5. Install piping adjacent to equipment and specialties to permit servicing and maintenance.
  - 6. Install piping free of sags and bends.
  - 7. Install fittings for changes in direction and branch connections.
- E. System Component Selection – Select system components with pressure rating equal to or greater than system operating pressure.
- F. Pipe Penetrations –
  - 1. Install escutcheons for penetrations of walls, ceilings, and floors exposed to view.
  - 2. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- G. Equipment Verification – Verify final equipment locations for roughing-in and with other trades.
- H. Exterior Piping
  - 1. Rooftop Piping – Refer to Division 23 Section 0529 “Pipe Hangers, Supports and Penetrations” for products and installation instructions.



2. Equipment Connections –
  - a. Provide a shutoff valve and a dirt and moisture leg with screwed end cap on the pipe drop to each item of equipment.
  - b. Unions and flanges shall be installed at pipe connections to fixtures and equipment and as required for erection purposed.
3. Pressure Regulators – Gas pressure regulators shall be installed in accordance with the manufacturer's instructions.
  - a. Assembly – Provide valved pressure gauge taps upstream and downstream of the regulator and a pressure gauge on either side of the regulator. Provide pilot regulator piping and miscellaneous valves, devices and piping to complete the installation.
  - b. Venting – Vent piping shall be extended individually from each regulator and gas venting device to an approved location away from ventilation openings, doors, windows, and any fresh air intake.
4. Painting – Piping installed above ground and outdoors shall be prime coat and painted to protect it from corrosion. Painting shall be gray in color.

I. Indoor Piping Installation

1. Location Restrictions – Valves, unions and threaded joints are not permitted in inaccessible locations.
2. Equipment Connections –
  - a. Provide a shutoff valve and a dirt and moisture leg with screwed end cap on the pipe drop to each item of equipment.
  - b. Unions and flanges shall be installed at pipe connections to fixtures and equipment and as required for erection purposed.
3. Pressure Regulators – Gas pressure regulators shall be installed in accordance with the manufacturer's instructions.
  - a. Assembly – Provide valved pressure gauge taps upstream and downstream of the regulator and a pressure gauge on either side of the regulator. Provide pilot regulator piping and miscellaneous valves, devices and piping to complete the installation.
  - b. Venting – Vent piping shall be extended individually from each regulator and gas venting device to outside the building in an approved location away from ventilation openings, doors and windows.
4. Hangers, Supports, and Penetrations – Refer to Division 22 Section "Pipe Hangers, Supports, and Penetrations" for hanger, support, escutcheon, and sleeve requirements.

- J. Identification – Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for equipment and piping labeling requirements.

- K. Electrical Bonding – The aboveground portion of the gas piping system shall be electrically continuous and bonded to an effective ground-fault current path. Refer to the IFGC for additional information.
- L. Purging – Comply with NFPA 54/the International Fuel Gas Code (IFGC) for installation and purging of natural-gas piping.
- M. Inspections & Pressure Testing – Refer to Field Quality Control Section below.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Cleaning –
  - 1. Ream ends of pipes and tubes and remove burs.
  - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. Threaded Joints –
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burs and restore to full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Welded Joints –
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.
  - 3. Patch factory-applied protective coating as recommended by manufacturers at field welds and where damage to coating occurs during construction.

### 3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance.
- B. Install regulator with maintenance space adequate for servicing and testing.

### 3.4 CONNECTIONS

- A. Connect to existing gas piping on roof.
- B. Grounding – Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

- C. Equipment Access – Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Equipment Connections – Connect piping to appliances using manual gas shutoff valves and unions. Install valves within 72 inches of each gas-fired appliance and equipment. Install a union between the shutoff valves and appliances or equipment.
- E. Dirt Traps – Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.5 FIELD QUALITY CONTROL

- A. Testing – Test, inspect, and purge natural gas according to NFPA 54 /the International Fuel Gas Code and authorities having jurisdiction. Test pressure shall be 3 psi or 1.5 times the working pressure whichever is greater.
- B. Natural gas piping will be considered defective if it does not pass tests and inspections. Install new piping or components as required to pass tests.
- C. Reporting – Prepare test and inspection reports.

END OF SECTION 22 1613

## SECTION 22 3436 –GAS-FIRED STORAGE WATER HEATERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
  - 1. Commercial, power-burner, storage, gas water heaters.
  - 2. Water heater accessories.

#### 1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

#### 1.3 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/IESNA 90.1-2010 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

#### 1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired 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 Period: From date of Substantial Completion:
  - a. Commercial, Gas Water Heaters: 10 years.

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, Power-Burner, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
  1. Storage-Tank Construction: Non-ASME-code 444 stainless steel with 150-psig working-pressure rating.
    - a. Tappings: Threaded ends according to ASME B1.20.1 Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank finishes, including extending finish into and through tank fittings and outlets.
  2. Factory-Installed, Storage-Tank Appurtenances:
    - a. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    - b. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    - c. Jacket: Steel with enameled finish.
    - d. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
  3. Burner: Comply with UL 795 for power-burner water heaters and for natural-gas fuel.
    - a. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
  4. Temperature Control: Adjustable thermostat.
  5. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
  6. Special Requirements: NSF 5 construction.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - a. A. O. Smith, Water Products Company American Water Heaters, Inc.

- b. Lochinvar, Inc.
- c. American Water Heaters.

## 2.2 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than 3/4".
- E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.

## PART 3 - EXECUTION

### 3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
- B. Install 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.
- C. Install gas water heaters according to NFPA 54.
  - 1. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
  - 2. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
  - 3. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install vacuum relief valve on incoming cold water line.
- F. 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 water heaters that do not have tank drains.

- G. Install thermometer on outlet piping of water heaters.
- H. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- I. Fill water heaters with water.

### 3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
  - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 3436

## SECTION 22 4200 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Faucets for lavatories and sinks.
  - 2. Flushometers.
  - 3. Drinking Fountains
  - 4. Toilet seats.
  - 5. Protective shielding guards.
  - 6. Fixture supports.
  - 7. Water closets.
  - 8. Urinals.
  - 9. Lavatories.
  - 10. Countertop sinks.
  - 11. Service sinks.

#### 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. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. 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 product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.



1.4 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. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act" for plumbing fixtures for people with disabilities and Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Stainless-Steel Residential Sinks: ASME A112.19.3.
  - 2. Vitreous-China Fixtures: ASME A112.19.2M.
  - 3. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 8. NSF Potable-Water Materials: NSF 61.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Supply Fittings: ASME A112.18.1.
  - 11. Brass Waste Fittings: ASME A112.18.2.
- G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  - 1. Atmospheric Vacuum Breakers: ASSE 1001.
  - 2. Brass and Copper Supplies: ASME A112.18.1.
  - 3. Manual-Operation Flushometers: ASSE 1037.
  - 4. Plastic Tubular Fittings: ASTM F 409.
  - 5. Brass Waste Fittings: ASME A112.18.2.

- H. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Toilet Seats: ANSI Z124.5.
6. Supply and Drain Protective Shielding Guards: ICC A117.1.

## PART 2 - PRODUCTS

### 2.1 Fixtures and Trim

- A. Refer to the notes/schedule on the drawings for fixture and associate trim specifications.
- B. All waste and supply trim exposed to view shall be chrome plated brass.
- C. Toilet Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bemis Manufacturing Company.
    - b. Centoco Manufacturing Corp.
    - c. Church Seats.
    - d. Kohler Co.
    - e. Olsonite Corp.
    - f. Beneke Div, Sanderson Plumbing Products, Inc.
    - g. Sperzel.
  2. Description: Toilet seat for water-closet-type fixture.
    - a. Material: Molded, solid plastic with antimicrobial agent.
    - b. Configuration: Open front without cover.
    - c. Size: Elongated.
    - d. Hinge Type: Self-sustaining check.
    - e. Class: Heavy-duty commercial.
    - f. Color: White.

### 2.2 FIXTURE CARRIERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Josam Company.
  2. MIFAB Manufacturing Inc.
  3. Smith, Jay R. Mfg. Co.

4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Sioux Chief Manufacturing.

B. Water-Closet Carriers:

1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include single, vertical, hubless waste fitting as required for piping arrangement; faceplates; couplings with neoprene gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Lavatory Carriers:

1. Description: Lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include rectangular steel uprights with feet.

D. Drinking Fountain Carriers:

1. Description: Carrier with hanger and bearing plates for wall-mounted fixture. Include rectangular steel uprights with feet.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install feet and anchor lugs of carriers securely affixed to floor using all bolt holes provided.
- C. Install fixtures level and plumb according to roughing-in drawings.
- D. Attach supplies to supports or substrate within pipe spaces behind fixtures to prevent loose piping fitting piping thru walls. Install -supply stop on each water supply to each fixture connected to water distribution piping. Install stops in locations where they can be easily reached for operation.
- E. 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.
- F. Install toilet seats on water closets.
- G. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding

fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

- H. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### 3.2 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.

### 3.3 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.
- E. Adjust flow regulators for proper flow and stream height and adjust water cooler temperature settings for drinking fountains.
- F. Install fresh batteries in sensor-operated mechanisms.

### 3.4 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 224200

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## SECTION 23 0001 – BASIC HVAC REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements
2. Definitions
3. Scope of Work
4. Drawings and Specifications
5. Reference Standards
6. Allowances, Unit Prices and Alternates
7. Site Visit
8. Permits, Regulations and Inspections
9. Project Management and Coordination
10. Temporary Utilities
11. Workmanship
12. Protection
13. Painting
14. Cleaning
15. Miscellaneous Equipment Connections
16. Equipment Selection
17. Shop Drawings
18. Final Inspection and Punch List
19. Operation and Maintenance Manuals
20. Record Drawings
21. Warranties
22. Project Closeout
23. Operation and Adjustment of Equipment
24. Operating Demonstration and Instruction

#### 1.2 GENERAL REQUIREMENTS

- A. All provisions of Division 00 Front End Documents and Division 01 General Requirements apply to work specified in this Division.
- B. Specification provisions of other relevant Divisions shall apply where applicable work is required to be performed under this HVAC work.
- C. A complete and functional HVAC system installation shall be provided under this Division. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

- D. The Mechanical and Electrical drawings and specifications assign work (labor and/or materials to be provided by the General, Plumbing, Fire Suppression, HVAC or Electrical Contractor or their sub-contractors. Understanding that the contractors for mechanical and electrical work are sub-contractors to the (General) Contractor, such assignments are not intended to restrict the Contractor in assignment of work among the sub-contractor to accommodate trade agreements and practices or the normal conduct of the construction work.

### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

### 1.4 SCOPE OF WORK

- A. The scope of the HVAC work includes furnishing, installing, testing and warranty of all HVAC work shown on the HVAC drawings and specified herein, including Division 00, Division 01, Division 23 and applicable provisions of other relevant Divisions.

### 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "proved," as used, shall mean "furnish and install." If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Architect for approval before proceeding with the work.
- B. Make all necessary field measurements to insure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Architect for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Having ductwork, pipe and fittings fabricated

and delivered in advance of making actual measurements shall be sufficiently in advance as to not cause extra work or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.

- D. The Architect/Engineer shall reserve the right to make minor adjustment in locations of system runs and components where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as not to cause extra work or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties.
- E. Equipment, ductwork or piping shall not be installed or run above electrical switchgear or panelboards, nor in or above the access space in the immediate vicinity of the electrical switchgear/panelboards, in accordance with NEC Article 384.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The Architect's decision shall be final in regard to the arrangement of ductwork, piping, etc., where conflict arises.
- G. Provides offsets in system runs, additional fittings, necessary drains and minor valves, traps, dampers and devices required to complete the installation, or for the proper operation of the system. Each Contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

#### 1.6 REFERENCE STANDARDS

- A. Where standards (NFPA, NEC, ADTM, UL, etc.) are referenced in the specifications or in the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

#### 1.7 ALLOWANCES, UNIT PRICES AND ALTERNATES

- A. Refer to Sections 012100 Allowances, 012200 Unit Prices and 012300 Alternates.

#### 1.8 SITE VISIT

- A. Refer to Section 017300 Execution.
- B. Each bidder shall visit the project site to understand the existing conditions and compare the conditions with information shown on the drawings. Report immediately to the Architect on any issues or discrepancies which are discovered that affect the bid. Changes to contract price will not be considered for site condition issues that are readily apparent from a thorough site review.



#### 1.9 PERMITS, REGULATIONS AND INSPECTION

- A. Work must conform to applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawing and specifications shall govern. Install no work contrary to minimum legal standards.
- B. Except where the permit application is made by the Architect or the Engineer, the HVAC contractor shall be responsible for filing and obtaining all required permits from the governing inspection agencies for the HVAC work. Where the Architect or Engineer is the Architect or Engineer of record, they will furnish sealed and signed drawings and specifications required by the permit authorities.
- C. Include payment of all permits and inspection fees applicable to the work in this Division.
- D. All work shall be subject to inspection and approval of Federal, State and local agencies as may be appropriate as well as the Architect and Engineer.
- E. Furnish for the Owner certificates of approval from the governing inspection agencies as a condition for final payment.

#### 1.10 PROJECT MANAGEMENT AND COORDINATION

- A. Refer to Section 013100 Project Management and Coordination.

#### 1.11 TEMPORARY UTILITIES

- A. The use of the permanent HVAC system for temporary heating and ventilation during the latter stages of construction shall be allowed. Expedite completion of system as practicable to this end. Maintain the system during this period. Provide and maintain temporary air filters to protect coils and ducts. Replace temporary filters with the specified filters (clean) when the systems are placed on permanent duty. Air filters specified for the systems and units, including specified spare filters, are not to be used for temporary service.
- B. Cover all return duct openings with temporary filter media when recirculating air. Stop fans during heavy dust generating operations. Before turning the system over to the Owner, the Contractor shall clean duct interiors and interior surfaces and components with the air handling equipment if dirt, dust and debris have accumulated on these surfaces.
- C. Warranty periods on equipment, materials and system shall commence upon Owner acceptance of the building or system. Temporary heat use shall not jeopardize or alter the warranty requirements.

#### 1.12 WORKMANSHIP

- A. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all

respects, and the Architect shall have the right to stop the work if highest quality workmanship is not maintained.

- B. HVAC work shall be performed by licensed HVAC Contractors in accordance with requirements of the jurisdiction.

#### 1.13 PROTECTION

- A. Each Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Architect.
- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide plastic sheeting, drop cloths or similar barriers where dust and debris is generated, to protect adjacent areas.
- C. Contractors should protect all equipment and materials from detrimental effects of weather or construction activity. All items shall be stored and secured in a protected location away from the daily work area. Equipment or materials shall be placed on raised skids to protect from surface moisture. Where appropriate, provide plastic sheeting or similar vapor barrier underneath the stored products to reduce the effects of ground moisture or concrete curing on the local humidity levels. Where unfinished ferrous products or finished ferrous products with raw edges are stored, provide local, dry heat to maintain ambient relative humidity levels below 65% RH to prevent rust.
- D. All equipment shall retain the original packaging until required to be removed for installation or operation. Open ends of ducts, piping, conduit, etc. shall be capped or sealed and ventilation openings into equipment shall be wrapped and sealed in plastic sheeting to prevent dust or dirt entry both when stored and after installation but still open to the effects of construction activity. Stored items as well as installed equipment shall be always covered with plastic sheeting until placed in service or until dust generating activity in the area has ceased.

#### 1.14 PAINTING

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in Division 23:
  - 1. Ferrous metal which is not factory or shop painted or galvanized and which remains exposed to view in the finished areas of the building / building including finished areas, mechanical rooms, storage rooms, and other unfinished areas shall be given a prime coat of paint.
  - 2. Ferrous metal installed outside the building which is not factory or shop painted or galvanized shall be given a prime coat of paint.
  - 3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be

cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch-up.

4. Inside of ducts, behind grilles and registers, shall be painted flat black to eliminate the viewing of shiny surfaces.
- B. Painting, surface preparation and application shall conform to applicable portions of the Painting section of Division 09 Finishes. All rust must be removed before application of paint.
- C. Finish painting is included in the General Contract except where otherwise required under remodeling work. Refer to the "Cutting and Patching" paragraph in this Section for finishing requirements.

#### 1.15 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the Owner is continuing to occupy or use; any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.
- B. The Owners dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.
- C. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain. The contractor shall also clean duct interiors and interior components of new or existing air handling system equipment if dirt, dust or debris has been generated in the course of work have accumulated on these surfaces.
- D. Before placing each system in operation, the equipment shall be thoroughly cleaned; cleaning shall be in accordance with equipment manufacturer's recommendations.
- E. Refer to appropriate Sections for cleaning of other equipment and systems for normal operation.

#### 1.16 MISCELLANEOUS EQUIPMENT CONNECTIONS

- A. General – Certain categories of fixtures and equipment, including laundry and equipment, require piping connections and/or duct connections as shown on the drawings. Equipment will be furnished and set in places by the equipment supplier.
- B. Piping Connections – Make all final connections to these fixture and equipment, as indicated and in accordance with the manufacturer's recommendations. All piping connections shall be provided with a shutoff valve and final connections made with unions.
- C. Rough-in Drawings – Roughing-in drawings shall be obtained for the various fixtures and items of equipment as the time approaches when such information is required; allow a reasonable period, from the time of notice to obtain this information.

- D. Manufacturer's Guidelines – Connections to equipment shall be in accordance with the manufacturer's installation guidelines. Any additional accessories recommended by the manufacturer such as gauges, shut-off valves, unions at connection points, etc., shall be provided by this Contractor.

#### 1.17 EQUIPMENT SELECTION

- A. Materials and equipment furnished under this contract shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be manufactured by the same manufacturer.
- B. The selection of materials and equipment to be furnished under this contract shall be governed by the following:
1. Where trade names, brands, or manufacturers of equipment or materials are listed in specifications, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products provided shall be of the first quality line of the manufacturers listed herein.
  2. Where the words "or approved equal: appear after a manufacturer's name, specific approval must be obtained from the Architect during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.
  3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval.
- C. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.
- D. Before bidding equipment, and again in the preparation of shop drawings the Contractor and his supplier shall verify that adequate space is available for entry and installation of the item of equipment, including associated piping and accessories. Also verify that adequate space is available for servicing the equipment.
- E. If extensive changes in pipe, duct or equipment layout or electrical wiring and equipment are brought about by the use of equipment which is not compatible with the layout shown on the drawings, necessary changes shall be deemed to be included in the contract.

1.18 SHOP DRAWINGS

- A. One set of shop drawings, in electronic format (pdf), with descriptive information shall be assembled by each Contractor of piece of equipment and all materials furnished in his contract and submitted to the Architect and/or Engineer for review as stated in Division 01. These shall be submitted as soon as practicable and before special equipment is manufactured and before installation.
- B. Shop drawings for equipment fixtures, devices and materials shall be labeled and identified same as on the Contract Documents. Failure to do so may be cause for rejection of shop drawings.
- C. The review of shop drawings by the Architect or Engineer shall not relieve the Contactor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.
- D. Shop drawings for the following HVAC equipment and materials shall be submitted:
  - 1. Vibration Isolators.
  - 2. Ductwork Insulation.
  - 3. Ductwork and Sealing Systems.
  - 4. Air Duct Accessories.
  - 5. Rooftop Heating and Cooling Units.
  - 6. Fans.
  - 7. Sound Attenuators.
  - 8. Air Control Terminal Units.
  - 9. Variable Air Volume/Temperature Control System.
  - 10. Diffusers, Registers and Grilles.
  - 11. Temperature Controls System.

1.19 FINAL INSPECTION AND PUNCH LIST

- A. As the work completion approaches, the Contractor shall survey and inspect his work and develop his own punch list to confirm that it is complete and finished. He shall then notify the Architect and request that a final inspection be made. It shall not be considered the Architect's or Engineer's obligation to perform a final inspection until the Contractor has inspected the work and so states at the time of the request for the final inspection.
- B. Requests to the Architect, Engineer or Owner for final inspection may be accompanied by a limited list of known deficiencies in completion, with appropriate explanation and schedule for completing these; this is in the interest of expediting acceptance for beneficial occupancy.
- C. The Architect and/or Engineer will inspect the work and prepare a punch list of items requiring correction, completing or verification. Corrective action shall be taken by the Contractor to the satisfaction of Architect and Engineer within 30 days of receipt of the Architect/Engineer's punch list.

#### 1.20 OPERATION AND MAINTENANCE MANUALS

- A. Three / Two copies each of operating and maintenance manuals shall be assembled for the HVAC work by the Contractors.
- B. The operation and Maintenance manuals shall include the following from each manufacturer of the principal items of equipment:
  - 1. All shop drawings
  - 2. Installation, maintenance and operating instruction pamphlets or brochures
  - 3. Wiring diagrams,
  - 4. Parts lists and other information
  - 5. All warranties
- C. Testing, adjusting and air and water balancing reports should also be included.
- D. In addition, the Contractor shall prepare a chart listing all items of equipment which are furnished under his contract and indicating the nature of maintenance required, the recommended frequency of checking these points and the type of lubricating media or replacement material required.
- E. Format – An index and tabbed sheets shall separate the sections included. These shall be submitted to the Architect or Engineer for review. Upon approval, manuals shall be turned over to the Owner. The manuals shall be assembled into:
  - 1. Three-ring loose lead binders or other appropriate binding
  - 2. Combined into a single electronic file in .PDF format.

#### 1.21 RECORD DRAWINGS

- A. Each Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawing shall be turned over to the Architect.

#### 1.22 WARRANTIES

- A. This Contractor shall warrant all workmanship, equipment and material entering into this contract for a period of one year of date of final acceptance or date of beneficial use, as agreed to between Contractor and Architect. Any materials or equipment proving to be defective during this warranty period shall be made good by this Contractor without expense to the Owner.
- B. This provision is intended specifically to cover deficiencies in contract completion or performance which are discovered after systems are placed in operation. Also included shall be supplementary assistance in balancing, adjusting or providing operating instructions as the need develops, and replacing overload heater elements in starters where necessary to keep systems in operation. Heater element sizes shall not exceed the motor manufacturer's recommendations.

- C. This provision shall not be construed to include maintenance items such as replacing filters, re-tightening or repacking glands, greasing, oiling belt tightening and cleaning strainers after these have been done for final close-out.
- D. Provisions of this warranty shall be considered supplementary to warranty provisions under General Conditions.
- E. Extended Warranties – Extended warranties shall be provided where indicated in the equipment specification sections.

#### 1.23 PROJECT CLOSEOUT

- A. The following schedule summarizes actions to be taken or submittals to be completed by Contractor prior to issuance of the Contract Completion Certificates. Refer to applicable paragraphs of the Division 23 Sections and other applicable trade Divisions for additional requirements. This information should be submitted at least thirty days in advance of request for final inspection. Where possible, the information shall be bound in 8 – ½' x 11" hard back binders.
  - 1. Material / Suppliers List
  - 2. Record Drawings
  - 3. Certificate of Inspection
  - 4. Tests and Adjustments
  - 5. Operating Instructions and Maintenance Manuals
  - 6. Equipment and Piping Identification
  - 7. Receipt of spare pump seals
  - 8. Receipt of spare filters
  - 9. Completed Punchlist
  - 10. Waiver of Liens
  - 11. Affidavit of Wage Compliance
  - 12. Change Orders and Allowance Adjustments

#### 1.24 OPERATION AND ADJUSTMENT OF EQUIPMENT

- A. As each piping system and air distribution system are put into operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing air and water systems, adjusting fan speeds, belts, pulleys, tightening packing glands, and adjusting all operating equipment.
- B. Caution: Verify that all bearings are lubricated, all motors are operating in the right direction, and correct overload heater elements are provided on all motors. Do not depend wholly on the electrician's judgment in these matters. Follow specific instructions in regard to lubrication. Do not oil or grease presealed ball bearings unless upon manufacturer's specific instructions.
- C. Test relief valves, air vents and regulating valves to insure proper operation.

1.25 OPERATING DEMONSTRATION AND INSTRUCTIONS

- A. The Contractor shall set the various systems into operation and demonstrate to the Owner and Architect that the systems function properly and that the requirements of the Contract are fulfilled.
- B. The Contractor shall provide the Owner's representatives with detailed explanations of operation and maintenance of equipment and systems. A thorough review of the operating and maintenance manuals shall be included in these instructional meetings.
- C. A minimum of 16 hours shall be allowed for instructions to personnel selected by the Owner. Instructions shall include not less than the following:
  - 1. Show locations of items of equipment and their purpose.
  - 2. Review binder containing instructions and equipment and systems data.
  - 3. Coordinate written and verbal instructions so that personnel understand each.
  - 4. Separate instructions shall be given by manufacturer's representatives for the temperature control systems.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION – NOT APPLICABLE

END OF SECTION 23 0001



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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

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## SECTION 23 0006 – AGREEMENT AND WAIVER FOR USE OF ELECTRONIC FILES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The Engineer at their sole discretion and without obligation makes portions of the contract documents available in electronic format for use by the contractor. These electronic files are proprietary and shall remain the Engineer's Instruments of Service and shall be used solely with respect to this project, as provided in the Standard Form of Agreement between Owner/Architect and Engineer.
- B. Electronic files will only be released after bids have been received, and contracts have been signed.
- C. The contractor shall acknowledge receipt of electronic files, in the requested format, for this project. The electronic files are provided as a convenience to the User, for use in preparing shop drawings and/or coordination drawings related to the construction of this project only. The electronic files and the information contained within are the property of the Engineer and/or Architect and/or the Owner and may not be reproduced or used in any format except in conjunction with the project identified in the Agreement.
- D. The User acknowledges that the information provided in the electronic files is not a substitution or replacement of the Contract Documents and does not become a Contract Document. The User further acknowledges that neither the Engineer, Architect, Consultants, the Client or the Owner make any warranty or representation that the information contained in the electronic files reflects the Contract Documents in their entirety. The User assumes full responsibility in the use of the electronic files, including the responsibility to see that all manual modifications, addenda, bulletins, clarifications and Change Orders to the drawings executed as part of the Contract Documents have been incorporated.
- E. The User acknowledges that the receipt of electronic files in no way relieves the User from the responsibility for the preparation of shop drawings or other schedules as set forth in the Contract between the Contractor and the Owner.
- F. Electronic files are available in .DWG (AutoCAD) and .RVT (Revit) formats as indicated in the Agreement and Waiver For Use form. Documents will be provided in the version of said formats that the Engineer is currently using. It is the Contractor's responsibility to upgrade or purchase the required version that the files are provided in.
- G. All Revit models will be furnished without views.
- H. All .DWG files will be floor plans only. No details, notes, schedules etc. will be provided.
- I. All electronic files will be stripped of the Projects' name and address, the Architect's, Engineer's and any Consultant's name and address, and any professional licenses indicated on the contract documents, and all dimensions, verbiage and statistical information. Use of these electronic files

is solely at the contractor's risk and shall in no way alter the contractor's Contract for Construction.

- J. The User agrees to indemnify, hold harmless and defend the Engineer, Architect, the Consultants, the Owner, the Client and any of their agents from any litigation resulting from the use of these files. The Engineer makes no representation regarding the fitness or any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, inexactitudes, or anomalies in the data, information, or documents (including drawings) caused by the Engineer's or its consultant's computer software or hardware defects or errors; the Engineer's or its consultant's electronic or disk transmittal of data, information or documents; or the Engineer's or its consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Engineer's consultants to the Engineer.
- K. The contractor waives all claims against the Engineer, its employees, officers and consultants for any and all damages, losses, or expenses the contractor incurs from such defects or errors in the electronic files. Furthermore, the contractor shall indemnify, defend and hold harmless from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications, resulting from the contractor's distribution of electronic files to other contractors, persons or entities.
- L. to the full satisfaction of the utility owner.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

### 3.1 AGREEMENT AND WAIVER

- A. Attached Agreement and Waiver for Use of Engineering Computer Aided Design Files shall be submitted with accompanying payment to the Engineer prior to the delivery of files.

END OF SECTION 23 0006

## **Nauman & Zelinski LLC**

204 South Ludlow Street, Suite 400  
Dayton, Ohio 45402  
P: 937.223-3821  
F: 937.223-3849

### **AGREEMENT AND WAIVER FOR USE OF ENGINEERING COMPUTER AIDED DESIGN FILES**

#### **PROJECT:**

#### **OWNER:**

#### **CONTRACTOR:**

The undersigned acknowledges the receipt of electronic drawing files, which may include Revit/BIM files, (hereinafter "Electronic Files") or 2D AutoCad files for the above referenced project. These electronic files are provided as a convenience to the User, for use in preparing shop drawings and or coordination drawings related to the construction of this project only. These electronic files and the information contained within are part of the engineer's instruments of service and remain the property of Nauman & Zelinski LLC. The electronic files shall not be reproduced or used in any form except in conjunction with this project.

The User acknowledges that the information provided in these electronic files is not a substitute or replacement for the Contract Documents. The User acknowledges that neither Nauman & Zelinski, the Consultants, the Client, nor the Owner make any warranty or representation that the information contained in these electronic files reflects the hard-copy Contract Documents in their entirety. The User assumes full responsibility in the use of these electronic files, including the responsibility to see that all manual modifications, addenda, bulletins, clarifications and Change Orders to the drawings executed as part of the Contract Documents have been incorporated.

The User acknowledges that the furnishing of these electronic files in no way relieves the User from the responsibility for the preparation of shop drawings or other schedules as required by the Contract between the Contractor and the Owner including the need to check, confirm and coordinate the work with that of other contractors for this project.

The User agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against Nauman & Zelinski LLC, the Consultants, the Client, the Owner and any of their agents that may arise out of or in connection with the use of these electronic files.

Furthermore, the User shall, to the fullest extent permitted by law, indemnify and hold harmless against Nauman & Zelinski LLC, the Consultants, the Client, the Owner and any of their agents against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

If requesting Revit/BIM files for use in the coordination drawings process, the user acknowledges that there is no guarantee given to the accuracy of the model, the exact positions of elements may not be accurate within the model and some MEP elements may not be shown in the model, i.e. electrical conduits. It is therefore the responsibility of the installing contractors through their own coordination drawing process to deconflict any “collisions” detected.

Under no circumstances shall the delivery of these electronic files be deemed a sale by Nauman & Zelinski LLC, and no warranties, either express or implied, of merchantability and fitness for any particular purpose is made. In no event shall Nauman & Zelinski LLC be liable for any loss of profit or any consequential damages as a result of the use or reuse of these electronic files.

**USER (CONTRACTOR NAME):** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**ADDRESS:** \_\_\_\_\_

\_\_\_\_\_

**CITY:** \_\_\_\_\_ **STATE:** \_\_\_\_\_ **ZIP:** \_\_\_\_\_

**PHONE NO.:** \_\_\_\_\_

**SIGNED:** \_\_\_\_\_ **TITLE:** \_\_\_\_\_

**ELECTRONIC FILE FORMAT (Select One):**

**AutoCAD:** \_\_\_\_ (Only Floor Plan Drawings will be issued in electronic format)

**LIST OF DRAWINGS REQUESTED**

---

**FILE FORMAT: Revit:** \_\_\_\_ (Model only, no views will be included, no specific LOD.)

Plumbing Model: \_\_\_\_

HVAC Model: \_\_\_\_

Electrical Model: \_\_\_\_

The following costs are applicable to delivery of these files by e-mail.

**COST OF PREPARATION:**

Cost of Preparation for Electronic .DWG Files:

First Drawing:      \$50.00                      \$50.00

Additional Drawings \$15.00 each \_\_\_\_\_ x \$15.00 = \$ \_\_\_\_\_

**Total Cost:**                                      \$ \_\_\_\_\_

Cost of Preparation for Electronic .RVT model:                      \$500.00

Make all checks payable to Nauman & Zelinski LLC and include a copy of this form.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

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## SECTION 23 0513 - ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general requirements for electrical work for HVAC equipment including single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation and other electrical equipment, devices, fuses, wire, conduit and installation methods.
  - 1. Motors
  - 2. Starters

#### 1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.
- B. Refer to the Mechanical drawings and also the Electrical drawings for requirements related to each trade. Coordinate all aspects of electrical components and wiring to complete the systems.

#### 1.3 QUALITY ASSURANCE

- A. Equipment, devices shall be designed, constructed and installed in accordance with applicable standards of NEMA and the National Electric Code. Equipment shall be tested and listed by UL or other approved agency and installed in accordance with all instructions included as part of such listing.
- B. Electrical equipment, devices, fuses, wire, conduit and methods shall comply with applicable provisions of Division 26 - Electrical.



## PART 2 - PRODUCTS

### 2.1 MOTORS

- A. General duty motors shall be induction type 1750 rpm NEMA Design "B" with copper windings, Class B or F insulation, and motor enclosure to suit the application. Service factor shall be 1.15 minimum.
- B. Two-speed motors shall be two-winding type with six leads unless otherwise specified.
- C. Motors for other than general duty application shall be furnished to suit the application and operating environment.
- D. Premium efficiency motors shall be equal to Century "E + 3", General Electric "Energy Saver Premium Efficiency", Baldor "Super E Premium Efficient" or Reliance "Premium Energy Efficient" series. Motor efficiencies shall be tested and conform to NEMA Standard Publication MG-1 and IEEE 112 Test Method B.
- E. Motors used with variable frequency controllers shall be rated for inverter service in accordance with NEMA Standard Publication MG-1, Part 31, designed to handle 1600V at a 0.1 micro-second rise time and include Class F or H insulation, but with a Class B temperature rise. Motors shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings.
- F. Electronically Commutated Motors – Fans
  - 1. Motor enclosures: Open Drip Proof, Totally Enclosed Fan Cooled, Totally Enclosed Air Over, Totally Enclosed Non-Vented
  - 2. Electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
  - 3. Motors are permanently lubricated, heavy duty ball bearing type to match with the equipment load and pre-wired to the specific voltage and phase.
  - 4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor or integrated variable frequency drive.
  - 5. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
  - 6. Motors can achieve up to 95% efficiency, model and horsepower dependent.
- G. Motor sizes shown on the drawings are to be considered minimum. Motors furnished shall be sized so as to not operate in the service factor range. Motors for direct driven pumps and fans shall be selected so as to not operate in the service factor range at any point on the curve.
- H. The HVAC Contractor and equipment suppliers shall compare the electrical power requirements of the intended equipment with power feeders to the equipment shown on the Electrical drawings. Verify adequacy and compatibility of voltage, phase, wiring, capacity, number and size of conductors (versus equipment connection points), fusing and other

information on the electrical and mechanical drawings to that required for the equipment. If the selected equipment requires revision of the electrical, added cost must be borne by the HVAC Contractor.

## 2.2 STARTERS

- A. Magnetic starters shall comply with provisions of Division 26 - Electrical Specifications and shall be NEMA construction (IEC rated not acceptable) with thermal overload element on each phase, 115 volt control voltage and hand-off-automatic switch, where appropriate. An integral control transformer shall be incorporated in the starter for each motor of 200 volt and greater. A single control transformer is acceptable for multiple motor packaged equipment, however, when such is the manufacturer's standard. Duplex type units (pumps, compressors, etc.) are not included in this exception. A control transformer shall be provided in each starter to insure standby operating capability.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Motor connections of factory assembled equipment shall be made with flexible conduit except for plug-in electric cord connections.
- B. All power wiring shall be run in conduit. Control wiring shall be run in conduit except where open wiring is permitted in other applicable specification sections.
- C. Fuses shall be furnished and installed in fuse clips of equipment and switches provided by the Mechanical Contractors.
- D. If a non-basis of design manufacturer is provided by the HVAC contractor and the specific unit has a powered component with a MCA and/or MOCP greater than the basis of design, the HVAC contractor shall be responsible to provide all required electrical changes required to power the non-basis of design unit. The HVAC contractor shall coordinate with the Electrical Contractor any variances in the MCA and/or MOCP of the units provided.

END OF SECTION 23 0513

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

## SECTION 23 0530- EQUIPMENT BASES AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Roof Curbs
  - 2. Structural Steel Supports

#### 1.2 QUALITY ASSURANCE

- A. Coordinate exact dimensions, locations, and other details for the specific equipment provided with other trades.

### PART 2 - PRODUCTS

#### 2.1 ROOF CURBS

- A. Rooftop equipment shall be supported with a heavy gauge, galvanized steel support curb with a baseplate, continuously welded corner seams, integral raised cant to match roof insulation, internal insulation, wood nailer, and counter flashing.
- B. Curb height shall be minimum 14" above roof deck unless otherwise noted.

#### 2.2 STRUCTURAL STEEL SUPPORTS

- A. Structural steel angles, beams, or channels, Unistrut channels, or pipe supports shall be fabricated into a rigid framework with welded or bolted connections and cross / sway bracing.
- B. Supports shall be set of slab with baseplates or attached to permanent building structure.
- C. Wall brackets shall be anchored to steel framing members or masonry walls.

### PART 3 - EXECUTION

#### 3.1 WIND LOAD ANALYSIS

- A. HVAC Equipment, ductwork, piping, conduits, etc. exposed to wind shall have positive attachment to the building structure or ground to comply with wind load requirements of the building and mechanical codes.

- B. Wind speed design: 120 MPH.
  - 1. Refer to structural drawings for additional information.
- C. The contractor shall retain a specialty consultant to perform wind load calculations in accordance with the code and additional requirements in this section. A professional engineer experienced in wind load attachment design and installation shall be responsible for calculations, attachment selections, and installation details.
- D. The Wind Load Analysis consisting of attachment design, calculations, attachment selection, installation details including anchoring methods, fastener specifications, embedment and/or welded length, etc. shall be submitted for review and record. The submittal shall be signed and sealed by a professional engineer, as stated above. This submittal shall become part of the project design calculations, included in the project records, and when required, will be submitted to the Authority Having Jurisdiction (AHJ).
- E. The wind load attachment design shall clearly indicate the attachment points to the building structure and design forces in all horizontal and vertical axes at the attachment points. The wind load attachment engineer shall coordinate all attachments with the project structural engineer of record, who shall verify the attachment methods and the ability of the building structure to accept the loads imposed.
- F. The wind load attachment design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from submittals or the manufacturers. The equipment manufacturer shall verify that the attachment points on the equipment can accept the combination of wind load, weight, and other loads imposed.
- G. At the project Engineer of Record's discretion, equipment submittals may not be approved until the Wind Load Analysis has been submitted. It is the contractor's responsibility to schedule and coordinate the process in a timely manner, including revised Wind Analysis submittals for equipment approved pending Wind Analysis submittals.

### 3.2 INSTALLATION

- A. Roof curbs shall be installed, shimmed level, and secured to the roof deck/structure. Roof insulation and roofing shall be installed around each curb by the Roofing Contractor.
- B. Equipment Bracing & Attachment
  - 1. All equipment and curbs exposed to wind shall be installed and attached to structure in strict accordance with the Wind Load Analysis design. Attachment shall conform to the applicable building codes and manufacturers installation instruction.
  - 2. No rigid connections between equipment and the building shall be made that would degrade vibration isolation.
  - 3. Each manufacturer of equipment shall furnish a statement stamped by a professional engineer indicating that the equipment is designed and constructed to withstand wind

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

loads required by the building codes. Statement shall include supporting documentation, calculations, etc.

- C. Attachment to manufactured trusses, joists, purlins, and other engineered structural members and supports shall be done in accordance with the structural engineer's or manufacturer's recommendations. Refer to the architectural and structural engineer drawings for type of engineered structural system being used. Connections to these structural members shall be made with connection devices and methods approve by the structural engineer or manufacturer. Provide additional supports with supplemental steel shapes when spacing between structural members exceed specified distances. In cases of existing trusses, the structural engineer shall review and approve hanger attachment methods.

END OF SECTION 23 0530

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
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## SECTION 23 0548 - VIBRATION CONTROL

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Vibration Isolators
  - a. Hangers

#### 1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators.

### PART 2 - PRODUCTS

#### 2.1 VIBRATION ISOLATORS

A. Hangers

1. Spring Hanger
  - a. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - b. Housings: Neoprene in shear or double deflection LDS rubber upper and lower elements.
  - c. Mason Industries Series "30N"
2. Neoprene in Shear Hanger
  - a. Element: Double deflection LDS rubber isolator color coded for load carrying capacity.
  - b. Mason Industries Series "HD".

#### 2.2 MANUFACTURERS

- A. Mason Industries.
- B. Kinetics Noise Control
- C. Amber Booth



### PART 3 - EXECUTION

#### 3.1 APPLICATIONS

- A. Isolators installed outside shall be furnished weather protected, with springs PVC coated, and other ferrous parts hot dip galvanized, or cadmium plated.

#### 3.2 INSTALLATION

- A. Follow manufacturer's instructions in setting and adjusting isolators. Ensure that no direct hard surface to surface contact occurs. Fasten device to floor as recommended by the isolation supplier.
- B. Where electrical connections are to be made to equipment mounted on isolators, inform the Electrical Contractor to connect to the equipment with flexible conduits.
- C. See Specification Section 23 0529 Pipe Hangers and Supports for spring hanger locations and hanger installation requirements.
- D. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- E. Adjust active height of spring isolators.
- F. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 23 0548

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

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## SECTION 23 0553 - IDENTIFICATION FOR HVAC SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Equipment Labels.
2. Duct Labels.
3. Controls Equipment Labels.

#### 1.2 SUBMITTAL

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

#### 1.3 QUALITY ASSURANCE

- A. Labels, tags and markers shall comply with ANSI A13.1 for lettering size, colors and length of color field.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Each item or major equipment shall be labeled. This shall include fans, rooftop units and other similar equipment.
- B. Labeling shall be:
1. Permanently attached engraved brass or plastic laminated signs with 1" high lettering. Signs on exterior equipments shall be brass.
  2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.
  3. In addition to the labeling attached to each VAV terminal unit, provide a colored sticker on the ceiling grid below each VAV to mark it's location.

#### 2.2 DUCT LABELS

- A. Duct markings shall be applied to all ductwork.

- B. Identification markings shall include service (e.g. supply, return, exhaust, outside air) and direction of air flow provided integral with duct marker or separate at each marker.
- C. Duct markings shall be laminated plastic color-coded pressure sensitive vinyl tape, 2-1/2" width, 3 mil minimum thickness.

## 2.3 CONTROLS EQUIPMENT LABELS

- A. Each controls device or major controls equipment shall be labeled to match controls drawings. This shall include thermostats, switches, sensors, controllers, panels and other similar equipment.
  - 1. Equipment labels - Self-Adhesive, Engraved, Laminated Phenolic Label: Adhesive backed, with black letters on a white background. Minimum letter height shall be 3/8 inch.
  - 2. Device labels - Marker Tape: Self-laminating, clear polyester, 3/8" high tape with black lettering.

## 2.4 ACCEPTABLE MANUFACTURERS

- A. Labels, markings and tags shall be manufactured by:
  - 1. W.H. Brady
  - 2. Seton
  - 3. Allen
  - 4. Industrial Safety Supply

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification marking and tagging shall be applied after insulation and painting has been completed.
- B. Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled on drawings.
- C. The Plumbing, Fire Suppression and HVAC Contractors shall coordinate labeling, marking and tagging to attain coordinated and consistent systems of identification.
- D. Equipment labeling shall consist of unit designation as shown on the drawings. Exhaust labeling shall also indicate service of room or area of service.
- E. Pipe and duct markers shall be placed at 25 ft. centers in mechanical rooms and concealed spaces and at 50 ft. centers in other exposed locations.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- F. Refer to appropriate sections of this specification for installation of underground line marker tape.
- G. Valve tags shall be placed on each valve except those intended for isolation of individual items of equipment. Valve tag schedules shall be prepared as specified above.

END OF SECTION 23 0553

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

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## SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provide air and water balancing for the new and modified existing systems.

#### 1.2 SUBMITTALS

- A. Provide a certification sheet signed and sealed by the certified testing and balancing contractor.
- B. Provide a list of instruments to be used for procedures and proof of calibration.
- C. Submit plan for simulation of system diversity where required.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

#### 1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. Approved Balancing Contractors:
  - 1. Kahoe
  - 2. Air Balance Unlimited
  - 3. American Air Balance
  - 4. Airflow Pros
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.
- F. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.



- G. Verify that all equipment start-up services have been completed before beginning any balancing work. Confirm all safety interlocks and protective devices are functioning, and the system is ready to be balanced.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 AIR BALANCE

- A. Examine approved submittal data of HVAC systems and equipment.
- B. Obtain job specific fan curves for each fan being balanced, new and existing. Include fan curves in final report.
- C. Record nameplate data from fans, motors, air handling equipment etc.
- D. Record and measure fan and motor sheaves indicating number and size of belts along with center-to-center distances.
- E. Test and record fan operating rpm and record running amperage.
- F. Each air supply, return and exhaust system shall be set in operation. Determine the best location in main and branch ducts for accurate duct airflow measurements. Each air outlet and inlet device, item of equipment (fan coils, air control units, etc), shall be balanced to the quantities listed on the drawings within plus or minus 10%, except where more stringent requirements are required as defined below. Central fan systems (AHU's, exhaust fan systems etc.) shall be balanced to within plus or minus 5%.
- G. Rooms requiring positive or negative pressure relationships shall be tested and logged.
- H. Adjust drive/ECM fan speeds or drive pulleys to attain the required fan speed. Pulleys and belts of fixed drives and of adjustable drives not having sufficient adjustment range shall be changed out, at the direction of the balancer or Engineer, to obtain fan speed required. All labor and materials to make the recommended changes shall be including in the Div. 23 scope of work.
- I. Measure velocity reading across coils, filters, and dampers on the intake side of the fan. Include data in the report.
- J. Coordinate with the Temperature Controls contractor in setting the supply, return, and exhaust fans ECM controllers and outside air, return air and relief/exhaust air dampers. Supply air systems shall have ampere reading measured in the full heating, full cooling and economizer modes to determine the maximum brake horsepower.
- K. Witness all duct pressure and leakage tests. Refer to 23 3113 and coordinate accordingly.

- L. Total air quantities of the supply, return and exhaust fans shall be determined by pitot tube traverse. Where impossible to take accurate pitot tube traverses of the duct systems, the total sum of terminal device air volume readings may be used. Final settings of fan speeds shall be determined with ECM controllers at full speed.
- M. For variable air volume systems with diversified air flow rates, develop and implement a plan to simulate diversity.
- N. Check for proper sealing of air-handling unit components. Report all issues in the balancing report.
- O. Check for proper duct sealing. Minor issues shall be reported in the balancing report. If a major issue is found, stop balancing work and report the issue to the CM and Engineer.
- P. In balancing of variable air volume systems, the total air quantity of the devices generally exceeds the fan air quantity due to the nature of VAV systems. The fan speed shall be set to deliver the required maximum fan cfm with duct static pressure sufficient for proper operation. Terminal control units shall be positioned for fan balancing to deliver the maximum fan air flow rate. When dual minimum control sequences are specified, set up the heating and cooling minimums.
- Q. Balancing of terminal air control units and air devices shall be done to provide adequate but not excessive pressure in the branch ducts to air control units and air devices. Dampers in air device duct runouts shall be used as the secondary balancing means when other branch dampers are provided. Check, test and calibrate as required all terminal air control unit cfm settings (maximum and minimum).
- R. Mark equipment and balancing device setting with paint or other suitable permanent identification, including damper control positions, valve position indicators, fan speed controls and similar control devices. Record and list terminal unit K-Factors.

### 3.2 FINAL REPORT

- A. After completion of the balancing work, a full report shall be prepared in pencil, electronically submitted to the engineer for review. After review, additional balancing adjustments, drive replacements, readings and recordings deemed necessary shall be done and the report revised. An electronic copy of the final report shall be submitted to the engineer for review and approval. An approved copy of the report shall be included in the Operating and Maintenance manual.
- B. The report shall also include
  - 1. Table of Contents
  - 2. Notes explaining why certain final data in the report varies from indicated values.
  - 3. Fan Curves
  - 4. Final K-Factors on each terminal unit.

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|----------------------------------------------------------------------|--|-------------------------------------|

### 3.3 SEASONAL TESTING

- A. If the initial balancing procedure was not completed during near peak summer and winter conditions the balancing contractor shall perform additional testing, inspecting and adjusting during near peak summer and or winter conditions.

END OF SECTION 23 0593

## SECTION 23 0713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Insulation Materials:
  - a. Fiberglass.

#### 1.2 SUBMITTALS

##### A. Product Data:

1. For each type of product indicated:
  - a. Thermal performance ratings.
  - b. Thickness and covering table.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting 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.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

## 2.2 INSULATION MATERIALS

- A. Refer to 'Ductwork Insulation Schedule'.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Workmanship – Installation shall be done by tradesmen specializing in insulation work in strict accordance with manufacturer's recommendations.
- B. Duct Sealing – Ductwork joints shall be sealed prior to installation of insulation.
- C. Duct Supports – Duct insulation shall be installed around ductwork supports where moisture may condense on surface of cold ductwork in direct contact with supports. Extend past edge of ductwork 4" for trapeze style supports.
- D. Performance Markings – Insulation shall be marked with manufacturer, "R-Value", and flame spread and smoke development.
- E. Blanket Insulation –
1. Blanket insulation shall be wrapped tight to the duct.
  2. Insulation shall be secured to ducts 20" wide and greater with weld pins and fasteners, 18" on center maximum.
  3. Adhesive shall be applied to the duct as an aid to installation and adhesion.
  4. Vapor barrier jacket shall be lapped, stapled and sealed with adhesive and 3" wide FSK pressure sensitive tape.
- F. Board Insulation –
1. Insulation with factory applied jacket shall be secured to the duct with weld pins and fasteners, 12" on center maximum.
  2. Vapor barrier jacket shall be lapped, stapled and sealed with adhesive and 3" wide ASJ pressure sensitive tape.
- G. Internally Lined Ductwork –
1. Ductwork which is internally lined with acoustic insulation, flexible ductwork with factory applied insulation and fiberglass ductwork need not be further insulated.
  2. Required internal lining is shown on the drawings.
  3. Refer to Section 23 3113 Ductwork and coordinate with the various trades.
  4. Ductwork that is to be internally lined shall provide the free inside clear dimensions noted on the contract drawings excluding insulation thickness.
- H. Duct Accessories Insulation – Equipment and devices in supply ductwork which could potentially condense moisture shall be insulated. This includes but is not limited to:
1. Duct coils
  2. Air terminal unit reheat coils
  3. Air control dampers and valves

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- I. Damaged Insulation – Reinsulate existing ductwork where existing insulation has been damaged or removed in the performance of work in this project.
- J. Painting – All exposed insulation shall be painted to match base material colors.
- K. System Identification – Install markings for service and flow direction for each ductwork system on ductwork insulation. Refer to Section 23 0553 “Identification for HVAC Systems”.

END OF SECTION 23 0719

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## SECTION 23 0913 - INSTRUMENTS AND CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes instruments and control devices for HVAC Direct Digital Control (DDC) systems and components.

1. Electronic Sensors and Transmitters
  - a. Thermostats
  - b. Thermistor Temperature Sensors & Transmitters
  - c. Humidistats
  - d. Humidity Sensors
  - e. Pressure Transmitters & Transducers
2. Status Sensors & Switches
3. Electrical Controls Devices
4. Surge Protection Devices
5. Flow Measuring Devices
  - a. Water Flow Meters
  - b. Air Flow Measuring Stations
6. Heat Trace Tape
7. Detection Equipment
8. Actuators
9. Control Valves
10. Dampers

- B. Related Sections:

1. Section 23 0914 – Control Wiring and Cabling
2. Section 23 0923 – Direct Digital Control System
3. Section 23 0950 – Variable Frequency Motor Controllers

#### 1.2 SUBMITTALS

- A. Product Data: For each control component indicated.

- B. Shop Drawings:

1. Each component shall be labeled for proposed usage and its corresponding item tag per the control drawing, diagram and sequence of operation submittal.
2. Damper schedule.
3. Valve schedule.

- C. Operation and maintenance data.



### 1.3 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Where a list of manufacturers is not provided, products offered by the controls system contractor or their preferred vendor may be incorporated, subject to compliance with the specification.
- B. Where a list of manufacturers is provided under components below, the product shall be selected only from the list of manufacturers provided.

### 2.2 CONTROL SYSTEM COMPONENTS

- A. Refer to Section 23 0923 "Direct Digital Control System" for manufacturers and specifications for the DDC system, including operator workstation, distributed controllers, network requirements, accessories, control software and graphic requirements.
- B. Refer to Section 23 0914 "Control Wiring and Cabling" for power wiring, control cabling, transformers, fusing power distribution cabinets and power line filtering for the DDC system.
- C. Control system components specified in this Section include sensors, detection equipment, indicators, thermostats, humidistats, air flow measuring stations, meters, actuators, control valves and dampers.

### 2.3 ELECTRONIC SENSORS AND TRANSMITTERS

- A. Thermostats
  - 1. Low-Voltage Space Thermostat – Shall be 24V, bimetal-operated type with either adjustable or fixed anticipation heater. Provide subbase with manual or automatic switching as required to perform the specified functions.
    - a. Concealed Set Point adjustment
    - b. 55°F to 85°F setpoint range
    - c. 2°F maximum differential
    - d. Vented ABS plastic cover
    - e. Single or multi-stage or modulating as required.
  - 2. Line-Voltage Space Thermostat – Shall be bimetal-actuated, open contact or bellows actuated. Provide subbase with manual or automatic switching as required to perform the specified functions.

- a. Enclosed snap-switch type, or equivalent solid-state type
  - b. Heat anticipator
  - c. UL Listed for electrical rating
  - d. Concealed Set Point adjustment
  - e. 55°F to 85°F setpoint range
  - f. 1°F maximum differential
  - g. Vented ABS plastic cover
  - h. Single or multi-stage or modulating as required.
3. Low-Limit Thermostats – Low limit airstream thermostats shall be UL listed, vapor pressure type with an element 20-foot minimum length. Element shall cover the face of the coil at 1-foot centers and shall respond to the lowest temperature sensed by any 1-foot section. When one low limit stat cannot meet this requirement, provide multiple thermostats.
- a. Low Limit Thermostat shall be manually reset.
  - b. Provided with one (1) set of normally closed contacts wired directly to the fan circuit.
  - c. Provide one (1) set of normally open contacts to provide an alarm to the DDC system.

B. Thermistor Temperature Sensors & Transmitters

1. General
- a. Temperature sensors shall be thermistors or Resistance Temperature Device (RTD) and be suitable for the application. Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless necessary and approved by the engineer.
  - b. Precision thermistors may be used in applications below 200°F. Sensor accuracy over the application range shall be 0.36°F or less between 32 to 150°F.
  - c. Provide RTD sensors with platinum elements compatible with digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32°F. Temperature sensor stability error over five years shall not exceed 0.25°F cumulative. Direct connection of RTD's to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25°F. The total error for an RTD circuit shall not exceed 0.5°F.
  - d. Provide matched temperature sensors for differential temperature measurement.
2. Duct Sensors
- a. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 feet in length per 10 sq ft of duct cross section.
  - b. Mixed Air and Discharge Air sensors shall be averaging type.
3. Immersion Sensors

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|----------------------------------------------------------------------|--|-------------------------------------|

- a. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the design water velocities in the pipe.

4. Space Sensors

- a. Space sensors shall be equipped with a setpoint adjustment, occupancy mode override switch, display, and communication port. Sensor cover shall be rectangular high impact ABS plastic in a neutral color.

5. Outdoor Sensors

- a. Outdoor temperature sensors shall be platinum type and have a minimum accuracy of  $\pm 0.5^{\circ}\text{F}$  from  $-40^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ , and measuring range from  $-20^{\circ}\text{F}$  to  $120^{\circ}\text{F}$ . Outdoor temperature sensor shall be within a ventilated enclosure that protects the sensor from thermal building mass biasing, solar radiation and precipitation without affecting performance.

C. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 10% to 90%. Accuracy shall be  $\pm 3\%$  of range.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 0% to 100% RH. Accuracy shall be  $\pm 5\%$  of range. Sensors should be suitable for ambient conditions of  $-40^{\circ}\text{F}$  to  $170^{\circ}\text{F}$ . Outdoor humidity sensors shall be within a ventilated enclosure that protects the sensor from thermal building mass biasing, solar radiation and precipitation without affecting performance.
4. Humidity sensors drift shall not exceed 1% of full scale per year.

D. Pressure Transducers

1. Transducers shall have a linear output signal. Zero and span shall be field-adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than the calibrated span without damage.
3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 1 – 5 Vdc or 4 to 20 mA output, required mounting brackets, and block and bleed valves.
4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5 Vdc or 4 to 20 mA output, required mounting brackets, and five-valve manifold.
5. Air velocity pressure sensors shall use differential pressure to determine airflow rate and have repeatability within 1% of reading and an accuracy of  $\pm 5\%$  of range. The velocity range shall be from 0 to 3250 FPM.

2.4 STATUS SENSORS & SWITCHES

A. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type.
2. Paddle type switches (water service only) shall be UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA enclosure suitable for location.
3. Differential pressure type switches (air or water service) shall be UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure suitable for location, with scale range and differential suitable for intended application, or as specified.

B. Current Switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

2.5 ELECTRICAL CONTROL DEVICES

A. Relays

1. Control relays shall be UL Listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for the application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable +/- 200% (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage shall be suitable for the application. Provide NEMA enclosure suitable for location when not installed in local control panel.

B. Override Timers

1. Override timers shall be electronic or spring-wound line voltage UL Listed, with contact rating and configuration as required by the application. Provide 0 to 6 hour calibrated dial for spring-wound type or LCD display for electronic type unless otherwise specified. Timer shall be suitable for flush mounting on control panel face and or wall as shown.
2. Push button with D.O. and lighted button.

C. Current Transformers

1. AC current transformers shall be UL/CSA recognized and completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for +/- 1% accuracy at 5 A full scale output.
3. Transformers shall be split-core type for installation on new or existing wiring.

D. Voltage Transmitters

1. AC voltage transmitter shall be self-powered single loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.

2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 300 VAC, and 400 to 600 VAC full-scale, adjustable, with 1% +/- full-scale accuracy with 500-ohm maximum burden.
3. Transmitters shall be UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

E. Voltage Transformers

1. AC voltage transformers shall be UL/CSA recognized, 600 VAC rated, complete with built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 40 to 130 degrees F, and shall provide +/- 0.5% accuracy at 24 VAC and a 5VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

2.6 SURGE PROTECTIONS DEVICES

A. Surge and Transient Protection

Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

B. Power Line Surge Protection

1. Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following.
  - a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.
  - b. The device shall react within 5 nanoseconds and automatically reset.
  - c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.
  - d. The devices shall have an independent secondary stage equal to or greater than the primary stage joule rating.
  - e. The primary suppression system components shall be pure silicon avalanche diodes.
  - f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.
  - g. The device shall have an indication light to indicate the protection components are functioning.
  - h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.
  - i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13dB at 100 kHz to 300 MHz.
  - j. The device shall comply with IEEE C62.41, Class "B" requirements and shall be tested according to IEEE C62.45.
  - k. The device shall be capable of operating between -20 degrees F and +122 degrees F.

C. Telephone and Communications Line Surge Protection

1. Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines, in accordance with the following:
  - a. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges.
  - b. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology.
  - c. The device shall be installed at the distance recommended by its manufacturer.

D. Controller Input/Output Protection

1. Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.7 FLOW MEASURING DEVICES

A. Water Flow Meters

1. Water flow meters shall be insertion electromagnetic type which provide current and voltage analog output for a flow rate, a high-resolution frequency output drive to peripheral devices, a scalable pulse output for totalization, and a master alarm signal.
2. Materials: Wetted metal components shall be 316 Stainless Steel. Sensor head shall be XAREC.
3. Liquid temperature range: 15°F to 250°F.
4. Ambient Temperature range: -20 °F to 150°F.
5. Max. Operating pressure: 400 psi.
6. Pressure Drop: 0.1 psi at 12 ft/sec in 3" pipe, decreasing as line size increases.
7. Accuracy shall be +/- 1% of reading from 2 – 20 ft/sec, and +/- 0.02 ft/sec below 2 ft/sec.
8. Analog Output – One (1) 4-20 ma, and one (1) 0-10 V or 0-5 V.
9. Frequency Output – 0-15 V peak pulse, 0-500 Hz.
10. Scalable Output – Isolated solid-state dry contact, rated at 30 V at 1.2 A, pulse duration 0.5, 1, 2 or 6 seconds.
11. Electronics Enclosure – Weathertight NEMA 4 aluminum enclosure.
12. Onicon Model FT-3400 series or approved equal.

B. Air Flow Measuring Stations

1. The probe assembly shall consist of one or more electronic air flow measuring units capable of continuously monitoring airflow. Each probe shall contain multiple electronic flow sensors and be thermal dispersion type. They shall be mounted in an array format to produce a true velocity profile. The sensors shall operate over a 350 to 7500 fpm velocity range and the velocity measured by each sensor shall output a signal directly proportional to flow to the supporting electronics. The output signal shall be fully isolated. The signal transmitter shall be an electronic device capable of receiving airflow probe signals over the probe interconnecting cables, linearizing each signal and then summing and averaging them. Finally, the signals shall be converted to a 4 to 20 MA

output signal for automatic transmission to any suitable remote input and/or recording device. A 24-volt AC power supply is required for each transmitter. The control panel shall be provided with integral diagnostics including on-line zero and on-line sensor verification. It shall have an integral reference standard for field calibration of transmitter output. The output span shall be adjustable from a minimum 0 to 1000 to a maximum 7500 fpm. The transmitter assembly shall be housed in a metal enclosure having a hinged door and lock. This unit shall not require recalibration. System accuracy shall be +/- 2% of rate plus +/- 0.55 of full scale.

2. Each supply and return fan shall have an independent air flow measurement station. Multiple fan arrays shall sum flow of each fan to report a total fan array air flow.
3. The outdoor air intake damper shall have an independent air flow measuring station.
4. Air flow measuring station shall be manufactured by:
  - a. Ebtron Gold Series
  - b. Paragon Controls
  - c. Air Monitor
  - d. Tek-Air
  - e. Kurz

## 2.8 HEAT TRACE TAPE

- A. Antifreeze tapes shall be self-regulating plastic insulated resistance cables, having a heating density as recommended by the manufacturer for the application. Heat tape shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin. Install in strict accordance with the manufacturer's recommendations, including wrapping with insulating tape. Furnish a relay under control of an outdoor thermostat to energize the tape when the outdoor temperature drops below 34 degrees F. Wire into the 120-volt outlet with is provided under the electrical contract for this purpose. Provide a pilot light on the inside wall near the exit door which indicates that the heat tape is energized. Provide where indicated on the drawings.
  - a. Manufacturers:
    - 1) Raychem (XL-TRACE)
    - 2) Easy Heat
    - 3) Or approved equal.

## 2.9 DETECTION EQUIPMENT

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104°F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- B. Carbon Dioxide Sensor and Transmitter: Solid-state non-dispersive infrared (NDIR) sensors
  1. Temperature range: 32 to 122°F.
  2. Measuring range: 0-2000 ppm



3. Accuracy: 5% + or – or 75 ppm max.
  4. Calibration: required for span only (automatic zero adjustment)
  5. Digital display: 4-digit LED
  6. Output: 0-10 VDC, 4-20 mA, selectable
  7. Alarm relay: 1000 ppm, field adjustable from 700-1300 ppm
  8. Enclosure: High impact plastic enclosure, white approx. 5"W x 2.5"H x 2"D
  9. Duct mounted models: Sampling inlet/outlet ports, filter, tubing, mounting hardware
  10. Calibration kit: Canister of gas, regulator and digital calibration readout
- C. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.
- D. NO<sub>2</sub> & CO Gas Detection System:
1. System shall be complete with digital transmitters and a multi-channel controller.
  2. Transmitters:
    - a. Rugged PVC enclosure with hinged door
    - b. 24V DC power
    - c. Auto reset thermal fuse
    - d. LED indicator for power, alarm and fault
    - e. RS 485 communication bus to the central controller
    - f. Electrochemical sensors
    - g. CETCI model DST-ECO Carbon Monoxide transmitter, 0-200 ppm (fan start at 25 ppm, alarm at 100 ppm, adj.)
    - h. DST-END transmitter for Nitrogen Dioxide, 0-10 ppm (fan start at .7 ppm, alarm at 1.5 ppm, adj.)
    - i. Equal to Critical Environmental Technologies DST-W Digital Transmitter
  3. Multichannel Controller:
    - a. Field programmable, 8 analog transmitter capacity via RS485 communication to remote digital transmitters
    - b. BacNet output module
    - c. Eight SPDT relays
    - d. Audible alarm with silence button with remote combination 103 dB horn/4" diameter strobe light
    - e. 24 V power supply
    - f. Automatic reset thermal fuse
    - g. Two-line LCD display readings
    - h. UL certified
    - i. Equal to Critical Environmental Technologies PDC Multi-Channel Controller.
  4. Provide all power and communication cabling required in conduit. Utilize eight SPDT relays to hard wire fan actuation. Monitor on DDC system via BACnet communication.
  5. Calibration kit: Canister of gas, regulator and digital calibration readout.
- E. Refrigerant Gas Detection Equipment System:
1. Provide a stationary refrigerant gas leak detection system designed to alarm at a specified level of refrigerant gas in monitoring areas. The instrument shall be a wall mounted device with onboard sensor, using a pump to draw aspirated samples through tubing to the sensor, from the areas where refrigerant gases are most likely to concentrate. The

instrument shall be capable of sampling from an area and report data specific to each monitored channel. The refrigerant gas monitor shall meet the following specifications:

2. Coverage: single sensor onboard
3. Sensor type: Non-dispersive infrared (NDIR) sensor)
4. Gases detected: HFC, HFO, HCFC, CFC
  - a. The detector shall have an on-board gas library containing calibration data for >50 refrigerant gases, configurable to select a specific refrigerant for optimized accuracy of measurement
5. Accuracy:  $\pm 1$  ppm  $\pm 10\%$  of reading from 0-1,000 ppm ( $\pm 10$  ppm  $\pm 15\%$  of reading from 0-1,000 ppm for R-11, R-21, R-32, R-113)
6. Response time: T90 = 5 seconds plus sample transport time
7. Sample transport time: 19 seconds per 100 ft
8. Minimum detectable level: One part per million (1 ppm)
9. Automated zero-point calibration: The instrument shall periodically sample clean air and automatically perform a zero-point calibration
10. Number of channels: 1
11. Operating Temperature: 32°-122°F / 0°-50°C
12. Ambient Humidity: 5% to 90% RH (non-condensing).
13. Sampling Mode: sequential per channel
14. Pump rate: 6 liters per minute
15. Monitoring distance: 1,200 ft max. for combined length of sample and exhaust tubing (each channel)
16. User interface: Display screen and keypad; gas reading simultaneously displayed per channel for all channels a. Optional: Remote Display
17. Alarms: 3 levels
18. Power Status Indicator: Green LED
19. Alarm Status Indicator: Red LED, audible alarm, Modbus register, relay, display screen
20. Fault Status Indication: Yellow LED, Modbus register diagnostics, relay
21. Alarm reset: user selectable to be either manual or automatic.
22. Power: 100 to 240 VAC, 50/60 Hz, 20 W
23. Communications:
24. Modbus RTU: Baud rate 9,600 or 19,200, configurable
  - a. 4 x SPDT relays: low alarm, medium alarm, high alarm, fault
  - b. Optional: dual channel analog output; 4-20mA
  - c. Optional: BACnet
25. Certification: UL 61010-1, CAN/CA 22.2 No. 61010-1; EN61010-1, EN61326, EN14624; CE Mark
26. Manufacturer: Bacharach, SenTech, MSA Chillgard.
27. Warranty: One (1) year.

F. Manufacturers:

1. Brasch
2. ACME
3. Critical Environment Technologies

## 2.10 ACTUATORS

- A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers: Belimo Aircontrols (USA), Inc.
  2. Listing: Actuators shall have ISO 9001 quality certification and be UL listed under standard 873.
  3. Characteristics: Actuators shall be fully modulating/proportional, pulse width, floating/tri-state or two-position as required and be factory or field selectable. Each actuator shall have visual position indicators. Proportional actuators shall accept a 0-10VDC or 0-20mA input signal with 2-10VDC and 4-20mA operating range, respectively. Actuators shall be capable of operating on 24, 120 or 230VAC or 24VDC and Class 2 wiring as required by the application. Power consumption shall not exceed 10VA for 120V actuators and 8 watts for DC actuators. Actuators shall be capable of being mechanically and electrically parallel to increase torque if required
  4. Fail-Safe Operation: Mechanical, spring-return mechanism shall be provided on all dampers and valves except where noted otherwise. Provide external, manual gear release on non-spring return actuators.
  5. Valves: Size for torque required for valve close off at maximum pump differential pressure plus 25% safety factor.
  6. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch w.g. (of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch w.g. of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
    - g. Coupling: V-bolt and V-shaped, toothed cradle.
  7. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  8. Run Time: 12 seconds open, 5 seconds closed.

## 2.11 CONTROL VALVES

- A. General –
1. Factory fabricated, of type, body material, and pressure class based on fluid system, maximum pressure and temperature rating of piping system, unless otherwise indicated.

2. Manual Operation – Valves shall be equipped with a manual positioner to allow positioning of the valve in the absence of power.
  3. Sizing – Hydronic system control valves shall be sized as follows:
    - a. Two-Position: Line Size
    - b. Two- or Three-Way Modulating: 10 ft. hd. water pressure drop or as otherwise noted on the plans.
- B. Ball Valves 2” and smaller
1. Body
    - a. Cast Bronze or Brass, Nickel-plated Brass
    - b. ANSI B16.5 Class 150
    - c. Threaded or soldered pipe connection
  2. Trim
    - a. Stem: Stainless Steel
    - b. Ball: Stainless with an equal percentage flow characteristic or modified equal percentage flow characteristic for 2-way, linear for 3-way.
  3. Bonnet
    - a. Brass
    - b. Packing: Reinforced Teflon or carbon filled Teflon and EPDM O-Ring.
    - c. Seat: Reinforced Teflon or carbon filled Teflon.
- C. Butterfly Valves 2.5” – 12”
1. Body
    - a. Cast Iron with extended neck or flange and insulation clearance.
    - b. Flanged with full lugged connections.
  2. Trim
    - a. Stem: Stainless Steel
    - b. Disc: Stainless Steel, Nickel Plated Ductile Iron, or Ductile Iron coated with Nylon 11, equal percentage flow characteristics or modified equal percentage flow characteristics, bubble tight shut off.
    - c. Seat: EPDM
- D. Globe Valve 2” and Smaller
1. Body
    - a. ANSI B16.5 Class 125 and 250
    - b. Cast Bronze or Brass
    - c. Threaded (FNPT), union sweat, or flared connections
  2. Bonnet
    - a. Brass
    - b. Packing: Self-adjusting Ethylene Propylene Rubber (EPR) ring pack u-cups, spring loaded PTFE and Elastomer v-rings, or spring-loaded Teflon cone.
  3. Brass Trim
    - a. Stem: Stainless Steel
    - b. Plug: Brass, equal percentage flow characteristic or modified equal percentage flow characteristic.
    - c. Replaceable Seat: Brass against molded Elastomeric disc, or bronze.

4. Stainless Steel Trim (Steam Applications)
  - a. Stem: Stainless Steel
  - b. Plug: Brass, equal percentage flow characteristic or modified equal percentage flow characteristic.
  - c. Replaceable Seat: Stainless Steel.

E. Globe Valves 2.5" and Larger

1. Body
  - a. ANSI B16.5 Class 125 and 250
  - b. Cast Iron with black lacquer finish
  - c. Flanged Connections
2. Bonnet
  - a. Brass
  - b. Packing: Ethylene Propylene Terpolymer (EPT) ring packs, EDPM O-ring, or spring-loaded Teflon cone.
3. Trim
  - a. Stem: 316 Stainless Steel
  - b. Plug: Brass, equal percentage flow characteristic or modified equal percentage flow characteristic.
  - c. Replaceable Seat: bronze.

F. Pressure-Independent Characterized Control Valves (PIV)

1. Body
  - a. Brass rated at no less than 360 psi at 250°F.
2. Bonnet
  - a. Brass
  - b. Packing: Reinforced Teflon or carbon filled Teflon and EPDM O-ring.
3. Trim
  - a. Stem: Brass or Stainless Steel
  - b. Ball: Plated brass or Stainless Steel, equal percentage flow characteristic or modified equal percentage flow characteristic for 2-way, linear for 3-way.
  - c. Disc: Thrust-bearing Teflon disc with double O-ring design.
  - d. Seat: Reinforced Teflon or carbon filled Teflon with EPDM O-rings
  - e. Packing: EPDM O-ring.

G. Close-Off Pressure Rating – Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings.

1. Water Valves
  - a. Two-Way: 150% of total system pump head.
  - b. Three -Way: 300% of pressure differential between ports A and B at design flow rate or 100% of total system pump head.

H. Manufacturers –

1. Belimo

2. Griswold
3. Honeywell
4. Johnson Controls
5. KMC Controls
6. Siemens

## 2.12 CONTROL DAMPERS

- A. Dampers: AMCA 511 rated, parallel and opposed blade design as required by the application.
- B. Outside Air & Relief Air Dampers – Dampers exposed to outside air shall be severe cold, low leakage design with the following features:
  1. Frame: Extruded aluminum, 4" x 0.08" thickness with polystyrene foam insulation.
  2. Blades: Extruded aluminum, double wall profile with expanded polyurethane foam insulation filled cores and thermally broken. Insulation factor of R-2.29
  3. Seals: Blade and frame edge seals are extruded silicon, secured in an integral slot.
  4. Bearings: Celcon inner bearing fixed to a 7/16" aluminum hexagonal blade pin, rotating within a polycarbonate outer bearing without metal-to-metal or metal-to-plastic bearing contact.
  5. Linkage: Hardware mounted within the frame, aluminum and zinc plated steel construction.
  6. Operating temperature: -40 to 155°F.
  7. Leakage: Class 1A – 3 cfm/sq. ft. at 1" w.g., 4.9 cfm/sq. ft. at 4" w.g., maximum
- C. Return & Misc. Control Dampers – Dampers not exposed to outside air shall be constructed with the following features:
  1. Frame: Extruded aluminum, 5" x 0.125" thickness.
  2. Blades: Extruded aluminum, airfoil profile.
  3. Seals: Blade seals shall be extruded EPDM. Frame seals shall be extruded TPE thermoplastic, secured in an integral slot.
  4. Bearings: Molded synthetic
  5. Linkage: Hardware mounted within the frame, aluminum and zinc plated steel construction.
  6. Operating temperature: -72 to 275°F.
  7. Leakage: Class 1 – 4 cfm/sq. ft. at 1.0" w.g. max.
- D. Manufacturers –
  1. Greenheck
  2. Ruskin
  3. Nailor Industries
  4. Tamco
  5. Johnson Controls

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General – Verify location of wall mounted sensors with drawings and room details before installation. Install devices to match rough-in height of light switches provided by the Electrical Contractor. Coordinate location and placement with other wall mounted devices, cabinets, wall protective covering trim, etc.
- B. Wall-Mounted Room Temperature Sensors – Shall be installed on concealed metal junction boxes properly supported by the wall framing. Sensors located on exterior walls shall be provided with insulated bases.
- C. Averaging Duct Elements – Install averaging elements in ducts and plenums in a serpentine pattern.
- D. Low Limit Sensors – Sensors shall be installed in a serpentine manner horizontally across the coil. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each 1 square foot of coil area.
- E. Pipe Mounted Sensors – All pipe mounted sensors shall be installed in pipe wells. Wells and probe lengths shall be appropriate for the pipe diameters they are installed within. Install all liquid temperature sensors with heat-conducting fluid in thermowells.
- F. Outdoor Air Temperature/Humidity/Enthalpy Sensors – Install sensor on a north wall with a sun shield.
- G. Control Panels – Local control panels shall be provided for the equipment being controlled. The panel shall be mounted in the mechanical room with the equipment it serves. Mount panels on wall or independent support structure. Do not mount on equipment.
- H. Sensor Tamper Guards – Install plastic guards on room temperature sensors and/or thermostats in the following locations:
  - 1. Entrances.
  - 2. Public areas, such as lobbies.
  - 3. Gymnasiums & Weight Rooms.
  - 4. Public Restrooms.
  - 5. Corridors.
  - 6. Racquet Ball Courts
  - 7. Where indicated on drawings.
- I. Automatic Control Dampers –
  - 1. Dampers shall be furnished by the temperature controls subcontractor, installed by the HVAC Contractor in accordance with this section and Section 23 3300 "Air Duct Accessories."
  - 2. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

3. Damper linkages shall be through frame hardware; linkage attachments to blades are not acceptable.
4. Damper jack shafting is not permitted, provide an actuator for each damper section.

J. Identification of Hardware and Wiring:

- a. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination, with the DDC address or termination number.
- b. Permanently label or code each point/object of field terminal strips to show the instrument or item served.
- c. Identify control panels with minimum ½" letters on laminated plastic nameplates.
- d. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
- e. Identify room sensors relating to terminal units or valves with adhesive stickers.
- f. All identifiers shall match the naming convention on the drawings and within the DDC graphics.

### 3.2 SCHEDULES

A. Control Valves

| System Type                            | Valve Type(s)<br>(Per 2.6) | Fail Position |
|----------------------------------------|----------------------------|---------------|
| AHU Chilled Water Coil – 2" & Smaller  | Ball, Globe                | Closed        |
| AHU Chilled Water Coil – 2.5" & Larger | Globe                      | Closed        |
| AHU Hot Water Coil – 2" & Smaller      | Ball, Globe                | Open          |
| AHU Hot Water Coil – 2.5" & Larger     | Globe                      | Open          |
| VAV Terminal Unit                      | Ball, PIV                  | In-Position   |
| Unit Ventilators Chilled Water Coil    | Ball, PIV                  | Closed        |
| Unit Ventilators Hot Water Coil        | Ball, PIV                  | Open          |
| Unit Heaters                           | Ball, PIV                  | In-Position   |
| Finned Tube                            | Ball, PIV                  | In-Position   |



| Convectors                                 | Ball, PIV       | In-Position |
|--------------------------------------------|-----------------|-------------|
| Duct Mounted Heating Coils – 2” & Smaller  | Ball, Globe     | Open        |
| Duct Mounted Heating Coils – 2.5” & Larger | Globe           | Open        |
| Chiller Isolation                          | Ball, Butterfly | Closed      |
| Chiller Modulating Control – 2” & Smaller  | Ball, Globe     | Closed      |
| Chiller Modulating Control – 2.5” & Larger | Globe           | Closed      |
| Boiler Isolation                           | Ball, Butterfly | Closed      |
| Minimum Flow Bypass – 2” & Smaller         | Ball, Globe     | Open        |
| Minimum Flow Bypass – 2.5” & Larger        | Globe           | Open        |

B. Damper Actuators

| System Type    | Fail Position |
|----------------|---------------|
| Outside Air    | Closed        |
| Exhaust Air    | Closed        |
| Return Air     | Open          |
| Supply Air     | Open          |
| Storm Shelters | Open          |

END OF SECTION 23 0913

## SECTION 23 0914 – CONTROL WIRING AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes control wiring, both line and low voltage, transformers, power distribution, fusing and panels, power filtering and communication cabling which is required to perform the automatic control functions described.
- B. Related Sections:
  - 1. 23 0913 Instruments and Control Devices
  - 2. 23 0923 Direct Digital Control System

#### 1.2 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. Wiring, both line and low voltage, shall comply with NEC and shall be subject to approval by the local code enforcing authorities.
- C. Wire, conduit and installation methods shall conform to applicable provisions of Division 26 - Electrical except that wiring smaller than No. 12 and conduit smaller than 3/4" are permitted as appropriate for the application.
- D. Communication cabling shall conform to applicable provisions of Division 27- Section "Communications Horizontal Cabling".
- E. All wiring and cabling insulation in air return plenums shall not exceed maximum flame spread rating of 25 and smoke development rating of 50 as established by NFPA 255 test methods.

### PART 2 - PRODUCTS

#### 2.1 POWER SUPPLIES

- A. Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
  - 1. Output ripple of 5.0 mV maximum peak to peak.

2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

## 2.2 POWER LINE FILTERING

- A. Provide internal or external transient voltage and surge suppression for workstations or controllers with the following:
  1. Minimum dielectric strength of 1000 V.
  2. Maximum response time of 10 nanoseconds.
  3. Minimum transverse-mode noise attenuation of 65 dB.
  4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.3 POWER DISTRIBUTION, FUSING AND PANELS

- A. Power distribution transformers, fuses, termination strips etc. shall be organized in NEMA 1 enclosure panels. Panels shall be 16-gauge steel construction, with removable front cover and various size removable knockouts, arranged for surface mounting and polyester powder coat finish inside and outside, UL listed. Arrange and bundle wiring inside of panels neatly with cable ties. Panel and internal devices shall be permanently marked to correspond to power wiring diagram shop drawings provided in the operating and maintenance manual.

## 2.4 CABLING

- A. Primary Ethernet IP Cabling – Provide white colored, CAT 6A Ethernet shielded plenum-rated cabling to interconnect major controllers and workstation computer or Web server to establish the primary network configuration as determined by the direct digital control system architecture. Provide excess cabling at each connection for servicing by looping cable near the panel.
- B. Secondary Cabling – Secondary LON or BACnet MS/TP RS-485 3-conductor shielded plenum-rated bus wiring to secondary controllers such as unitary controllers serving VAV boxes shall be as required by the communication protocol.
- C. Plenum Rated – All cabling insulation shall be approved and labeled for use in air plenums where installed in these locations.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL POWER SUPPLIES

- A. The Electrical Contractor will provide a power source to motors through his starters only. Where power sources are required beyond these starters, or beyond sources explicitly shown on

the electrical drawings, these shall be provided by the Controls Contractor. Where auxiliary contacts are required on starters to perform the required functions, these too shall be provided by the Controls Contractor, where not provided under the Electrical Contract. Auxiliary relays may be provided in lieu of auxiliary contacts.

- B. Dedicated Circuiting – Circuits serving control panels, transformers for low voltage service, and other control equipment and devices shall be independent and used for no other purpose. These shall originate from the nearest appropriate emergency electrical panel. Circuit wiring from the electrical panel shall be included in this contract. These circuits shall be clearly identified at the panels.

### 3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install all work in accordance with the following:
  - 1. All wiring to be ran in a neat, workmanlike manner. All wiring to be tie wrapped or in conduit as per specifications. Wiring or conduit to be ran parallel or at right angles to building structure. Install all wiring free of sags. Bundle wiring together that follows a common path.
  - 2. All conduit, plenum wiring, and panels shall be supported directly from the building structure with beam clamps and bridle ring. Do not support from pipe, pipe hangers, threaded rod, ductwork, ductwork strapping or other conduit.
  - 3. Do not lay conduit or plenum wiring on acoustic ceiling tiles, grid members or uninsulated water piping. Conduit and wiring should be installed in such a way as not to interfere with removing ceiling tiles for above ceiling access.
  - 4. Do not run wiring near lighting ballasts or other high voltage devices that could cause interference.
  - 5. All line voltage wiring must be kept separate from low voltage wiring. Line and low voltage wiring may not be run in the same conduit. Line and low voltage wiring must be kept separate in control panels.
  - 6. Label all wire jackets at control panel/controller and at device with tag as shown on wiring details and flow diagrams.
  - 7. Observe proper polarity as shown on wiring diagrams when connecting 24VAC power and ground controllers and other devices. Note that all transformer secondary grounds must be tied to chassis ground as shown in wiring diagrams unless otherwise noted.
  - 8. Coordinate with General Contractor and all trades to perform rough-ins for temperature control sensors and devices.
  - 9. Coordinate with General Contractor and all trades to confirm mounting locations for temperature control panels.
  - 10. Completely seal all duct, unit and wall penetrations. Avoid ceiling penetrations if at all possible. Completely seal any ceiling penetrations that are absolutely necessary.
  - 11. All network communication wires shall be labeled at each controller with the designation or the controller that the communication wire originates from and terminates to
  - 12. Verify network communications and correct any issues.
  - 13. Clean all construction debris from inside temperature control panels before operation.
- B. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

- C. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." All line voltage wiring and low voltage wiring (except as stated below) shall be run in conduit. Low voltage wiring concealed above accessible ceilings and in hollow walls for drops to thermostats may be run without conduit. Open wiring dropping into walls shall be run in conduit. Thermostats shall be installed on a single gang box and conduit shall be installed to extend into the plenum. Open wiring shall be bundled and supported at 3 ft. maximum intervals with a system of J-hooks or equivalent means. Open wiring in air plenums shall be rated for such use and so labeled.
- D. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."
1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  2. Install exposed cable in raceway.
  3. Cabling concealed above accessible ceilings may be run without conduit. Cabling dropping into walls shall be run in conduit. Wall mounted sensors shall be installed on a single gang box and conduit shall be installed to extend to above an accessible ceiling location.
  4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

END OF SECTION 23 0914

## SECTION 23 0923 – DIRECT DIGITAL CONTROL SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. A complete system of computer based, direct digital automatic temperature controls shall be installed under this contract as required to accomplish the sequence of control for various items of equipment and systems indicated on the drawings and as specified in Division 23.
- B. Direct Digital Controls (DDC) upgrade for the existing building controls is part of the scope of work. Refer drawings for systems sequence of operations. Controllers, system architecture, communication cabling and network, software, graphics, etc. shall be seamlessly integrated as part of the new system.
- C. This Section includes Direct Digital Control (DDC) components, including operator workstation, controller/server, equipment specific and generic controllers, I/O interface, software and graphics.
- D. See Sections 23 0913 “Instruments and Control Devices” and Section 23 0914 “Control Wiring and Cabling” for requirements that relate to this Section.

#### 1.2 SUBMITTALS

- A. Product Data: For all hardware and software.
- B. Shop Drawings:
  - 1. Schematic air and fluid flow control diagrams.
  - 2. Sequence of operations descriptions and points list.
  - 3. Power and communication wiring diagrams.
  - 4. DDC System Hardware components, including controllers, actuators, sensors, valves, dampers, cabinet enclosures, power and communications wiring and devices, misc. controls devices, etc.
  - 5. Control System Software
  - 6. Graphics – Screen examples specific to the project for:
    - a. Air handling units
    - b. Packaged Rooftop Units
    - c. Fan Coil/Blower Coil Units
    - d. Fans
    - e. VAV Air Terminal Units
    - f. Heating hot water system
    - g. Chilled water system.
    - h. Condenser water systems
- C. Software and firmware operational documentation.

- D. Operation and maintenance data.

### 1.3 QUALITY ASSURANCE

- A. Each control subcontractor must be an authorized temperature control contractor in the business of installing and servicing direct digital temperature control systems for over five (5) years. The bidder must have installed and successfully completed at least ten (10) DDC systems of similar size using the same hardware that is proposed.
- B. Subcontractor installation and service office must be located within 75 miles (90 minute travel time maximum) of the building site.
- C. Design and installation of the digital control system shall be performed by employees trained and certified by the equipment supplier. Electrical power work other than low voltage shall be performed by licensed electricians.
- D. The temperature controls subcontractor shall provide all necessary engineering support for a complete and functional system, including but not limited to engineering, programming, installation, supervision, commissioning and troubleshooting.
- E. Refer to 23 0801 Mechanical Systems Commissioning.
- F. 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.
- G. ANSI/ASHRAE Standard 135 BACnet – A Data Communication Protocol for Building Automation and Control Networks.

## PART 2 - PRODUCTS

### 2.1 CONTROL SYSTEM

- A. The DDC control system shall operate on the Tridium Niagara 4 supervisor platform.
- B. Contractors: (Use for Dayton local contractors only)
1. Schneider Electric (TAC, Invensys) – I/A Series
  2. Point 2 Point
  3. Waibel Energy Systems
  4. Automated Solutions Group
- C. Manufacturers:
1. Tridium
  2. Distech
  3. Alerton
  4. Honeywell
  5. Vykon

- D. Complete DDC system shall consist of operator workstation, sensors, indicators, actuators, final control elements, interface equipment, wiring, cabling, power supplies and power distribution, other apparatus, accessories, software and graphics connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems as specified here and in related Division 23 Sections.

## 2.2 LICENSING AGREEMENT AND OPEN PROTOCOL

- A. A true Open Licensing Agreement shall be provided and executed with the Owner to permit total and open access to the system for servicing and software revisions by other qualified servicing contractors.
- B. The supplied system must incorporate open protocol with the ability to access all data using Java base Web enabled browsers without requiring proprietary operator interface and configuration programs.
- C. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. The software shall utilize a Java Database Connectivity (JDBC) compatible database such as MySQL, Oracle, IBM Db2, or Microsoft SQL Server databases, and HTTP/HTML/XML, CSV or text formats. This data shall reside on a server. Proprietary database and user interface programs are not acceptable (except for unitary controllers as noted below).
- D. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135, BACnet and LonMark to assure interoperability between all present and future system components is required.
- E. Proprietary programming shall not be utilized. In addition, all required programming software and graphics shall be embedded in the server or controllers without the need for external software to execute queries or revisions. All graphics shall reside in the server. Remote access via LAN or Web shall not require external software to provide complete access to all data, graphics, alarms, programming, etc.
- F. The licensing agreement shall provide a 5-year Software Maintenance Agreement (SMA) for the system supervisor and all controllers.

## 2.3 NIAGARA INFORMATION AND CONFORMANCE STATEMENT (NICS)

- A. The Niagara Information and Conformance Statement for all Niagara Software shall allow open access and be set as follows: `accept.station.in="**"; accept.station.out="**"; accept.wb.out="**"; accept.wb.in="**"`. In any case, the end user shall maintain the right to instruct the contractor to modify any software license, regardless of supplier, as desired by the end use. The contractor shall not install any "brand-specific" software, applications, or utilities on Niagara Framework-based devices unless accessible by any brand of Niagara tools.
- B. All hardware and field-level devices installed shall not be limited in their ability to communicate with a specific brand of Niagara Framework JACE. They shall also be constructed



in a modular fashion to permit the next generation and support components to be installed, in replacement of or parallel with existing components. All controllers must be able to be programmed with Niagara Workbench.

- C. At the completion of the project, the owner shall be given all existing platform and station login credentials to include; super user (admin) usernames; passwords and passphrases.

## 2.4 DDC ARCHITECTURE

- A. DDC system shall be complete with an Operators Workstation/Server, Configurable Controllers, Unitary Controllers, required I/O modules for controller expansion, communication cards in controlled devices such as chillers, boilers, ECM fan arrays, packaged rooftop units, variable frequency drives (furnished with the equipment, coordinate card requirements), etc., arranged for a completely integrated building automation system network.
- B. Communication Wiring:
1. Physical connection between the operator station and the owners Local Area Network (LAN) should be via ethernet CAT-6 cable.
  2. Physical connection between Configurable Controllers / Servers (JACE 9000) and the owner's LAN shall be via BACnet IP with CAT-6 cable.
  3. Unitary controllers shall be physically connected via **BACnetIP / BACnet MS/TP**. Daisy chains shall follow the specified Networking Protocol.
  4. Networking Protocol: **Rapid Spanning Tree (RSTP) / Network Time Protocol (NTP4)**
- C. Where data drops are not shown for the Configurable Controllers or Operator Station/Server, the temperature control subcontractor shall be responsible to provide the IP data drop to each network controller location for controller connectivity. Installation shall be subcontracted to the division 27 technology contractor; coordinate connection requirements. In addition, provide an additional IP data drop to each controller, or group of controllers to provide local access to data acquisition for the HVAC service technician.
1. If the project does not include a division 27 technology contractor, the temperature controls contractor shall still be responsible to provide the IP data drops to their controllers. Work shall be contracted out to a certified technology company capable of providing this scope of work.
- D. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the

point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

- F. DDC system accessibility over the LAN or the Internet shall be username and password protected. Provide separate user name/password for multiple level hierarchy to restrict access to appropriate personnel at the different levels (view, programming, etc.). The system must be set up to have at least 3 access levels: guest, user and administrator. Guest privileges shall be limited to view only. Users shall be able to make setpoint and schedule changes. Administrators shall have all privileges as users in addition to being able to assign passwords.

## 2.5 NIAGARA SUPERVISOR (Only required if there are multiple JACE's in a building)

- A. The Niagara Supervisor shall be hosted locally on the Local Operator Workstation/Server / Virtual Machine (VM) / Main Campus Data Center.
- B. Supervisor Operating Platform: Niagara 4.15.
- C. Provide all required software licenses required to import all monitored JACE controllers to the system.

## 2.6 OPERATOR WORKSTATION/SERVER

- A. An operator workstation/server shall be provided to effectively program, manage and access DDC information from all of the controllers. Interface shall utilize dynamic color graphics of each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- B. All DDC information shall be accessible through the server over the LAN as well as over the Internet via Ethernet IP.
- C. The operator workstation/server shall have the following minimum requirements (or equivalent):
1. Processor: Intel Xeon 4<sup>th</sup> Gen (or better), Intel Core i-series 12<sup>th</sup> Gen (or better), AMD Ryzen 5 Gen 3 (or better).
  2. Memory: 16 GB DDR4 minimum, 32 GB or more recommended for larger systems.
  3. Hard Drive: SSD 512 GB Minimum; provide larger hard drive space if required for data archiving.
  4. Network Support: Ethernet adapter (10/100/1000 Mb with RJ-45 connector)
  5. Monitor: 24" wide, 1080p (1920 x 1080) minimum resolution.
  6. Operating System: Windows 11 x64-bit; Windows Server 2025.
  7. Browser: Chrome, Firefox, Microsoft Edge.
  8. Mobile Browser: Safari on iOS, Chrome on Android.
  9. Relational Database: MS SQL Server 2022; MySQL Server 9.0.
  10. Keyboard – Hardwired.
  11. Mouse – Hardwired, Optical, Three Button with Scroll Wheel.
  12. Stereo Speakers.

- D. The server shall provide integrated control, supervision, data logging, alarming, scheduling and network management functions. The controller/server provides the Internet connectivity and Web serving capabilities, presenting real time information in Web based, rich graphical displays for the system. Application control programs to provide: Calendar functions, Scheduling, Trending, Alarm monitoring and routing, and Time synchronization.
- E. Proprietary programming shall not be utilized. In addition, all required programming software shall be embedded in the server or controllers without the need for external software to execute queries or revisions. All graphics shall reside in the server. Remote access via LAN or Web shall not require external software to provide complete access to all data, graphics, alarms, programming, etc.
- F. The server shall support standard Web browser access via the Intranet/Internet.
- G. Provide and maintain an Audit Log that tracks defined activities on the system. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached a user-defined buffer size. Archive the log locally. For each log entry, provide the following data: Time and date, User ID, Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- H. The controller/server shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval. Copies of the current database and the most recently saved database shall be stored in the server. The age of the most recently saved database is dependent on the user-defined database save interval. The controller/server database shall be formatted to allow for user viewing and editing, if desired.
  - 1. The standard backup shall occur weekly on Sunday's at 2:00AM.

## 2.7 JACE FIELD INTEGRATION CONTROLLER

- A. Controller: JACE-9000
- B. Provide a Niagara-4 embedded controller / server platform controller (JACE-9000) to operate as the primary field integration and supervisory node for the HVAC control system.
- C. The JACE shall integrate multiple HVAC subsystems and various communication protocols.
  - 1. Individual HVAC equipment, such as AHU's, Chillers, Boilers, air control box terminals, fan coils, unit heaters, etc shall utilize local Unitary Controllers (Refer to Section 2.8 Below).
- D. Controllers shall be capable of functioning in either a standalone capacity or integrated into the building network.
- E. Controllers shall be fully configurable type with both control and server capabilities including integrated control and management of external devices, supervision, data logging, alarming, scheduling, network management functions, Internet connectivity, web serving. The controller shall include software technology capable of integrating a variety of devices, interoperable

networks and protocols such as LonWorks, BACnet, ModBus, etc into a seamless operating platform.

- F. The controller shall be expandable to add additional BACnet integration points. Each JACE-9000 shall meet the following minimum hardware features. Where required for functionality provide additional communication or memory cards:
1. 1.6GHz NXP iMX8M+ Quad Core CPU
  2. 2GB LPDDR4 RAM
  3. 8GB onboard EMMC Storage
  4. 8GB Micro-SD card (backup media)
  5. Two (2) Ethernet Port -10/100/1000 Mbps
  6. USB type C connector
  7. Two (2) RS-485 ports
  8. BACnet driver (IP),
  9. Power Supply 24VAC power supply module,
- G. The JACE must be capable of operation over a temperature range of -20 to 60°C and storage temperatures of between -45 and 85°C. The controller/server must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.
- H. The controller/server shall support standard Web browser access via the Intranet/Internet.
- I. System Action Archive: Where acting as a server, provide and maintain an Audit Log that tracks all activities performed on the controller/server. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the controller/server), to another controller/server on the network, or to a server. For each log entry, provide the following data: Time and date, User ID, Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- J. System Backup: The JACE shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval. Copies of the current database and, at the most recently saved database shall be stored in the controller/server. The age of the most recently saved database is dependent on the user-defined database save interval. The controller/server database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.
- K. Controllers shall be fully programmable with “drag and drop” graphic representations of control algorithms and easy to use “wizards” that automate controller configurations.
- L. Controllers shall be “Native” BACnet devices with interoperable native BACnet IP, LON and BACnet MS/TP communication support.
- M. If the system size exceeds 80 BACnet devices across 2 network trunks with 4,000 total points, a second JACE shall be provided, and the control system shall be segmented accordingly.

## 2.8 CONFIGURABLE UNITARY CONTROLLERS

- A. Individual, configurable controllers shall be provided for each central HVAC equipment or system (AHU, Boiler, Chiller, etc.) Controllers designed specifically for VAV reheat air terminal units, fan coil, unit heater, etc., shall be used for each distributed HVAC equipment item. Local controllers shall be capable of functioning in a standalone capacity but shall be integrated into the building network.
- B. Controllers shall be equal to that of Distech Eclypse Connected controllers.
- C. Controllers shall be fully configurable type with both control and server capabilities including integrated control and management of external devices, supervision, data logging, alarming, scheduling, network management functions, Internet connectivity, web serving. The controller shall include software technology capable of integrating a variety of devices, interoperable networks and protocols such as LonWorks, BACnet, ModBus, etc into a seamless operating platform.
- D. I/O modules shall connect to the controller with a single multi pin plug, powered through the controller with a minimum of eight (8) universal inputs, four (4) analog outputs and four (4) relay outputs, Form A contacts. Do not exceed maximum I/O modules recommended by the manufacturer.
- E. Controllers shall be capable of functioning integrated into the building network or in a standalone state if communication with the JACE or Supervisor is lost.
- F. Each controller with I/O modules shall include input/output capabilities with, as a minimum, sufficient universal inputs, digital inputs, universal outputs and digital outputs to perform the required function and include an additional spare two (2) universal inputs, (2) analog outputs and two (2) relay outputs for future upgrade capability (spare points are not required for unitary controllers).
- G. Use of a dedicated network with a proprietary communication protocol that is compatible for integration into the configurable controllers is acceptable provided the unitary controllers use true peer to peer communication for all devices, the communication network uses simple non polarity sensitive twisted pair wiring and the network provides for interoperability between devices and controllers such as Echelon LonWorks is acceptable.
- H. For VAV reheat air terminal units:
  - 1. The controller shall include, where required, a digital communication to:
  - 2. The remote, space temperature and/or humidity wall sensor,
    - a. The remote wall sensor shall include a communication jack for connecting a laptop to the terminal unit controller for air/water balance purposes.
  - 3. Velocity pressure pneumatic input via polyethylene tubing for supply air flow reading,
  - 4. Supply air flow sensor,
  - 5. Flow balancing software (damper adjustment, set point monitoring and adjustment, flow validation and calibration, sequence/calibration/control set point logs)
    - a. Terminal unit supply air temperature sensor
  - 6. Integral controller/damper actuator is acceptable.

- I. Controllers used for remote temperature and humidity sensing, adjustment and override such as VAV air terminal unit controllers and fan coil units shall include S-link communication via two wire, unshielded cable (non polarity sensitive) to provide power and communication interface for remote sensors.

## 2.9 CONTROLLER ENCLOSURE AND LISTING

- A. Controllers shall be placed within enclosures that conform to NEMA-1 construction and shall further meet UL 94-5VA flammability ratings for plenum application use.
- B. Each controller shall be UL-916 listed and meet FCC Part 15 Class A.

## 2.10 GUI DISPLAY FRAMES

- A. System Access – The system must be set up to have at least 3 access levels: guest, user and administrator. Guest privileges shall be limited to view only. Users shall be able to make setpoint and schedule changes. Administrators shall have all privileges as users in addition to being able to assign passwords.
- B. Each air handling unit, heating water system, and cooling system shall have a minimum of 5 graphic screens available from the tree view.
  1. Diagrammatic – One diagrammatic screen shall display the airflow pattern with all dampers, coils and fans shown in their correct schematic location and dynamic data for all input values shown. This main graphic screen shall show the control devices in mechanical flow diagram format with directional arrows to indicate normal flow arrangement. These screens shall be available to anyone with access to the system, and therefore shall be view only.
  2. Text Screen – Text screen shall display text information with the following primary categories:
    - a. Occupied status
    - b. Unit status
    - c. Temperatures,
    - d. Heating, cooling mode
    - e. Economizer,
    - f. Static pressure & setpoints
    - g. Supply, return and exhaust fan status including setpoints.
  3. A loop tuning screen shall also be furnished for each control loop, so that people with the appropriate access can change loop tuning parameters from PCs without needing individual programming tools.
  4. Override screens shall be furnished for each controller to permit overriding control points without the need for vendor specific software.
  5. An alarm screen shall also be furnished for each AHU, heating plant or cooling plant. The heating and cooling systems shall have similar screens as the AHUs.
- C. Each VAV air terminal unit shall have a graphics screen and a text screen.

- D. Systems that won't permit creating these customized screens as described herein will not be acceptable. Systems that use controllers that won't permit overrides of inputs and outputs from a browser based graphic screen will not be acceptable.
- E. Animations
1. All shapes shall be 3-D with a common perspective.
  2. All dampers shall have a minimum of 5 animation levels to show partially open, half open, mostly open, fully open, and closed position of dampers.
  3. All analog inputs shall show the actual value and engineering units on the graphic screen.
  4. Binary inputs shall be linked to flashing animated displays.
  5. Safety alarms will flash when in alarm.
  6. Filter status shall be indicated when value indicates that they are dirty.
  7. To prevent clutter on the graphic displays, symbols will only be shown for equipment that is controlled or monitored by the DDC system.
  8. Normal status for safeties will not be indicated, and normal status for safeties will be indicated by an image of a clean filter.
  9. Pumps and fans shall rotate when flow is proven by a monitoring device. Coils shall change color when valves are open to permit water flow through the coils.
- F. Color Schema – Graphics shall use common color schemes to make the overall system easy to understand. All overall backgrounds shall be white or other neutral color. All text shall be black. Any value that is in alarm shall be red or have a red background. Any value that is overridden shall have a blue background. All like sensors shall be the same color. For example, all temperature devices shall be yellow, all pressure devices shall be purple, all humidity devices shall be teal, all fire alarm devices shall be red, and all CO2 devices shall be green.
- G. Current setpoints and occupancy status shall be shown at the bottom of each graphic screen.
- H. Floor Plans – Overall floor plan drawings shall be provided, and permit access to each zone's individual floor plan sections.
1. On the individual floor plan sections, room numbers and room temperature and setpoint shall be displayed. Values that are out of the acceptable range shall appear in a different background color and/or flash.
  2. Each VAV air terminal unit shall have its own graphic screen that contains the points from within its controller including the box flow setpoint, room temperature setpoint, maximum cooling flow setpoint, minimum cooling flow setpoint, and minimum heating flow setpoint, plus the discharge air temperature from the AHU supplying the unit. The VAV text screen shall have the same information as the graphic screen plus high and low flow calibration values, damper rotation adjustment (CW or CCW), and air balance set-up features.
  3. GUI shall permit operator the ability to enable, set or disable high and low occupied and unoccupied limits for each room temperature reading.
- I. Text Screens shall be available for all levels of access. Setpoint and output values are changeable from the text screen for users with appropriate access privileges and administrators, but not guests. When a value can be overridden or edited, a red box shall appear around it when the cursor is position on it. A single click of the mouse shall bring up pop up menu that provide options to make a permanent override, change setpoint, or release a previous override of an output point. Analog inputs shall have pop up menus that allow setting high and low alarm

limits and the ability to enable and disable alarm limits as appropriate for the sensing device. Pop up menus must be customized to include a description of the point that is being modified. Generic override menus are not permitted because they would not describe to an operator what is about to be modified. The Control Contractor shall set up all initial alarms as indicated in the point matrix.

- J. Text screens shall include schedule information including current state and date and time of next scheduled event. Positioning the mouse over the current state shall permit single click access to the schedule. The schedule screen shall allow the operator to edit a yearly, weekly, daily, holiday or special event schedule for the system being viewed. Temperature values and setpoints shall be displayed below the schedule information, and shall have a minimum of 1 decimal place. Heating, cooling and damper outputs shall be displayed next. The OA temperature for economizer switchover shall be displayed and adjustable from the text screen. Air flow readings shall be shown with setpoint and actual readings. Fan information shall be shown next, followed by static pressure readings and setpoints, which shall have a minimum of 2 decimal places. Miscellaneous setpoints including night setback cooling and heating, average zone temperature, return air warm-up and cool-down, dehumidification, and unoccupied mixed air temperature setpoints shall all be shown and adjustable. All safeties shall be shown, followed by coil pump control information.
- K. Each system shall have its own specific alarm screen available to all operators but only editable by operators with user and administration access privileges. From the alarm screen, users and administrators shall be able to enable and disable alarms. Points that are in alarm shall have an alarm symbol highlighted in red. Points that are not in alarm shall be shown in gray. Alarms that are disabled shall have a way to indicate this on the alarm screen graphic.
- L. Loop tuning screens shall be available through the web browser interface to save the owner the cost and time associated with using vendor specific software for tuning loops. Access to these screens shall not be provided to guests. Air handling units shall have dedicated screens for discharge air temperature, static pressure, and outside air control loops. Loop tuning screen for discharge air temperature shall include the discharge air temperature, discharge air temperature setpoint, cooling loop throttling range, I-gain and ramp time, heating loop throttling range, I-gain and ramp time, economizer loop throttling range, I-gain and ramp time, unoccupied heating loop throttling range, I-gain and ramp time, cooling valve output, heating valve output, and damper control output. Screens shall also have graphs that show 5 minutes of live data for the discharge air temperature, setpoint, cooling valve, heating valve and mixed air dampers. Each loop tuning screen shall include the appropriate throttling range, I-gain and ramp time.
- M. Each non-unitary controller shall have an override screen. These screens shall be available on-site for use during point-to-point check-out and commissioning. The override screen shall show the inputs and outputs for each controller with the points in their wired location. Unused points shall be shown as spares. Points that are in alarm shall have a red background, and points that are overridden shall have a blue background just as on other screens. These screens shall show the actual values that come back from the controller, not the values that may have been typed in for override at the GUI if the controller software is not accepting the override value. The override screen shall also permit timed overrides.
- N. Each air handling unit shall also have an overview screen listing every VAV terminals data in a text format that includes occupancy mode, room temperature, room setpoint, box flow, flow



setpoint, temperature leaving VAV terminal, % cooling and % heating. Also, each VAV AHU shall have an air balance screen that will permit balancing the system through a computer connected to the Ethernet or directly to the appropriate BC without vendor specific software. The air balancing screens shall permit at least 8 manual override commands: normal, position (%), flow value, flow percent, open, close, min flow, and max flow.

- O. Heating systems and cooling systems with multiple pieces of equipment such as pumps with lead-lag control shall display which device is lead and when the other device will become lead on the text screen.
- P. Although only one outside air temperature sensor is needed per building, the GUI shall use independent outside air temperature points, so that during check-out and commissioning, the outside air temperature for a system can be changed without changing the outside air temperature for the whole building. The GUI shall also have a global outside air temperature point that can be overridden from the screen for the controller where the point is physically connected. Overriding this outside air temperature value will change it for all systems, except when outside air temperature has been overridden for an individual system.
- Q. The system shall allow for the easy development and editing of dynamic graphics. Wizards shall be utilized to assist the operator with their manipulation of the graphic system. The operator shall be able to, through a single mouse function, select between the dynamic display mode and the graphic edit mode for the currently viewed graphic frame, assuming appropriate access level is provided to the operator. Systems requiring multiple mouse or operator keyboard commands to enter the graphic edit mode are not desirable and require thorough definition of steps involved to accomplish function.
- R. Animation of system data shall be provided via graphic elements on the display frames. Standard graphic element library shall be provided to assist the operator with their implementation. The ability to define and add new animated graphic elements shall be provided. As a minimum, the ability to move, size, draw, arrange, align, layer, space, rotate, invert, duplicate, cut, copy, paste, erase any animated element shall be provided. System parameters and setpoints shall be assignable and modifiable by the animated graphic elements, relieving the need for keyboard commands for system manipulation.
- S. The ability to simultaneously display a dynamic X/Y chart of selected points, shall be provided. The chart shall be an element of the graphic display and shall automatically update with the display data. The chart shall allow dynamic manipulation to modify the range, rate, and timeframe of view, in both real-time as well as historical configuration. A minimum of 4 values shall be included on any chart display element. There shall not be a limit to the quantity of chart elements displayed on a graphic frame. Trace colors and X values shall be User configurable. Systems not providing this capability are required to provide an equivalent charting package with the GUI offering.
- T. The ability to provide graphically displayed global scheduling and editing functions should be provided. The ability to link these functions to the associated equipment or zone frames shall be a standard feature. A calendar shall be provided for display and modification of the SDC time clock functions. The User shall be able to view a daily, weekly, monthly, annual, special or holiday schedule from a defined display frame. A list of served areas shall be displayed on the same screen, this list shall be always displayed, pull down menus or other means of

accessing these areas shall not be acceptable. The system should have a master override screen that will allow an operator to change the schedule for every piece of equipment in every building by changing the master schedule.

- U. All analog values shall be trended every 15 minutes. The trend samples shall be saved in the BC for at least 36 hours. Access to trended data shall be available by the single click of a mouse on the analog value. Systems that open other windows and require a selection of the desired data are not acceptable.

## 2.11 GUI ALARMING

- A. The GUI shall provide, as standard, alarm annunciation of system data. On every display frame, the ability to view, acknowledge, delete and manipulate real-time and historical alarms shall be provided. The ability to provide a unique and custom alarm display for every display frame shall be provided. The ability to continuously or upon request, view the alarm display, shall be provided.
- B. Alarm conditions shall be capable of invoking, as a minimum; a display frame, an email message, and a text message sent to a pager or cellular phone.
- C. Alarm logging shall be provided in a user definable configuration. All alarms shall be displayed and/or routed as follows, as a minimum; GUI display frame, local printer, server printer, client printer, logged to file, and archived in standard format for information management. Alarm groupings shall be hierarchical in nature allowing up to 8 alarm groups and 16 sub-groups. The GUI shall not possess any limits on the quantity of alarms that can be logged, including historical data archiving. Systems possessing limits must define the restrictions and may not be acceptable.
- D. Provide up to 999 alarm priorities with up to 5 alarm color changes, per priority, according to alarm status.

## 2.12 GUI TRENDING

- A. The GUI shall automatically perform time based, user defined, periodic collection of real time point data. The data shall be presented as an X/Y chart in the display frame. The data shall be stored and archived in a file format that allows for the manipulation and utilization of the data by third party applications.
- B. A dynamic trend shall be defined as a group of at least 4 data points, with a circular buffer of 2000 data points. A historical trend shall be defined as a group of at least 8 data points, with the sampled points limited only by archival disk space. Sampling rates shall be user selectable from instantaneous (one per second) to once a week. Collection of data shall be user selectable to start and stop on a specific time and date. There shall be no limit to the number of X/Y charts within a display frame.

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- C. X/Y charting and column and row reporting shall be an integral part of the system. All points shall be chartable or reportable. Analytical data shall be displayed for any of the selected points in a clearly displayed X/Y chart. This analytical data shall consist of at least the following: Average Mean, Standard Deviation, Simple Average, Current Value, Cycle Length, Cycle High and Cycle Low.
- D. X/Y charting shall provide for the following chart manipulation: display, zoom, scroll, centering, pen legend and export to Excel, Text via Dynamic Data Exchange.

### PART 3 - EXECUTION

- 3.1 Furnish a complete set of shop drawings showing the kind of control equipment for each of the various systems and their functions, along with indication on the drawing of all original setpoints and calibration values and set up parameters, and sequence of operation and also that of the automation system. These drawings shall be submitted for approval to the Engineer, together with a complete brochure describing the equipment and their function and operation.
- 3.2 The control equipment supplier shall submit a detailed outline of the owner training material for review and comment by the Engineer during the shop drawing phase. The control system training program shall be customized to reflect the systems installed under this contract and shall cover, as a minimum: software navigation (via custom graphics and Windows based icons), system architecture, pass wording and system security features, input/output control functions, alarm functions/acknowledgement, trending/long term reporting, and control component operation.
- 3.3 Provide all required IT network connections to the DDC system.
- 3.4 Upon completion of the project, furnish and turn over to the Owner and Architect (3) complete sets of brochures describing the various items of equipment, their functions and directions for operation and maintenance.
- 3.5 Upon completion of the control system, the Control Contractor shall adjust all components of the system. The Controls Contractor shall make all adjustments in the control system required and as directed by the air balance contractor to achieve the desired air balance quantities. All instruments shall be carefully calibrated and each control function shall be demonstrated to function properly, to the satisfaction of the Engineer and the Owner. Provide a complete instruction manual covering the function and operation of all components. At the time of demonstration, each function shall be simulated to insure that controls respond properly to all signals, and the Owner shall be instructed in the proper operation of the system.
- 3.6 In addition to the adjustments and fine tuning, the Contractor shall include as a part of this contract an additional 40 hours of service technician time for work as directed or authorized by the Engineer to make software changes or field adjustments to hardware.
- 3.7 During the first year of operation, after acceptance by the Owner, the Control Contractor shall provide complete service to adjust or assist the Owner in adjusting the equipment to obtain optimum performance from the control equipment and from the heating and air conditioning systems in general. This shall be done without additional expense to the Owner. This work shall include revisions to DDC software programs and controller programs, and all PC front end software upgrades. A backup of final field programs shall be created and stored in a safe location, as coordinated with the owner.

3.8 The control equipment manufacturer shall provide instruction and training of the Owner's personnel regarding the hardware and software of the system. Software training shall include programs, methods of programming, control loops, scheduling and reports. Training covering hardware shall include operation information, functional use, wiring diagrams and schematic diagrams necessary to troubleshoot the operating system. Training shall include "hands on" instructions to completely familiarize Owner's personnel with the equipment and system. Training of Owner's personnel shall be equal in scope and detail to that provided by the manufacturer to its service technicians.

3.9 Coordinate with Owner's IT Department for instruction on connection to the LAN.

### 3.10 TRAINING

The control equipment supplier shall provide 40 hours of instruction at the job site to familiarize the Owner's personnel in the application and details of the installed system. Site training classes shall not be scheduled for longer than 4 hours duration except at the discretion of the Owner.

### 3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- C. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check instrument tubing for proper fittings, slope, material, and support.
  - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check dampers. Verify that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:
  - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
  - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
  - c. Verify that spare I/O capacity has been provided.
  - d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

END OF SECTION 23 0923

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## SECTION 23 3113 - DUCTWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Duct Materials
2. Rectangular Ductwork
3. Single Wall Round and Flat Oval Ductwork
4. Duct Liner
5. Branch Duct Connectors
6. Sealants and Gaskets
7. Hangers and Supports

##### B. Related Sections:

1. Division 23 Section 0713 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Division 23 Section 0713 "Duct Insulation" for insulation and duct liner products.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  1. Fabrication, assembly, and installation techniques.



2. Factory- and shop-fabricated ducts and fittings.
3. Reinforcement and spacing.
4. Seam and joint construction.
5. Duct Liner
6. Duct Connectors
7. Duct Sealants and Gaskets
8. Penetrations through fire-rated and other partitions.
9. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
10. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Welding certificates.

#### 1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

### PART 2 - PRODUCTS

#### 2.1 DUCT MATERIALS

A. Refer to 'Ductwork Systems Schedule' on drawings.

#### 2.2 RECTANGULAR DUCTWORK

A. Construction

1. Single wall factory- or shop-formed continuous helical (spiral) lock seam.

B. Joints & Seams

1. Butt Joints
  - a. Flanged System – Equal to Ductmate Industries "25 and "35" Adhere strictly to manufacturer's instructions.
  - b. Slip & Drive connections

2. Seams
  - a. Pittsburgh Lockseam

C. Fittings & Transitions – Shall conform to SMACNA Figure 2-7.

1. Transition angles shall be limited to 30 degrees on converging transitions and 20 degrees on diverging transitions.
2. Elbows – Fittings shall have an inside radius equal to the duct width. 90-degree elbows shall be square with double wall turning vanes. Elbows less than 90 degrees shall be radiused. Non-radiused elbows less than 90 degrees, with or without turning vanes are not permitted.
3. Branch take-offs, where not detailed otherwise, shall be with a static boot (45-degree clinch collar) per SMACNA Figure 2-6 or conical spin-in fitting. Straight tap take-offs are not permitted.
4. Square throat, radius heel 90-degree elbows are not permitted.
5. Radiused, angled (15° Max.), or Mitered (15° Max.) offsets.
6. Concentric Transitions,  $\theta = 45^\circ$  Max.
7. Eccentric Transitions,  $\theta = 30^\circ$  Max.

2.3 SINGLE-WALL ROUND AND FLAT OVAL DUCTWORK

A. Medium Pressure Applications – 2” in. w.c. S.P. and higher

1. Construction
  - a. Single-wall factory- or shop-formed continuous helical (spiral) lockseam.
2. Joints & Seams
  - a. Butt Joints
    - 1) Slip connections with EPDM or neoprene gaskets equal to McGill Airflow #Uni-Gasket.
    - 2) Flanged system with EPDM or neoprene gaskets equal to McGill Airflow #Uni-Flange.
  - b. Seams
    - 1) Spiral lockseam
3. Fittings & Transitions – Shall be compatible with duct system.
  - a. 90-Degree Branch tees shall be streamlined, spin-in conical type with Y branches.
  - b. 45-Degree lateral tee wherever possible.
  - c. Die-stamped elbows,  $r/D = 1.5$  (minimum).
  - d. Radiused, angled (15° max.) or mitered (15° max.) offsets.
  - e. Concentric transitions,  $\theta = 45^\circ$  max.
  - f. Eccentric transitions,  $\theta = 30^\circ$  max.

B. Low Pressure Applications (1” S.P. or less).

1. Construction
  - a. Single-wall factory- or shop-formed continuous helical (spiral) lockseam.

2. Joints & Seams
  - a. Butt Joints
    - 1) Slip connections with EPDM or neoprene gaskets equal to McGill Airflow #Uni-Gasket.
    - 2) Flanged system with EPDM or neoprene gaskets equal to McGill Airflow #Uni-Flange.
  - b. Seams
    - 1) Spiral lockseam
    - 2) Round Ductwork: Longitudinal seams may be utilized for 1" and less (positive and negative) static pressure construction class at final air devices.
3. Fittings & Transitions – Shall be compatible with duct system.
  - a. Factory- or shop-formed and welded.
  - b. Elbows shall be long radius type.
  - c. Elbows for longitudinal seam round ductwork shall be factory- or shop-formed segmented standing seam or pleated. Other fittings shall be comparable to the elbows.
  - d. Round Ductwork Additional Provisions:
    - 1) Standard tees allowed.
    - 2) Segmented elbows allowed.

## 2.4 DUCT LINER

- A. Refer to the "Ductwork Insulation Schedule" on Drawings for products and thickness.

## 2.5 BRANCH DUCT CONNECTORS

- A. Round duct branch connection to rectangular sheet metal duct
  1. Conical flanged press-on or spin-in connector with manual damper for branch ducts to air devices.
  2. Damper: Single Blade with heavy duty quadrant locking handle. Provide shaft stand-off for insulated duct systems. Stand-off depth per duct insulation thickness.

## 2.6 SEALANT AND GASKETS

- A. Duct sealant materials shall be:
  1. Water based synthetic latex emulsion duct sealant equal to Ducmate PROSeal.
    - a. No V.O.C.'s
    - b. UL 181B-M Listed, UL 723 classified
    - c. For applications up to 15" w.g.
    - d. Gray Color
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## 2.7 HANGERS AND SUPPORTS

- A. Strap and Rod Sizes / Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- B. Strap Hangers:
  - 1. Strap hanger material shall match that of the ductwork it is supporting.
  - 2. Structure Connections
    - a. Steel Construction:
      - 1) Loop strap around
    - b. Concrete Construction:
      - 1) Concrete Structure Shot Fire Attachment
      - 2) Pre-Set Concrete thread attachment
      - 3) Drilled expansion anchor.
    - c. Wood Construction
      - 1) Lag Bolt – Min. 2" Length
    - d. Cold Rolled Steel Construction
      - 1) Sheet Metal Screw
- C. Hanger Rods
  - 1. Noncorrosive Environments: Cadmium-plated steel rods and nuts.
  - 2. Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - 3. Structure Connections:
    - a. Steel Construction: Threaded Rod Universal C-Type Clamp: Equal to Anvil Fig. 92.
    - b. Concrete:
      - 1) Pre-Set Concrete thread attachment
      - 2) Drilled threaded expansion anchor
    - c. Wood Construction
      - 1) Vertical threaded rod anchor: Equal to Sammy 1/4" x 2"
    - d. Cold Rolled Steel Construction
      - 1) Threaded retaining nuts and washers, both sides of steel.
  - 4. Provide swivel attachment for hanger rods anchored to angled construction. Equal to Anvil #AF777.
- D. Steel Cables
  - 1. Product equal to Gripple No. 3 or No. 4 cable.
  - 2. Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
  - 3. Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- E. Steel Cable End Connections - Assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
  - 1. Cable End Fitting: Equal to Gripple #LG, #LS, or #HG
  - 2. Cable Locking Fastener: Equal to Gripple #HF

3. Rectangular Ductwork Trapeze Hanger: Equal to Gripple #DT2.
  4. Trapeze Hanger: Equal to Gripple #TZ3.
  5. Beam or Purlin Clamp: Equal to Gripple #GCB.
  6. Wood Truss Eyelet: Equal to Gripple #EYQG.
  7. Concrete Structure Shot Fire Attachment:
    - a. General Concrete Structure: Equal to Gripple #SF35.
    - b. Post Tensioned Concrete: Equal to Gripple #C945 or #NZ90.
  8. Cold Rolled Steel 90-Degree Eyelet: Equal to Gripple #EY90\*G.
  9. Metal Deck Insert: Equal to Gripple #MDI-Y
    - a. Pre-install prior to concrete pour.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

##### A. General

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
2. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

##### B. Ductwork Coordination

1. General Coordination – Coordinate duct layout carefully with other trades to avoid conflict with structural elements, lighting and plumbing- heating piping. Flattening of ductwork and offsets to fit ductwork in available space is generally shown. In the absence of such, the Contractor shall arrange the ductwork to maintain concealment and allow ceilings and lights to be installed as intended. Do not hang ductwork until possible interferences with electrical and mechanical trades have been resolved. Having ductwork fabricated and delivered in advance shall not be justification for interference with other trades.

##### C. Joints & Seals

1. Transverse joints and longitudinal seams shall be assembled with sealant to conform to SMACNA Class B seal. Selection of sealant materials shall be compatible with the application. Sealants shall be applied in accordance with the manufacturer's recommendations.
  2. Exterior ductwork shall be sealed with mineral impregnated fiber tape. Ductwork shall be supported as noted or detailed on the drawings.
  3. System Pressure Testing – Ductwork systems operating at 3" S.P. or greater (positive or negative) and all exterior ductwork shall require duct pressure testing.
- D. Hangers, Straps, & Supports – Attachment of hangers, straps, and supports to the structure shall be as follows:
1. Refer to Duct Hanger & Support detail on drawings for structural connection types and details as well as connection to ductwork.
  2. Provide swivel attachment for threaded rod hangers mounted to angled structure.
  3. Steel cables are permitted to loop through joist structure.
  4. Unistrut Channel – Unistrut type channel support systems permitted to support any size ductwork. Channels should be attached to the structure with inserts or clamps. Utilize threaded rod or steel cable and appropriate attachments with channels as required.
  5. Attachment to metal decking that does not contain concrete above is prohibited. In those instances, hanger connections shall be to steel structure with supplemental unistrut members where needed.
  6. Attachment to wood decking is prohibited. Connections shall be made to wood joists / beams only.
  7. Supplemental Steel - Supplemental steel shapes intended for ductwork support are to be provided by the H.C.
- E. Duct Routing and Penetrations
1. General Coordination – Coordinate openings required for the passage of ductwork through walls, partitions, floors and roofs with the General Contractor. Openings shall be oversized to allow continuous insulation through penetrations.
  2. Electrical Coordination – Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures. Ductwork shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment in accordance with NEC.
  3. Cutting – Cutting of the existing structure i.e. roof, walls, floors, etc. shall be by the HVAC Contractor.
  4. Wall Penetrations
    - a. Non-Fire-Rated Penetrations – Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
    - b. Fire-Rated Penetrations – Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers where required or fire seal perimeter of duct when no damper is required. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
  5. Structural Support for Penetrations – Supplemental steel structural members required to support penetration openings in the structure for ductwork shall be provided by:

- a. The General Contractor for penetrations in new construction. Refer to drawings for locations and additional details, but are to include wall, floor, and roof penetrations.
6. Sleeves & Concrete Curbs
  - a. Sleeves – Sheet metal sleeves in conjunction with fire dampers shall be placed in walls and floors to pass ductwork. Floor sleeves shall project 4” above the finished floor in equipment rooms and areas of similar usage, and shall form a waterproof seal.
  - b. Concrete Curbs – Exceptions to sleeves shall be at locations where the opening is protected from drainage falling thru by means of concrete curbs or shaft walls. This Contractor shall be responsible for providing 4” high x 4” wide concrete curbs with beveled edges to protect floor openings related to his work in equipment rooms or providing an equal effective waterproofing metal curb, if not specifically included in the General Contract.
- F. Duct Protection & Cleaning
  1. Protect duct interiors from moisture, construction debris and dust, and other foreign materials by covering each open end of the duct with visqueen secured with duct tape before the end of each day’s work. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."- Duct Cleanliness Level – Intermediate.
  2. The Contractor shall take care in erecting and maintaining a clean duct system. Each duct section shall be wiped out with a wet cloth and dried with a clean, dry cloth immediately before installation. Before the end of each day’s work, all open ductwork, fittings and air devices shall be sealed with heavy visqueen plastic and completely taped around all edges. Just prior to starting the air system, the visqueen barriers shall be removed and a temporary filter shall be placed over all return air openings or registers. Secure the filters firmly in place. If deficiencies in storing practices are found by the Engineer, the Contractor will be required to thoroughly clean all interior surfaces with alcohol prior to installation.
- G. Duct Liner – Interior insulating duct liner shall be installed in strict accordance with manufacturer’s printed instructions and SMACNA standards. Liner in rectangular duct shall be shop-applied with adhesive over 90% of the surfaces and with weld pins. Edges not factory-sealed, cut edges and all joints shall be coated and closed with an adhesive-sealant, both in shop fabrication and field assembly. Leading edges shall be protected with metal “Z” or channel nosing where air velocity exceeds 3,000 fpm. Duct liner shall be protected from getting wet or dirty while being transported to the building site, stored on site and after installation.
- H. Duct Connectors
  1. Connectors shall not be installed on transition or elbow fittings.
  2. Connector press-on flanges shall not overlap edge of ductwork. Duct height must be tall enough to accommodate entire flange diameter. Utilize spin-in type for limited height conditions.
- I. Painting
  1. Where interior duct surfaces are visible through grilles, registers, diffusers and louvers, the inside of the duct shall be coated with flat black paint before the device is installed, to eliminate obtrusive appearances.

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2. All exposed ductwork not installed with insulation in finished spaces to be painted shall be prepared for painting by the General Contractor to match Architect's base material colors.

END OF SECTION 23 3113



## SECTION 23 3300 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Air Control Dampers & Accessories
  - a. Manual Balancing Dampers
  - b. Backdraft Dampers
2. Pressure Differential Gauges
3. Turning Vanes
4. Duct-Mounted Access Doors
5. Flexible Connectors
6. Flexible Ducts
7. Sound Attenuators
  - a. Duct Silencer
  - b. Return Air Canopy
8. Dryer Duct Accessories
  - a. Dryer Wall Box
  - b. Dryer Wall Vent Cap/Hood
  - c. Dryer Roof Vent Gooseneck

##### B. Related Sections:

1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.
2. Division 23 Section "Ductwork" for ductwork materials, requirements, and schedules.
3. Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

#### 1.2 SUBMITTALS

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

##### B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.

d. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

### 1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

## PART 2 - PRODUCTS

### 2.1 AIR CONTROL DAMPERS & ACCESSORIES

#### A. MANUAL BALANCING DAMPERS & ACCESSORIES

##### 1. Steel Rectangular Dampers

###### a. Construction

- 1) General – Single cross-blade up to 12 blade widths and in larger sizes, multiple blade type 6" maximum width with opposed blade arrangement.
- 2) Frame – 16 ga., galvanized steel hat channel with reinforced corners
- 3) Blades – 14 ga., galvanized steel, one piece airfoil shape, **opposed/parallel** blade. Synthetic blade edge seals.
- 4) Jamb Seals – 300 Series stainless steel cambered compression type.
- 5) Linkage – Out of airstream steel assembly
- 6) Leakage Class – Class 1A

###### b. Manufacturers

- 1) Ruskin #CD60 or approved equal by:
- 2) Greenheck
- 3) Nailor
- 4) Pottorff

##### 2. Steel Round Dampers

###### a. Construction

- 1) General – Single blade design.
- 2) Frame – 20-ga. galvanized steel.
- 3) Blades – 20-ga. galvanized steel.
- 4) Control Shaft – Square axle shaft.
- 5) Max Velocity – 1500 fpm.

###### b. Manufacturers

- 1) Ruskin #MDRS25 or approved equal by
- 2) Greenheck

- 3) Nailor
- 4) Pottorff

3. Damper Adjustment Handle

- a. Construction
  - 1) General – Locking quadrant positioner with handle
  - 2) Handle – Heavy gage steel handle to accept square rod.
- b. Schedule
  - 1) Uninsulated ductwork – Ventfabrics "Ventlock" #641
  - 2) Externally insulated ductwork – Ventfabrics #644
- c. Manufacturers
  - a) Ventfabrics
  - b) Duro Dyne
  - c) DynAir

B. BACKDRAFT DAMPERS

- 1. Construction
  - a. General – Adjustable, counterbalanced type.
  - b. Frame – Extruded aluminum, 12-ga., galvanized steel brace at corners.
  - c. Blades – Extruded aluminum with extruded vinyl blade edge seals mechanically locked into blade edge.
  - d. Bearings – Corrosion resistant, synthetic type.
  - e. Counterbalance – Zinc plated bar on blades.
- 2. Manufacturers
  - a. Ruskin #CBD6 or approved equal by:
  - b. Greenheck
  - c. Nailor
  - d. Pottorff
  - e. United Enertech

2.2 PRESSURE DIFFERENTIAL GAUGES

- A. Pressure differential gauges for air filter application shall be dial type gauges. Range shall be appropriate for the application. Gradations shall read in inches w.c.
- B. Each gauge shall be furnished with vent valves, aluminum or plastic tubing, static pressure tips and mounting bracket or flange.
- C. Manufacturer
  - 1. Dwyer "Magnehelic" Series 2000 or approved equal.

## 2.3 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. METALAIRE, Inc.
  4. SEMCO Incorporated.
  5. CLWard Industries, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 36 inches wide and double wall for 36" wide and larger dimensions.

## 2.4 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Ventfabrics, Inc.
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 30 oz./sq. yd.
  2. Net Fabric Width: 4" wide.
  3. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  4. Service Temperature: Minus 40 to plus 200°F.

- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Net Fabric Width: 4" wide.
3. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
4. Service Temperature: Minus 50 to plus 250°F.

## 2.5 FLEXIBLE DUCTS

- A. Insulated Flexible Duct – For use with ductwork systems requiring insulation.
1. Construction – Galvanized steel spiral wire mechanically locked to an airtight aluminum or polyester inner core, 1" thick 3/4 lb. density fibrous glass insulation and a polyethylene or reinforced metalized vapor barrier outer jacket.
  2. Pressure Rating – Duct shall be rated at a minimum of 6" w.g. positive and 4" w.g. negative static pressure
  3. Certifications – Shall be listed as Class 1 Air Duct or Air Duct Connector with 25-50 flame-smoke ratings per UL181 and comply with NFPA 90A.
  4. Manufacturer – Flexmaster USA Type 5 or 5M or approved equal.
- B. Non-Insulated Flexible Duct – For use with duct systems not specified to be insulated, with similar restriction stated above.
1. Manufacturer – Flexmaster USA #5NI-C or approved equal.
- C. Dryer Vent Flexible Ductwork – Shall be utilized for dryer vent final connections to dryers. Refer to vent box assemblies in Dryer Duct Accessories below.
1. Construction – Triple lock flexible aluminum ductwork.
  2. Pressure Rating – For positive pressure up to 10" w.g. and negative pressure down to 12" w.g.
  3. Certifications – UL181
  4. Manufacturer – Flexmaster USA NI-TL or approved equal.
- D. Flexible duct shall be used at final connections to air control terminal units and ceiling air diffusers except as limited in Part 3.

## 2.6 SOUND ATTENUATORS

- A. Duct Mounted Silencer
1. Sound attenuators shall be constructed of sheet metal with inner perforated metal lining and baffles backed with sound absorbing fiberglass, designed for maximum attenuation with minimum air resistance.
  2. Dynamic insertion loss in Decibels for a 5 ft. rectangular unit shall be:

| <u>Octave Band</u> | <u>dB</u> |
|--------------------|-----------|
| 1                  | 6         |
| 2                  | 10        |
| 3                  | 18        |

|   |    |
|---|----|
| 4 | 30 |
| 5 | 42 |
| 6 | 33 |
| 7 | 22 |
| 8 | 11 |

3. Units shall be:
  - a. Industrial Acoustics "Quiet Duct" Type MS or equal by
  - b. Semco
  - c. Vibro-Coustics.

B. Return Air Canopy

1. Performance – ASHRAE, SMACNA pressure and velocity classifications and ASTM E477, ASTM E84 25/50 Flame/Smoke Spread
2. Construction – 20-gauge solid steel casing, absorptive acoustic fiberglass acoustic media. Fiberglass to be shot-free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin.
3. Manufacturer:
  - a. Price Industries
  - b. Titus
  - c. Tuttle & Bailey

2.7 DRYER DUCT ACCESSORIES

A. Dryer Wall Box

1. Construction – Recessed 22 ga. aluminized steel box with flange with 4" top outlet.
2. Manufacturer –
  - a. Inovate #DB350 for 4" stud wall
  - b. Inovate #DB480 for 6" stud wall
  - c. Or equal by Aldes Corporation

B. Dryer Wall Vent Cap/Hood – For wall installation

1. Construction – Powder coat painted galvanized or aluminized steel with 4" outlet, backdraft damper and hood.
2. Manufacturer
  - a. Inovate
  - b. Aldes Corporation
  - c. Greenheck

C. Dryer Roof Vent Gooseneck – For flat roof installation

1. Construction – 27" tall, plastic insulated dryer roof cap with integral backdraft damper, removable bird screen, and rain collar
2. Manufacturer – RoofGooseVent #RG-Dryer or approved equal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. GENERAL

1. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
2. Materials – Install duct accessories of materials suited to duct materials use:
  - a. Galvanized-steel accessories in galvanized-steel and fibrous-glass ducts,
  - b. Stainless-steel accessories in stainless-steel ducts,
  - c. Aluminum accessories in aluminum ducts,
  - d. Or as noted above.

#### B. BACKDRAFT DAMPERS

1. Install at discharge of exhaust fans at least one half the fan diameter away from fan.

#### C. VOLUME DAMPERS

1. Locations:
  - a. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
  - b. Install volume damper upstream/downstream of each supply, return or exhaust air device, register or grille.
  - c. Volume dampers shall be in accessible locations for testing, balancing, and adjusting purposes. Coordinate with reflected ceiling plans.
2. Lined Ductwork – Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
3. Install steel volume dampers in steel ducts.
4. Install aluminum volume dampers in aluminum ducts.
5. Set dampers to fully open position before testing, adjusting, and balancing.

#### D. PRESSURE DIFFERENTIAL GAUGES

1. Install air filter pressure differential gauges in a readable location on or near the air handling unit, filter housing or as otherwise indicated on the drawings.

#### E. ACCESS DOORS

1. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - a. On both sides of duct coils.
  - b. Upstream / and downstream from duct filters.
  - c. At outdoor-air intakes and mixed-air plenums.

- d. At drain pans and seals.
  - e. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - f. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - g. For control devices requiring inspection.
  - h. Elsewhere as indicated.
2. Install access doors with swing against duct static pressure to ensure closure.
  3. Label access doors according to Division 23 Section "Identification for HVAC System" to indicate the purpose of access door.

F. FLEXIBLE CONNECTORS

1. Location: Install flexible connectors to connect ducts to equipment.
2. For fans developing static pressures of 5-inch w.g. and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

G. FLEXIBLE DUCTS

1. Connect flexible ducts to metal ducts with Panduit straps or stainless-steel clamps. End of the insulation and jacket shall be sealed to the metal duct with double wrapped duct tape. Maximum length of flexible duct shall be:
  - a. Terminal units to supply ducts – 3 ft.
  - b. Air devices to ducts – 7 ft.
2. Flexible duct installation locations:
  - a. Shall be installed:
    - 1) At final air devices above accessible ceilings.
  - b. Shall *not* be installed:
    - 1) Where ductwork is exposed.
    - 2) Above inaccessible ceilings – coordinate with reflected ceiling plan.
    - 3) Through any wall, ceiling, floor, or fire rated assembly.
    - 4) In the immediate vicinity of, and connecting to, air devices in fire rated ceilings where the assembly details require steel ductwork.

H. SOUND ATTENUATORS

1. Return Air Canopy – Install above return air device per manufacturer's recommendations in lieu of shop-fabricated plenum per detail.



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END OF SECTION 23 3300

## SECTION 23 3400 - FANS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Inline Square Centrifugal Fan.
  - 2. Downblast Power Roof Ventilator.
- B. Related Sections
  - 1. 23 0513 Electrical Requirements for HVAC Equipment
  - 2. 23 0548 Vibration Control

#### 1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- 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.
- C. Operation and maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. Fans shall be constructed, rated and labeled in accordance with AMCA Standard 210-67. Fans shall be statically and dynamically balanced throughout the operating range.
- 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.
- E. ASHRAE 90.1 Section 6 "Heating, Ventilating, and Air Conditioning".
  - 1. Fractional Horsepower Fan Motors – Motors 1/12 hp or greater and less than 1 hp shall be electronically commutated motors (ECM).

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Fans shall be provided as specified below and shown on the drawings, complete with motors, drives and associated devices.
- B. All fans of any one listed type shall be of the same manufacturer.
- C. Drives - All fans shall be direct drive. Fans with motors 1/12 hp or greater and less than 1 hp shall be ECM type. Fans greater than 1 hp shall be provided with a VFD, either integral to fan or shipped loose for remote installation.
- D. Motor HP shall be sufficient to handle the full load of the fan, including drive losses, at the selected condition without exceeding the motor rating. In no case shall the motor size be less than shown without prior approval from the Engineer.
- E. Motorized backdraft dampers, where specified, shall be furnished with a motor with voltage compatible with the fan motor voltage and electric service to the fan. If not compatible, a transformer shall be furnished with the fan and damper to afford the appropriate voltage.
- F. Motorized backdraft dampers, where specified, shall be furnished with a 120V actuator. Refer to HOA controller details on HVAC drawings for additional information.
- G. All fans shall be provided with a Hand/Off/Auto controller from the unit manufacturer.

### 2.2 MOTORS

- A. Refer to Section 23 0513 - Electrical Requirements for HVAC Equipment

### 2.3 INLINE SQUARE CENTRIFUGAL FAN

- A. Construction – Backward inclined fan wheel, direct drive ECM motor, as indicated, motor disconnecting means and inlet cone. Housing shall be constructed of square galvanized sheet metal with 1” acoustical lining.
- B. Mounting – Mounting brackets with neoprene vibration isolators for suspension mounting.
- C. Direct drive units shall have motor out of the air stream and be furnished with a solid state speed controller with off position, and cover plate. The speed controller shall be turned over to the Electrical Contractor for installation.
- D. Finish – The exterior of the fan shall be galvanized.
- E. Refer to the drawings for capacities, arrangement, class and other features and accessories. Fans shall be manufactured by:

1. Acme
2. Carnes
3. Cook
4. Greenheck
5. Twin City Fan

## 2.4 DOWNBLAST POWER ROOF VENTILATOR

- A. Construction – Power roof ventilator shall consist of a spun aluminum weather hood, counterflashing base, vertical shaft open centrifugal wheel, direct drive ECM, motor disconnecting means in the motor compartment, motorized backdraft damper and bird screen.
- B. Finish – The exterior of the fan shall be galvanized.
- C. Mounting – A 14” high insulated metal roof curb with straight edges and wood nailer on top shall be provided with each fan. Provide wood cant strips around the curb only if recommended for the roofing system.
- D. Refer to the drawings for capacities, arrangement, class and other features and accessories. Fans shall be manufactured by:
  1. Greenheck
  2. Cook
  3. Carnes
  4. PennBarry
  5. Twin City Fan

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install fans and roof curbs level and plumb, in accordance with manufacturer’s written instructions.
- B. Support units as described below using the vibration control devices specified in Section 23 0548 Vibration Control.
  1. Roof curb mounted units: Set unit on the curb and fasten the fan base to the curb.
  2. Suspended unit: Suspend unit from structural steel support frame using threaded steel rods and vibration isolation springs.
- C. Arrange installation of fans to provide access space around fans for service and maintenance.
- D. Adjust damper linkages for proper damper operation. Motorized backdraft dampers are to be wired by the Electrical Contractor to open when the fan operates.

E. Perform the following operations and checks before start-up.

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork and electrical are complete. Verify proper thermal overload protection is installed in motors starters and disconnects.
3. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Align belts and reinstall belt guards.
4. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.
5. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full open position.

F. Mechanical equipment and supports that are exposed to wind shall be designed and installed to resist the wind pressure determined in accordance with the building codes. Refer to specification 23 0530 for additional requirements.

END OF SECTION 23 3400

## SECTION 23 3600 - AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:

1. Single-duct air terminal units

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Operation and maintenance data.

#### 1.3 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. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- D. Terminal units shall be certified to comply with ARI Standard 880.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Unit sizes (inlet duct dimension) shall conform to those listed on the drawings except where larger size is required (or smaller size is acceptable) to meet noise or operational requirements. Resultant noise level from the control unit, ductwork and diffusers, as a system, shall not exceed a room NC level of 25 from both airborne and radiated noise, based on a 10 db room absorption coefficient, with 1.5" s.p. differential across the unit at maximum cfm setting. Sound performance shall be ARI certified.

- B. Pressure drop through the terminal unit and electric reheat coil shall not exceed the maximum drop listed on the drawings. The coil face area shall be upsized if necessary to meet this requirement. The terminal unit casing shall be correspondingly upsized or the larger coil furnished separately. For a separately furnished coil and intervening duct transition, with internal insulation same as that in the terminal unit casing, shall be provided.

## 2.2 COMPONENTS AND ACCESSORIES

- A. Casing Construction – Unit casing shall be 22-gauge minimum thickness, galvanized or galvanized sheet metal with beaded round inlet duct connection. Provide galvanized construction for use in exposed locations for field application of paint.
- B. Casing Liner – Casing shall be lined internally with:
1. Material – Unit casing liner shall be of the following construction:
    - a. Standard Construction – 1” thick, 4 p.c.f. dual density aluminum foil faced rigid fiberglass board/1” thick fiber free foam lining.
    - b. Mylar, Tedlar or similar facing materials are not acceptable.
  2. In lieu of foil facing, sheet metal liner may be provided.
  3. Acoustical considerations must be fully addressed.
  4. Performance – Minimum R-Value = 4.0.
  5. Sealing & Enclosure – Edges, joints and other exposures shall be additionally coated with approved sealants and/or protected with metal edging.
  6. Compliance – Insulation and facing lining shall meet:
    - a. UL 181 air erosion/ mold growth & humidity standards.
    - b. UL 723/NFPA 90A for 25/50 fire and smoke requirements.
    - c. ASTM C665 biological and fungi standards.
- C. Fan Blower (Fan Powered Units Only) – Blowers shall be constructed of steel with forward curved blades, dynamically balanced wheels and direct drive motor. Unit shall include a backdraft damper at the fan section outlet to prevent cold primary air from flowing back through the fan into the ceiling plenum. Motor shall be an ECM DC brushless motor complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and sensor motor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Motor shall maintain a minimum of 70% efficiency over its entire operating range. Motor shall be direct coupled to the blower. Provide isolation between the motor and the blower assembly. Unit shall include a manual fan speed control for field adjustment of fan air flow set point.
- D. Electrical Reheat Coils
1. Certifications – Coil shall be ETL listed to UL 1995 approved and provided by the terminal unit manufacturer.
  2. Coil Construction – Open coil heater elements of high grade 80/20 resistance wire, 45 watts per square inch maximum density.
  3. Control Panel Enclosure - Safety and control devices shall be mounted in a NEMA 250 Type 1 control panel attached to the coil. Devices shall include:
    - a. Power disconnect switch with “dead front” feature associated with the hinged cabinet door,
    - b. Magnetic contactor(s)

- c. Primary automatic reset high temperature limit switch,
  - d. Secondary manual reset high temperature limit cutout,
  - e. Minimum differential pressure air flow switch,
  - f. Fused control transformer,
  - g. Terminal strips for power and control wiring.
  - h. Silicon-controlled-rectifier (SCR) controller.
- 4. Wiring – The coil and devices shall be factory wired. Control wiring shall be arranged to ensure that the damper actuator and contactor(s) are properly sequenced for control.
- 5. Insulation – Coil to be provided with fiberglass insulation from factory.
- 6. Electrical Connection – Units with Fan motors and electric reheat coils shall be provided with a single point power connection.
- E. Air Flow Control Damper or Valve – Damper or valve shall have linear control characteristics and shall be 16-gauge galvanized steel or extruded aluminum with gasketing and self-lubricating bearings.
- F. Velocity Sensor – Multi-point averaging type. The velocity sensor shall be mounted in the inlet air stream and shall amplify the air flow signal to provide accurate control at low, as well as high, inlet static pressure conditions. The required minimum static pressure of the volume regulator shall not exceed 0.25 in. w.g. for proper operation.
- G. Air Flow Taps – Taps and differential pressure airflow device shall be provided to enable direct reading of total and static pressures. A conversion chart shall be attached to each unit to convert pressure readings to air flow quantities.
- H. Bottom Access Doors – Units with a heating coil section shall be provided with an access door on the upstream side of the coil. Access doors shall be insulated type with edge seals and either snap or quarter-turn sash latches, screws will not be acceptable. Access doors shall be provided at the bottom of the unit unless otherwise noted.
- I. Air Leakage – Casing leakage and damper leakage shall each not exceed 2% of maximum air flow cfm at 3.0" s.p. differential across the unit.
- J. Controls Enclosure – Units installed in a return air plenum shall have a sheet metal housing to enclose non-plenum-rated control devices and wiring which are mounted on the exterior of the casing.

## 2.3 MANUFACTURERS

- A. Units shall be manufactured by:
  - 1. Price
  - 2. Titus
  - 3. Tuttle & Bailey
  - 4. Enviro Tech
  - 5. Krueger
  - 6. Trane



### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Unit Supports – Support the units on all four (4) corners from the building structure with galvanized steel cable and duct trapeze hanger, Gripple #DT2 or #BT2, attached to bottom of terminal unit. See drawing details for attachment of cables to building structure.
- B. Unit Access Coordination
  - 1. Coordinate unit locations with ceiling components, light fixtures, and other equipment, services, elements or obstructions to ensure adequate clearance for access and servicing.
  - 2. Provide ceiling access panels where the ceiling system does not afford ready access.
  - 3. Coordinate right/left hand control and access panels prior to placing order. Units ordered with control enclosure boxes on inaccessible sides shall be re-ordered, the mounting of units “up-side-down” is not acceptable.
- C. Electrical Connections – Coordinate power connections with the E.C. where required.
- D. Temperature Controls Devices
  - 1. The Temperature Controls Contractor shall furnish the following:
    - a. The digital controller
    - b. Damper operator and linkage
    - c. Space temperature sensor
    - d. Duct mounted discharge air temperature sensor.
  - 2. The digital controller, damper operator and linkage, furnished by the Temperature Controls Contractor, are to be sent to the terminal unit manufacturer for factory mounting. Coordinate accordingly.
  - 3. Refer to the Temperature Control specification sections and Drawings for additional control devices and points and coordinate to provide a complete and operational system.

END OF SECTION 23 3600

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## SECTION 23 3713 - DIFFUSERS, REGISTERS, GRILLES, & LOUVERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Grilles
2. Registers
3. Diffusers

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for volume-control dampers not integral to diffusers, registers, grilles, and return air canopies.

#### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1 GRILLES, REGISTERS AND DIFFUSERS

- A. Air outlet and inlet devices shall be equal to those specified by catalog number and description in the schedule on the drawings. Damper operators shall be concealed screw type. An auxiliary mounting frame shall be furnished with each grille and register except those mounted on exposed ducts or in lay-in application.
- B. Linear "T" bar air supply diffusers shall be slotted diffusers with fixed air pattern control complete with a galvanized sheet metal supply plenum having a round or oval duct connection and 1/2" neoprene coated fiberglass insulation on the interior. The unit shall be designed to mount on or alongside the ceiling "T" bar and shall include flanges on both sides of the diffuser to support the ceiling tiles. Additional "T" bars matching those of the ceiling system shall be provided by the HVAC Contractor if the diffuser does not have these flanges. Units shall have a center notch where required to accommodate intervening "T" bars.
- C. Manufacturers:

1. Price
2. Titus
3. Tuttle & Bailey
4. Krueger

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Ceiling System Verification – The Contractor shall be responsible for comparability of ceiling mounted devices with the ceilings and suspension systems (lay-in, concealed spline, plaster, drywall, etc.). Verify with architectural drawings. Provide appropriate mounting frames.
- B. Alignment and Supports – Carefully align square and rectangular devices with the vertical and horizontal building lines. Diffusers shall be attached rigidly to the ductwork. Where connected by flexible ducts, special flexible duct supports shall be provided, either from the ceiling suspension system or by independent suspension wires or rods from the building structure.
- C. Air Balancing – Each ducted air device shall be provided with a balancing damper, located either at the run-out duct to the final air device for accessible locations or an integral damper at the air device for inaccessible locations. Transfer air devices are not required to have balance dampers, unless noted. Duct mounted air devices shall be provided with standoff frame and integral balance damper or scoop style damper, as noted. Refer to drawings for other specific instances.
- D. Painting – Paint interior visible surface of ductwork and plenums behind grilles, registers, diffusers and louvers flat black, as needed, to eliminate the sight of shiny surfaces.

END OF SECTION 23 3713

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## SECTION 23 7413 – PACKAGED, OUTDOOR, AIR HANDLING UNIT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Unit Construction
    - a. Unit Casing.
    - b. Base Rail.
  - 2. Fans.
  - 3. Air Filtration.
  - 4. Coils
  - 5. Refrigerant Circuit Components.
  - 6. Gas Furnace.
  - 7. Electrical power connections and Devices.
  - 8. Controls.
  - 9. Unit Accessories.
  - 10. Roof curbs.

#### 1.2 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including:
  - 1. Rated capacities,
  - 2. Dimensions, weight loadings, required clearances,
  - 3. Characteristics,
  - 4. Furnished specialties,
  - 5. Electrical characteristics,
  - 6. Connection requirements,
  - 7. Accessories
- 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.
  - 2. Provide computer generated fan curves with specific operating point clearly plotted.
  - 3. Manufacturer's installation instructions.
- C. Operation and maintenance data.
- D. Warranty.

### 1.3 QUALITY ASSURANCE

#### A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies.
2. Comply with ARI 270 for testing and rating sound performance.
3. Comply with ARI 1060 for testing and rating of energy recovery module.

#### B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigerant system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

#### C. ASHRAE/IESNA 90.1-2019 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

#### D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

#### E. UL Compliance: Comply with UL 1995.

#### F. 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.

#### G. Motors 1 HP and larger shall be "premium efficiency" series motor.

### 1.4 WARRANTY

#### A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five (5) years non-prorated from date of equipment shipment from the factory.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than twenty-five (25) years from date of equipment shipment from the factory.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Manufacturers – Subject to compliance with requirements, provide products by one of the following:

1. Aeon (Basis of Design)
2. Daikin (Rebel Applied)

3. Trane Inc. (Intellipak)
4. York (Premier)

## 2.2 UNIT CONSTRUCTION

### A. Unit Casing

1. Exterior Casing Material – Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Unit casing construction shall be double wall minimum R-16 foam insulation.
3. Airstream Surfaces – Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### B. Base Rail

1. The unit base shall be designed with a recessed curb mounting location. The recessed curb mounting surface shall provide a continuous surface for field application of curb gasketing to create a weather tight seal between the curb and unit.

### C. Access Panels

1. Double wall access doors shall be provided in the fan, coil, filter and inlet sections with a solid liner and minimum 2-inches thick. Doors shall be attached to units with stainless steel piano hinges. Standard pull, 90-degree opening door latches shall be provided.
2. Panels shall be completely gasketed with closed cell neoprene. Door tiebacks should be provided for all doors to secure them while servicing unit. Panels shall be easily removable for servicing all components.

## 2.3 FANS & MOTOR CONTROLS

### A. Air Circulating Fans

1. Fan Section – Fan sections shall contain, fans, motor, drive components and accessories. Motor and drive shall be mounted with the casing and isolated. Fans shall be direct drive airfoil plenum type with VFD. See fan duty and HP requirements listed on the drawings. Minimum of two supply fans and one return fan.
2. VFD – A single VFD shall be provided for each fan array to control the fan volume. VFD shall include an integral DC line reactor to reduce harmonic distortion in the incoming and outgoing power feeds. If a DC line reactor is not provided, an AC line reactor shall be provided. A 3% impedance AC line reactor shall be provided for the supply fan VFD.
3. Factory Testing – All drives shall be factory run tested prior to unit shipment.
4. Fan Array – The fan array will be arranged with high-performance direct drive, single inlet, plenum fans with backwards inclined, high efficiency welded-aluminum or high-performance composite impeller with galvanized or aluminum support frame. Manual blank-off plates shall be provided to block fan airflow, one plate to be provided per array.
5. Belt drive fans will not be acceptable.
6. Shaft grounding rings on motors shall be provided.



7. Airflow Measurement – Provide fan with an airflow measuring station viewable on the control panel to be communicated across the Building Automation System (BAS).

B. Return Fan(s)

1. Unit shall be furnished with a return fan(s), return and vent dampers for powered venting, controlled in conjunction with the economizer and minimum outdoor air requirements.
2. Fan(s) shall be direct drive plenum style with ECM or VFD control and factory tested.
3. Fan Control –
  - a. Control Point – Fan(s) to be controlled to provide constant positive pressure (adj.) within the return air plenum.
  - b. Airflow Measurement – Provide fan with an airflow measuring station viewable on the control panel to be communicated across the Building Automation System (BAS).
  - c. Damper Control – Vent and return air dampers to be controlled via field provided and installed building pressure sensor. Dampers shall be capable of independent modulation.
4. Belt drive fans will not be acceptable.
5. Shaft grounding rings on motors shall be provided.

2.4 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pre-Filter – 2” Cartridge MERV 8
  2. Final Filter – 4” Cartridge MERV 13
- B. Filter Access – Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings through a slide track. Provide sealing spacers as required on filter rack.
- C. Unit shall include a clogged filter switch.

2.5 COILS

A. Evaporator and Condenser Refrigerant Coils:

1. Construction –
  - a. Evaporator Coils – Shall be constructed of copper tube, aluminum fin, copper headers. Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a stainless-steel casing.
  - b. Condenser Coils – Microchannel condenser coils constructed of parallel flow aluminum alloy tubes brazed to aluminum alloy fins.
2. Distributors – Refrigerant evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. Where a hot gas bypass is required, the inlet shall

be at the refrigerant distributor. Expansion valves and related accessories are to be factory installed and tested.

3. Tube Circuiting – Refrigerant coils with multiple compressors shall be alternate tube circuited to distribute the cooling effect over the entire coil face at reduced load conditions. Provision for use of thermal expansion valves must be included.
4. Pressure Testing – Coils shall be factory tested with air at 450/650 psig, depending on the refrigerant, while immersed in an illuminated water tank.

## 2.6 REFRIGERANT CIRCUIT & CONDENSER COMPONENTS

### A. Refrigerant Circuits

1. Unit shall contain two (2) refrigerant circuits.

### B. Compressors

1. Type – Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
2. Variable Speed – Refrigerant circuit #1 (Lead Circuit) shall contain two variable speed digital scroll compressors capable of modulation from 10-100%.
3. Two Stage Control – Refrigerant circuit #2 (Lag Circuit) shall contain two 2-speed scroll compressors capable of modulating between 67% and 100%.
4. Circuit #2 (Lag) shall be provided with hot gas bypass to protect against evaporator frosting and prevent excessive compressor cycling.
5. Accessories – Provide compressors with sound blankets.

### C. Condenser Coils

1. Accessories – Provide units with coil hail guards.

### D. Condenser Fans –ECM direct driven propeller type with aluminum or composite blades and wire guards.

### E. Refrigeration Specialties:

1. Refrigerant: R-454B, R-32 / R-513A
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Liquid line filters.

### F. Low Ambient – Compressors shall operate down to -10 deg. F and resume cooling at -7 deg. F by monitoring the refrigeration system liquid line pressure and adjusting the condenser airflow to maintain the proper liquid line pressure to protect unit operation. Airflow adjustment shall occur through a combination of ECM/VFD driven condenser fans and fan cycling. Liquid line

pressure transducers shall be included to provide pressure information on the unit control display.

G. Refrigerant Detection & Mitigation Control

1. Refrigerant systems with an A2L or higher flammability classification, as defined in ASHRAE Standard 15 and 34, shall be equipped with a refrigerant leak detection system. The leak detection system shall provide the following mitigation controls to ensure there is never a buildup of refrigerant greater than the lower flammability of the respective refrigerant. The following shall occur
  - a. Activate refrigerant system safety shut-off valves to reduce releasable refrigerant charge.
  - b. Energize the air circulation fan(s).
  - c. De-energize potential ignition sources, including open flames (direct and indirect gas furnaces) and unclassified electrical sources of ignition with apparent power rating greater than 1kVa, where the apparent power is the product of the circuit voltage and current rating.

2.7 GAS FURNACE

- A. Description – Heating units shall be indirect natural gas fired approved for both sea level and high-altitude areas. The entire package should be factory assembled, piped and wired, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package. All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire. Operating natural gas pressure at unit(s) manifold shall be 7" – 14" w.c. Gas fired units shall be approved for operation in -40 deg. F locations.
- B. Compliance
  1. ANSI Z21.47/Z83.8
  2. NFPA 54.
  3. Gas manifolds shall be provided to IRI standards.
  4. CSA Approval: Designed and certified by and bearing label of CSA.
- C. Burner
  1. Fuel – Natural Gas.
  2. Burner Assembly – Constructed from stainless steel, blow-through, positive pressure type.
  3. Ignition – Electronically controlled electric spark or hot-surface igniter with flame sensor.
  4. Flame surveillance shall be with a solid-state programmed flame relay c/w flame rod.
  5. The burner and gas train shall be in a cabinet enclosure.
  6. Insulation in the burner section shall be covered by a heat reflective galvanized steel liner.
  7. Power Vent – Integral, motorized centrifugal fan interlocked with gas valve. Atmospheric burners, or burners requiring power assisted venting are not acceptable.
  8. High Turndown Modulating Natural Gas Furnace (10.0 : 1 turndown) shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be

capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment.

9. Heat trace shall be include on the condensate drain line.

D. Heat-Exchanger:

1. Type – Primary drum and multi-tube secondary assembly constructed of stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with a stainless-steel condensate drain pan and connection. The heat exchanger casing shall have 1" (25mm) of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not acceptable.

E. Safety Controls:

1. Gas Control Valve: Modulating.  
2. Gas Train: Single-body, regulated, redundant, 24-V AC gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 ELECTRICAL POWER CONNECTION & DEVICES

- A. Provide for single connection of power to unit (unit-mounted fused disconnect switch provided by the EC accessible from outside unit).  
B. SCCR Minimum Rating – 65 KAIC.

2.9 CONTROLS

A. Factory Installed and Factory Provided Controller

1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system. **Refer to sequence of operation on drawings and provide necessary components, controllers and programming to active the stated sequence.**  
2. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.  
3. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

B. Variable Air Volume Controller

1. Unit shall utilize a variable capacity compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling

loads and to save operating energy. Supply fan speed shall modulate based on supply air duct static pressure. Cooling capacity shall modulate based on supply air temperature.

2. Unit shall modulate heating with constant airflow to meet space temperature heating loads. Modulating heating capacity shall modulate based on supply air temperature.
- C. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet IP network.
- D. Direct Digital Control System – Additional control equipment, devices and sequence of operations are specified in Division 23 Section "Direct Digital Control System" and on the drawings. All other unit control devices should be mounted and wired by the HC/TC.

## 2.10 UNIT ACCESSORIES

- A. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Unit shall include outside air-opening bird screen and outside air hood.
- B. Air Flow Measuring Stations
  1. Air flow measuring stations shall be EBTRON GTC116 and shall be provided on the following:
    - a. Outdoor air intake
    - b. Supply Fan
    - c. Return Fan
- C. Dampers
  1. Dampers shall be extruded aluminum with aluminum frame. Dampers shall be low leak with extruded EPDM blade seals. Dampers shall be AMCA rated for Leakage Class 1A at 1 in. w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
  2. All dampers shall be motorized with actuators mounted and wired in the factory.
  3. Dampers shall be as follows:
    - a. Outdoor Air
    - b. Return Air
    - c. Relief/Exhaust Air
- D. Condenser Coil Guards – Painted, galvanized-steel wire.

- E. Unit shall be provided with a safety shutdown terminal block for field installation of a return air smoke detector and supply air high static pressure sensor.

## 2.11 ROOF CURBS

- A. 24" Roof curb for each roof mounted unit shall be furnished with the unit, fabricated of steel with insulation, wood nailer, counterflashing, cant strip and seals for a watertight installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The General Contractor shall install required steel framing for units prior to roof curb installation. Coordinate location of steel according to actual rooftop unit dimensions as ordered.
- B. The roof curb shall be set in place, shimmed level and secured. After the roofing contractor applies the roofing membrane to the curb, the unit shall be set in place and the installation completed. Make final ductwork connections.
- C. **Mechanical equipment and supports that are exposed to wind shall be designed and installed to resist the wind pressure determined in accordance with the applicable building codes. Refer to specification 23 0530 for additional requirements.**
- D. Refer to drawings for condensate drain and trap height requirements. Provide a spill block on top of additional pieces of roofing material or pipe to local storm drain.
- E. The Electrical Contractor will provide power wiring through a fused disconnect switch to one set of power terminals in each unit. All other power and control wiring required for the completion of the systems shall be furnished and installed by the HVAC Contractor. All wiring shall be furnished and installed by the HVAC Contractor. All wiring shall be run in ½" and larger conduit in accordance with applicable provisions of the Electrical Specifications.
- F. The PC shall provide all required gas accessories, including a shut-off valve, outside of the unit.

END OF SECTION 23 7415

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## SECTION 26 0001 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes the following:

1. General Requirements
2. Definitions
3. Scope of Work
4. Drawings and Specifications
5. Reference Standards
6. Allowances, Unit Prices and Alternates
7. Site Visit
8. Permits, Regulations and Inspections
9. Project Management and Coordination
10. Temporary Electric Services
11. Workmanship
12. Protection
13. Painting
14. Cleaning
15. Equipment Selection
16. Shop Drawings
17. Testing
18. Final Inspection and Punch List
19. Operation and Maintenance Manuals
20. Record Drawings
21. Warranties
22. Operation and Adjustment of Equipment
23. Operating Demonstration and Instruction

#### 1.2 GENERAL REQUIREMENTS

- A. All provisions of Division 00 Front End Documents and Division 01 General Requirements apply to work specified in this Division.
- B. Specification provisions of other relevant Divisions shall apply where applicable work is required to be performed under this Electrical work.
- C. A complete and functional Electrical system installation shall be provided under this Division. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.



- D. The Mechanical and Electrical drawings and specifications assign work (labor and/or materials to be provided by the General, Plumbing, Fire Suppression, HVAC or Electrical Contractor or their sub-contractors. Understanding that the contractors for mechanical and electrical work are sub-contractors to the (General) Contractor, such assignments are not intended to restrict the Contractor in assignment of work among the sub-contractor to accommodate trade agreements and practices or the normal conduct of the construction work.

### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

### 1.4 SCOPE OF WORK

- A. The scope of the electrical work includes furnishing, installing, testing and warranty of all electrical work and complete electrical systems shown on the electrical drawings and specified herein, including Division 00, Division 01, Division 26 and applicable provisions of other relevant Divisions.

### 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "provide", as used shall mean "furnish and install". If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Architect for approval before proceeding with the work.
- B. Make all necessary field measurements to insure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Architect for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset

which may be necessary to complete the systems. Having equipment, wireways and fittings fabricated and delivered in advance of making actual measurements shall not be sufficient cause to avoid making offsets and minor changes as may be necessary to install wireways, fittings and equipment.

- D. The Architect shall reserve the right to make minor adjustment in locations of system runs and components where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.
- E. Equipment, ductwork and piping shall not be installed in the dedicated electrical space above or in the working space required around electrical switchgear, motor control centers or panelboards as identified by NEC 110.26 Spaces About Electrical Equipment – 1000 Volts Nominal or Less. For Equipment rated over 1000 volts nominal – 110.32 Work Space About Equipment – 110.33 Entrance and Access to Work Space – 110.34 Work Space and Guarding. The Electrical Contractor shall caution other trades to comply with this stipulation.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the Contractor causing such conflict. The Architect's decision shall be final in regard to arrangement of equipment, conduit(s), devices, wireways etc., where conflict arises.
- G. Provide offsets in system runs, additional fittings, necessary conduit, pull boxes, conductors, switches and devices required to complete the installation, or for the proper operation of the system. Each contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved from the work which is specified under his branch until instructions in writing are received from the Architect.

#### 1.6 REFERENCE STANDARDS

- A. Where standards (NFPA, NEC, ASTM, UL, etc.) are referenced in the specifications or on the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

#### 1.7 ALLOWANCES, UNIT PRICES AND ALTERNATES

- A. Refer to Sections 012100 Allowances, 012200 Unit Prices and 012300 Alternates.

#### 1.8 SITE VISIT

- A. Refer to Section 017300 Execution.

- B. Each bidder shall visit the project site to understand the existing conditions and compare the conditions with information shown on the drawings. Report immediately to the Architect any issues or discrepancies which are discovered that affect the bid. Changes to contract price will not be considered for site condition issues that are readily apparent from a thorough site review.

#### 1.9 PERMITS, REGULATIONS AND INSPECTION

- A. Work must conform to applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawing and specifications shall govern. Install no work contrary to minimum legal standards.
- B. Except where the permit application is made by the Architect or the Engineer, the Electrical contractor shall be responsible to file for and obtain all required permits from the governing inspection agencies for the Electrical work. Where the Architect or Engineer is the Architect or Engineer of record, they will furnish sealed and signed drawings and specifications required by the permit authorities except fire alarm permit documents shall be prepared and submitted by an approved, licensed fire alarm subcontractor.
- C. Include payment of all permit and inspection fees applicable to the work in this Division.
- D. All work shall be subject to inspection and approval of Federal, State and local agencies as may be appropriate as well as the Architect and Engineer.
- E. Furnish for the Owner certificates of approval from the governing inspection agencies as a condition for final payment.

#### 1.10 PROJECT MANAGEMENT AND COORDINATION

- A. Refer to Section 013100 Project Management and Coordination.

#### 1.11 TEMPORARY ELECTRIC SERVICES

- A. Refer to Section 015000 – Temporary Facilities and Controls for division of responsibilities for temporary utilities.
- B. The temporary service and temporary lighting for construction is provided by the Electrical Contractor.
- C. The Electric Contractor shall furnish, install and pay for all necessary conduit, wire, metering, poles, switches, receptacles, lights and accessories to provide a 400 amp, 120/230 volt, 3 phase, 4 wire temporary electric service with the main disconnect switch and a 42 circuit load center at a location specified by the General Contractor.
- D. Labor, receptacles, boxes, fixtures, wire, etc. required by the various Contractors inside their offices shall be paid for by the respective Contractors.

- E. Lighting fixtures shall be placed every 40 ft. along each corridor or where corridors do not occur, along the long axis of all rooms. Provide a minimum 800 lumen lamp in a commercial grade molded plastic socket and lattice wire guard temporary lighting assembly with extra heavy duty "ST" 3-wire cord. Lamps shall be spaced a minimum of 10 ft. apart. For large open areas or during the early stages of construction, high lumen (4,000 minimum) LED "Corn Cob" lamps may be utilized. Receptacle circuits shall consist of 1-gang cast "FS" type box with grounded duplex receptacles a maximum of 50 ft. on center with a maximum of 4 per circuit. All receptacle circuits shall be protected by its own overcurrent device in a panel board. Install wiring and equipment above 6'-6" and below the finished ceiling. Extend circuits as required. Provide GFCI protected receptacles and circuits as required by NEC and OSHA.
- F. Contractors requiring extension cords shall provide their own cords and plugs up to capacity of 20 amperes. For services to larger items of equipment and welders, this Contractor shall extend proper feeders as requested at the expense of the Contractors requiring the service.
- G. The Electrical Contractor shall maintain the temporary light and power system for the duration of the work and shall remove it from the site when directed. Temporary wiring and equipment shall remain the property of the Electrical Contractor.
- H. The use of the permanent electrical system for temporary services during the latter stages of construction shall be allowed. Expedite completion of system as practicable to this end. Maintain the system during this period.
- I. Warranty periods on equipment, materials and systems shall commence upon Owner acceptance of the building or systems. Temporary use shall not jeopardize or alter warranty requirements.
- J. The complete temporary service shall comply with OSHA, and all Code requirements.

#### 1.12 WORKMANSHIP

- A. Refer to Section 01400 Quality Requirements.
- B. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all respects, and the Architect shall have the right to stop the work if highest quality workmanship is not maintained.
- C. Electrical work shall be performed by a licensed Electrical Contractor in accordance with requirements of the jurisdiction.

#### 1.13 PROTECTION

- A. Each Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Architect.

- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide plastic sheeting, drop cloths or similar barriers where dust and debris is generated, to protect adjacent areas.
- C. Contractor shall protect all equipment and materials from detrimental effects of weather or construction activity. All items shall be stored and secured in a protected location away from the daily work area. Equipment or materials shall be placed on raised skids to protect from surface moisture. Where appropriate, provide plastic sheeting or similar vapor barrier underneath the stored products to reduce the effects of ground moisture or curing concrete on the local humidity levels. Where unfinished ferrous products or finished ferrous products with raw edges are stored, provide local, dry heat to maintain ambient relative humidity levels below 65% RH to prevent rust.
- D. All equipment shall retain the original packaging until required to be removed for installation or operation. Open ends of ducts, piping, conduit, etc. shall be capped or sealed and ventilation openings into equipment shall be wrapped and sealed in plastic sheeting to prevent dust or dirt entry both when stored and after installation but still open to the effects of construction activity. Stored items as well as installed equipment shall be covered with plastic sheeting at all times until placed in service or until dust generating activity in the area has ceased.

#### 1.14 PAINTING

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in the Electrical Contract:
  - 1. All metal which is not factory or shop painted and which remains exposed to view in the building including finished areas, mechanical rooms, storage rooms and other unfinished areas shall be given a prime coat of paint.
  - 2. All metal installed outside the building which is not factory or shop painted shall be given a prime coat of paint.
  - 3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch-up.
  - 4. Apply Z.R.C. Cold Galvanizing Compound, or approved equal, for touch-up of previously galvanized surfaces.
  - 5. Paint, surface preparation and application shall conform to applicable portions of the Painting section of Division 09 Finishes. All rust must be removed before application of paint.
- B. Finish painting is included in the General Contract. Refer to the Cutting and Patching paragraph in this Section for finishing requirements.

#### 1.15 CLEANING

- A. Debris, dust, dirt, etc shall be removed daily, particular attention shall be paid to areas that the

Owner is continuing to occupy or use; any mess created in corridors, stairwells and egress paths that are maintained during construction shall be cleaned immediately.

- B. The Owners dumpsters and trash receptacles shall not be used. If a dumpster is required, it shall be provided by the contractor and located where approved by the Owner. Coordinate dumpster requirements with other contractors.
- C. Before turning an area back over to the Owner, thoroughly clean the space to leave the area in a similar condition before the start of the project where finishes are to remain.
- D. Before placing each system in operation, the equipment shall be thoroughly cleaned; cleaning shall be in accordance with equipment manufacturer's recommendations.
- E. Refer to appropriate Sections for cleaning of other equipment and systems for normal operation.

#### 1.16 EQUIPMENT SELECTION

- A. Materials and equipment furnished under this contract shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be of the same manufacturer.
- B. All electrical equipment and wiring shall bear the Underwriters Laboratories, Inc. label where UL label items are available, and shall comply with NEC (NFPA-70) and NFPA requirements.
- C. The selection of materials and equipment to be furnished under this contract shall be governed by the following:
  - 1. Where trade names, brands, or manufacturers of equipment or materials are listed in the specification, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products shall be first quality line of manufacturers listed.
  - 2. Where the words "or approved equal" appear after a manufacturer's name, specific written approval must be obtained from the Engineer during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.
  - 3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval during shop drawing submittal.
- D. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.
- E. Before bidding equipment, and again in the preparation of shop drawings, the Contractor and his supplier shall verify that adequate space is available for entry and installation or the item of equipment, including associated accessories. Also verify that adequate space is available for servicing of the equipment and that required NEC (and other applicable Code's) clearances are

met. The Contractor and his supplier shall also verify compatibility of equipment specified with available system/service voltages, etc.

- F. If extensive changes in conduit, equipment layout or electrical wiring and equipment are brought about by the use of equipment or existing site conditions which are not compatible with the layout shown on the drawings, necessary changes shall be deemed to be included in the contract.

#### 1.17 SHOP DRAWINGS

- A. Refer to Section 016000 Product Requirements.
- B. One set of shop drawings, in electronic format (pdf), with descriptive information shall be assembled by each Contractor of equipment and materials furnished in his contract, and submitted to the Architect and/or Engineer for review as stated in Division 01. These shall be submitted as soon as practicable and before special equipment is manufactured and before installation.
- C. Shop drawings for equipment fixtures, devices and materials shall be labeled and identified same as on the Contract Documents. Failure to do so may be cause for rejection of shop drawings.
- D. The review of shop drawings by the Architect or Engineer shall not relieve the Electrical Contractor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.
- E. Shop drawings of the following electrical equipment and materials shall be submitted:
  - 1. Firestopping.
  - 2. Wireway.
  - 3. Cable trays.
  - 4. Miscellaneous cabinets.
  - 5. Plenum cable.
  - 6. Wiring devices and coverplates.
  - 7. Dry type transformer – secondary.
  - 8. Panelboards and associated distribution equipment.
  - 9. Fuses.
  - 10. Motor controllers (VFD's) and disconnects.
  - 11. Lighting Controls including layout plans of Occupancy Sensors.
  - 12. Low voltage switching/lighting control system
  - 13. Lighting fixtures.
  - 14. Lighting standards.
  - 15. Fire alarm system with schematic and point to point wiring diagrams.

#### 1.18 TESTING

- A. As each wiring system is completed, it shall be tested for continuity and freedom from grounds.

- B. As each electrically operated system is energized, it shall be tested for function.
- C. The Contractor shall perform megger and resistance tests and special tests on any circuits or equipment when an authorized inspection agency suspects the system's integrity or when requested by the Architect or Engineer.
- D. All signaling and communications systems shall be inspected and tested by a qualified representative of the manufacturer or equipment vendor. Submit four (4) copies of reports indicating results.
- E. Tests shall be witnessed by field representatives of the Architect or Engineer or shall be monitored by a recorder when appropriate. Furnish a written record of each system test indicating date, system, test conditions, duration and results of tests.
- F. Instruments required for tests shall be furnished by the Contractor.

#### 1.19 FINAL INSPECTION AND PUNCH LIST

- A. Refer to Section 017700 Closeout Procedures.
- B. As the time of work completion approached, the Contractor shall survey and inspect his work and develop his own punch list to confirm it is complete and finished. He shall then notify the Architect and request that a final inspection be made. It shall not be considered the Architect's or Engineer's obligation to perform a final inspection until the Contractor has inspected the work and so states at the time of the request for the final inspection.
- C. Requests to the Architect, Engineer or Owner for final inspection may be accompanied by a limited list of known deficiencies in completion, with appropriate explanation and schedule for completing these; this is in the interest of expediting acceptance for beneficial occupancy.
- D. The Architect and/or Engineer will inspect the work and prepare a punch list of items requiring correction, completion or verification. Corrective action shall be taken by the Contractor to the satisfaction of Architect and Engineer within 30 days of receipt of the Architect/Engineer's punch list.

#### 1.20 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 017823 Operation and Maintenance Data.
- B. Digital copy (pdf) of operating and maintenance manuals shall be assembled for the Electrical work by the Contractor and provided on a flash drive.
- C. All shop drawings and installation, maintenance and operating instruction pamphlets or brochures, wiring diagrams and other information, along with warranties, shall be obtained from each manufacturer of the principal items of equipment. In addition, the Contractor shall prepare a chart listing all items of equipment which are furnished under his contract and indicating the nature of maintenance required, the recommended frequency of checking these points and the



type of replacement material required. Major items of equipment shall consist of not less than the following:

1. Distribution switchgear.
2. Motor controllers
3. Fire Alarm System.
4. Specialty equipment.

- D. Standard NEMA publications on the operation and care of equipment may be furnished in lieu of manufacturer's data where the manufacturer's instruction is not available.
- E. These shall be combined into a single electronic file in .PDF format. An index and tabbed sheets to separate the sections shall be included. These shall be submitted to the Architect or Engineer for review. Upon approval, manuals shall be turned over to the Owner.

#### 1.21 RECORD DRAWINGS

- A. Refer to Section 017839 Project Record Drawings.
- B. The Electrical Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawings shall be turned over to the Architect. This shall apply particularly to underground and concealed work, and to other systems where the installation varies to a degree which would justify recording the change.

#### 1.22 WARRANTIES

- A. Refer to Section 017700 Closeout Procedures.
- B. This Contractor shall warrant all workmanship, equipment and material entering into this contract for a period of one (1) year minimum from date of final acceptance or date of beneficial use, as agreed to between Contractor and Architect. Any materials or equipment proving to be defective during this warranty period shall be made good by this Contractor without expense to the Owner.
- C. This provision is intended specifically to cover deficiencies in contract completion or performance which are not immediately discovered after systems and placed in operation. These items include, but are not limited to, motor controller malfunction, heater element changes required for motor controller, fuse replacement where fuses blow due to abnormal shorts, adjustments and/or replacement of malfunctioning equipment and adjusting special equipment and communication systems to obtain optimum performance.
- D. This provision shall not be construed to include maintenance items such as making normally anticipated adjustments or correcting adjustment errors on the part of the Owner's personnel.
- E. Provisions of this warranty shall be considered supplementary to warranty provisions under General Conditions.

- F. Extended warranties shall be provided where indicated in the equipment specification Sections.

#### 1.23 OPERATION AND ADJUSTMENT OF EQUIPMENT

- A. As each system is put into operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing and adjusting voltages and currents and adjusting all operating equipment.
- B. Caution: Verify that all bearings of equipment furnished are lubricated, all motors are operating in the right direction, and correct overload heater elements are provided on all motors. Do not depend wholly on the other trades judgment in these matters. Follow specific instructions in regard to lubrication of equipment furnished under this Contract.

#### 1.24 OPERATING DEMONSTRATION AND INSTRUCTIONS

- A. Refer to Section 017900 Demonstration and Training as well as individual Division 26 Sections for requirements.
- B. The Contractor shall set the various systems into operation and demonstrate to the Owner and Architect that the systems function properly and that the requirements of the Contract are fulfilled.
- C. The Contractor shall provide the Owner's representatives with detailed explanations of operation and maintenance of equipment and systems. A thorough review of the operating and maintenance manuals shall be included in these instructional meetings.
- D. A minimum of 4 hours shall be allowed for instructions to personnel selected by the Owner. Instructions shall include not less than the following:
1. Show locations of items of equipment and their purpose.
  2. Review binder containing instructions and equipment and systems data.
  3. Coordinate written and verbal instructions so that personnel understand each.
  4. Separate instructions shall be given by manufacturer's representatives for the various special and communications systems.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION – NOT APPLICABLE

END OF SECTION 26 0001

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## SECTION 26 0004 – FIRESTOPPING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Firestopping assemblies shall be tested and rated in accordance with ASTM E814 (ANSI/UL 1479) Fire Tests of Through-Penetration Fire Stops (minimum positive pressure of .01 inches of water column) and E119 (ANSI/UL 263) Fire Tests of Building Construction and Materials Time-Temperature Curve. Firestopping shall provide an “F” fire rating equal to that of the construction being penetrated. Firestop systems shall meet all requirements of the Ohio Building Code.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
  - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view or above ceilings in air return plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of

construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Products: Firestopping materials shall be manufactured and/or supplied by:

1. Hilti, Inc.
2. Specified Technologies Inc.
3. 3M; Fire Protection Products Division.

### 2.2 FIRESTOPPING

A. Materials shall be in the form of caulk, putty, sealant, intumescent material, wrap strip, fire blocking, ceramic wool and other materials required for the UL listed assemblies. These shall be installed in conjunction with sleeves and materials for fill and damming.

## PART 3 - EXECUTION

### 3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Installation of all materials and assemblies shall be in accordance with UL assembly drawings and the manufacturer's instructions.
- B. Installation shall be done by an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary training and experience.
- C. Provide firestop system for every conduit or opening at penetration of all fire resistance rated walls and horizontal assemblies.
- D. Provide rigid supports for conduit on both sides of the fire resistance rated wall or assembly where required as part of the fire stop assembly.
- E. Coordinate opening size and additional framing requirement with the General Contractor for each opening to meet the firestop installation requirements.
- F. Refer to 26 0533 Raceway and Boxes for Electrical Systems for sleeve requirements and treatment of penetrations not requiring firestopping.
- G. Annular space of penetrations of nonfire-resistant-rated floor, floor/ceiling assemblies, or the ceiling membrane of a nonfire-resistant rated roof/ceiling assembly shall be filled with an approved firestopping material to resist the free passage of flame and products of combustion.

H. Smoke Barriers:

1. Penetrations shall be sealed with a firestopping system to prevent the passage of smoke.

I. Smoke Partitions:

1. Penetrations shall be sealed with a caulking material to prevent the passage of smoke.  
Non-rated smoke partitions do not require a fire stopping system.

3.2 BUILDING STRUCTURE FIRE STOPPING

- A. Where building structural members have a fire stopping system installed and portions of this fire stopping system are removed to install new systems hangers, the E.C. shall provide new fire stopping system onto portions of the building structure and hanger where fire stopping was removed. The fire stopping system shall be equal to the existing system and be 2-hour rated.

END OF SECTION 26 0004

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## SECTION 26 0005 – EXCAVATION, BACKFILL AND SURFACE RESTORATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Excavating and backfilling for all in-grade underfloor conduit, exterior ducts, conductors, conduit, lighting standard bases, manholes, handholes, pullboxes, utility trenches and any incidental work included in the Electrical Contract.

#### 1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over conduit or duct in a trench, including haunches to support sides of conduit.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Course placed over the excavated sub-grade in a trench before laying manhole, pullbox or conduit.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below topsoil materials.



- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

### 1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

### 1.4 GENERAL

- A. Excavate for all in-grade underfloor conduit, exterior ducts, conductors, conduit, lighting standard bases, manholes, handholes, pullboxes, utility trenches and any incidental work included in the Electrical Contract.. Backfill to finish grade or to levels consistent with the General Contractor's and Site Contractor's activities. Cut existing street, drive and parking lot paving, walks, curbs and other permanent hard surfaces which are to be encountered. Repair or restore exterior surfaces to original condition where such are not affected by Division 2 – Site Work. Cut existing floor slabs and replace slabs in conformance to 26 002 Basic Electrical Materials and Methods. All work shall comply with requirements set forth in Division 2.
- B. Excavation and trench wall supporting, cribbing, sloping and stepping of excavations required for safety shall be done in accordance with OSHA and local requirements. Pumping of water from excavations and trenches which may be required during construction shall be included in this contract.
- C. Contact the Ohio Utilities Protection Service (1-800-362-2764) well in advance of the start of any excavation to determine if any of the utility companies or departments have underground utilities in or near the project area.
- D. Contact local water and sewer departments, gas company, electric company, telephone company, etc., regarding the possibility of encountering existing utilities. The integrity of all existing utilities shall be respected.
- E. Existing utilities encountered during excavation work shall be protected in a manner acceptable to the utility owner. Any utilities that are damaged shall be repaired or replaced by the Contractor to the full satisfaction of the utility owner.

## PART 2 - PRODUCTS

- 2.1 Refer to Division 31 Earthwork for bedding and backfill materials

## PART 3 - EXECUTION

### 3.1 EXCAVATION FOR UTILITY TRENCHES

- A. Interior and exterior trenches shall be over-excavated and the conduits, ducts or conductors shall be laid on 6" minimum depth sand bed.
- B. Backfilling of excavations and trenches inside the building and outside under paved or other hard surfaced areas, shall be with graded pea gravel, graded coarse sand or crushed limestone, 3/4" maximum size, to prevent undue settlement. Backfill material for plastic piping shall be pea gravel or sand. Other excavations and trenches shall be backfilled with similar materials up to 18" above the top of the conduit or conductor. The remainder shall be with similar materials or with excavated material having no large clods, stones or rocks.
- C. Maintain in place adequate barricades, guards, planking, plating signage, warning lights, etc., at and around excavations.
- D. Backfill shall be mechanically compacted in layers not over 6" deep. Water settling will not be permitted. Where excavations have not been properly filled or where settlement occurs, they shall be refilled, compacted, smoothed off, and finally made to conform to the initial requirements. Excess excavated materials shall be removed from the site or disposed of as directed by the General Contractor. Refer to Division 31 Earthwork for compaction requirements.
- E. Concrete floor slabs, paving, sidewalks, curbs sodded and other finished surfaces which have been damaged or removed in order to install the underground work shall be replaced but this Contractor equal to original conditions. Refer to Division 32 for Surface Restoration requirements. This requirement is not applicable in areas where the General Contractor or the Site Contractor is obligated to provide new surfaces.
- F. Excavation, backfill, surface repair and traffic control within the public right-of-way shall be in accordance with governing agency rules and regulations. Any fee for activity in the roadways shall be included in this contract so that no additional cost will accrue to the Owner.
- G. All exterior underground direct buried conductor, conduit and concrete encased ducts shall be protected against future excavation damage by placing a plastic tape warning marker in each trench during backfill. Tape shall be 6" wide with black letters identifying the type of service. Tape shall be equal to that manufactured by Seton. Install tape full length of the trench approximately 18' above and on the centerline of the conductor, conduit or duct.

END OF SECTION 26 0005

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## SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 VAC and less.
2. Connectors, splices, and terminations rated 600 VAC and less.
3. Photovoltaic wires and cables rated for 1500 VDC or less.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

#### 1.3 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 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.
- C. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC and metal-clad cable, Type MC with ground wire.
- D. Photovoltaic Wiring: Comply with NEMA WC 70 for PV Wire.

## 2.2 CONNECTORS AND SPLICES

- 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:
  - 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.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR SIZE

- A. Refer to schedule on drawings.

### 3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Stranded for No. 8 AWG and larger.
- B. PV Strings: Copper. Stranded for No. 12 AWG and larger.

### 3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. PV Strings: Type PV Wire with MC4 connectors.
- 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. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- E. Class 2 Control Circuits: Power-limited cable, in raceway.
- F. Use conductors such as type FEP with high temperature insulation as identified in the NEC for connections to resistance heating elements or in other areas subject to temperature exceeding the rating of THWN, XHHW or THHN.

- G. In addition to the conduit system, a separate grounding conductor shall be installed with all feeders and branch circuitry.
- H. Equipment grounding conductors shall be green, or completely taped green, at all accessible points.
- I. Wire size ampacity shall equal or exceed its overload protective device. Where sizes shown on the drawings are greater than the apparent ampacity requirements, the size shown shall prevail to compensate for voltage drop. In no instance shall conductors be installed that are less than required by the N.E.C. Minimum conductor size shall be No. 12 AWG except No. 14 AWG may be used for control wiring or where otherwise specifically indicated.

### 3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, 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. Conduit systems should be clean and clear before pulling wires. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Pulling of branch circuit conductors shall be performed by manual means without the use of levers or heavy pulling devices that may compromise the conductor's or insulation integrity.
- D. A maximum of 8 conductors shall be installed in a branch circuit conduit unless specifically noted otherwise on the drawings. Equipment ground conductors are not counted when determining maximum fill.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Wiring in vertical raceways shall be supported with strain relief devices; Kellems grips or approved equal.
- G. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- H. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- I. 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 and UL 486B.
- J. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

- K. Underground splices (including splices in exterior pullboxes and manholes) shall be made using sealing kits or wire nuts U.L. listed and approved for the application.
- L. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack. Refer to additional notes on plans for branch circuitry installation requirements.

### 3.5 TESTING

- A. As each wiring system is completed, it shall be tested for continuity and freedom from grounds.
- B. As each electrically operated system is energized, it shall be tested for function.
- C. On all electric services including change-outs, backfeeds, etc. the Contractor shall verify phase rotation and voltage readings to assure the final installation is proper. Submit to the Engineer in writing a record of voltage readings and current readings taken at no-load and fully loaded conditions.
- D. The Contractor shall perform megger and resistance tests and special tests on any circuits or equipment when an authorized inspection agency suspects the system's integrity or when requested by the Engineer.
- E. Tests shall be witnessed by field representatives of the Engineer or shall be monitored by a recorder. Furnish a written record of each system test indicating date, system, test conditions, duration and results of tests. Copies of all test reports shall be included in the O&M manuals.
- F. Instruments required for tests shall be furnished by the Contractor.

END OF SECTION 26 0519

## SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

#### 1.3 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 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 wide and 1/16 inch thick.



## 2.2 GROUNDING RODS

- A. Grounding Rods shall be copper clad, molten welded copper to steel; unless otherwise designated,  $\frac{3}{4}$ " diameter X 10 ft. long.

## 2.3 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. Clamps and continuity devices shall be non-ferrous material, UL approved. Connections to ground rods and all underground connections shall be made with welded connections ("Thermoweld" or "Cadweld").

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.

2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels.
- 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. Wiring devices shall be connected with grounding jumper from ground pole on device to grounding screw (or grounding pigtail) in the outlet box.
- D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor 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.
  2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
- C. Main service neutral shall be grounded to the street side of the building water service. A bonding jumper shall be installed around the water meter. In addition to using the water service as a grounding electrode, effectively grounded building steel, driven ground rods outside or buried electrode shall be provided and connected. Bond to interior metallic water, gas and all other metallic lines.
- D. The complete metal conduit system shall be used for the equipment grounding system. Conduit systems and associated fittings and terminations shall be made mechanically tight to provide a continuous electrical path to ground and shall be safely grounded at all equipment by bonding

all metallic conduit to the equipment enclosures with locknuts cutting thru paint of enclosures. Bond all conduits entering service entrance switchboard with a ground wire connecting the grounding bushings to the equipment ground bar. Conductors shall be sized per NEC Tables 250-66 and 250-122. Bond all communications conduit systems to ground.

- E. In addition to using the conduit system for grounding, a complete auxiliary green wire equipment grounding system shall be installed, continuous from main ground, thru distribution and branch circuit panelboards and paralleling all feeders and branch circuit wiring. Grounding conductor sizes shall comply with NEC Table 250-122, minimum size shall be #12 copper except #14 on control circuits. This shall apply to all circuits rated 100 volts or more above ground potential.
- F. Ground neutral of all transformers for separately derived systems.
- G. Motor frames shall be bonded to the equipment grounding system by an independent green wire, sized as shown.
- H. Cord connected appliance frames shall be grounded to the equipment grounding system thru a green wire in the cord.
- I. A green grounding conductor shall be installed in each non-metallic conduit and all flexible conduits, including exterior underground conduits.
- J. System neutral connections shall be insulated from metal enclosures except at the neutral of the service entrance equipment and on the neutral of a separately derived system. Connections to the main service enclosure shall be by means of bonding jumpers.
- K. The building neutral shall be identified throughout with white conductors for 280/120 volt systems and grey conductors for 480/277 volt systems. Where there are neutral conductors from a separately derived system (such as 120/208 volt, 3 phase, 4 wire where the main building service is 277/480 volt, 3 phase, 4 wire) the neutrals of the two systems shall be separately identifiable per NEC Article 200.
- L. A minimum #6 ground wire shall be run from each telephone backboard/data rack back to the main building ground. Or where indicated on the drawings or in the specifications, a separate communications grounding system shall be provided and bonded to the electrical grounding system at the main ground bar.
- M. Where metal covers on pull boxes and junction boxes are used, they shall comply with the grounding and bonding requirements of NEC Article 250.
- N. Connections to driven ground rods or other such electrodes shall be a minimum of 3 feet from the building foundation wall or beyond the roof drip line, whichever is greater.

END OF SECTION 26 0526

## SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

### 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. 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. 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.
  - f. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. 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. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. 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. 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) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) 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. Toggle Bolts: All-steel springhead type.
  6. 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 in diameter.

- C. Utilize supports with swivel type attachments to maintain true vertical support from sloped structure or inclined structural elements (such as beam clamp with swivel option).
- D. 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.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, 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.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on blocking attached to substrate by means that meet anchorage requirements.
- 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.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.4 CONCRETE BASES

- A. Provide dowel rods to connect concrete bases to concrete floors/slabs/substrates. Unless otherwise indicated, install dowel rods on maximum 18-inch centers around the full perimeter of concrete base.
- B. Provide epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor/slab/substrate, unless concrete bases are installed directly on grade. Place and secure anchorage devices. Using setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast galvanized or stainless-steel anchor-bolt inserts into bases.
- D. Indoor bases shall be at least 4" thick and shall have straight and finished sides and a 1"-45 degree chamfer at the top perimeter. Reinforcing steel bars shall be placed in both directions of the bases. Where required for supplemental support, provide lateral support work to adjacent wall(s). Provide concrete bases/housekeeping pads beneath all electrical power and systems distribution equipment that is floor mounted or wall mounted within 4" of the floor.
- E. Outdoor bases shall be at least 6" thick and shall have straight and finished sides and a 1"-45 degree chamfer at the top perimeter. Perimeter of pads shall extend down below the frostline. Reinforcing steel bars shall be placed in both directions of the bases and a mesh overlay shall be provided. Where required for supplemental support, provide lateral support work to adjacent wall(s). Provide concrete bases/housekeeping pads beneath all electrical power and systems distribution equipment that is slab or grade mounted or mounted within 6" of slab or grade.
- F. Unless indicated otherwise in specifications or on drawings, use minimum 3000-psi, 28-day compressive-strength concrete. Size and provide concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
- G. Forms: As required for equipment pads or other special applications in field, provide forms made of steel, wood, or other suitable material of size and strength to resist movement during concrete placement, and to retain horizontal and vertical alignment until removal. Use straight forms, free distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends. Do not remove forms for 24 hours after concrete has been placed. Set forms to required grades and lines, rigidly braced and secured. Provide sufficient quantity of forms to allow continuous progress of work, and so that forms can remain in place at least 24 hours after concrete placement. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage. Form areas that involve termination of spare conduits below grade, or that involve continuation of conduits by others, accordingly to accommodate easy future access to the ends of conduits for future extensions.

- H. Reinforcement: Cut bars true to length with ends square and free of burrs. Provide metal expansion caps for one end of each dowel bar in expansion joints. Design caps with one end closed and minimum length of 3" to allow bars movement of not less than 1", unless otherwise indicated. Provide these for joining applications where continuous pouring cannot be accomplished.
- I. Concrete Placement: Remove loose material from subbase surface immediately before placing concrete. Check subbase and forms for line and grade before placing concrete. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Place concrete using methods that prevent segregation of mix. Use splash boards to divert the flow of concrete away from the trench sides, and to avoid dislodging soil and stones. Coordinate with Owner's Representative at least 72 hours prior to placing concrete. Line up concrete trucks as required to achieve one continuous pour where applicable. Do not backfill until a minimum of 48 hours have passed.
- J. Concrete Finishing: Smooth surface by screeding after striking-off and consolidating concrete. Provide Class A finishing. Broom finish concrete pads, and aprons around pullboxes and structures. Protect concrete from damage until acceptance of work. Exclude traffic over affected areas for at least 14 days after placement.

### 3.5 PLYWOOD EQUIPMENT BOARDS

- A. Plywood Equipment Boards: Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent. Provide plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 3/4 inches deep. Provide marine grade plywood where subject to moisture conditions. Provide Simpson Strong Tie (or equal) expansion screw anchors.
- B. Unless otherwise noted, boards shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 1/2" rustproof spacers between back of plywood and wall. Cut, fit, and place plywood equipment boards accurately in location, alignment, and elevations to support and anchor electrical materials and equipment. Select fastener sizes that will not 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 members. Attach to substrates as required to support applied loads. Maintain at least 4 inches from bottom of plywood equipment boards and the finished floor surface.
- C. Unless directed otherwise in field, plywood equipment boards shall be 8 feet high by 3/4 inches deep by length shown on drawings (as dimensioned or as scaled) or length as required to accommodate equipment if not indicated on drawings. Unless directed otherwise in field, provide plywood equipment boards for all indoor surface mounted panelboards and systems "head-end" equipment for all applications where located in mechanical or electrical rooms/areas and only where specifically shown on drawings for all other applications.

END OF SECTION 26 0529



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## SECTION 26 0533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

#### 1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

#### 1.3 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. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. 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. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2. Fittings for EMT: Steel only; set-screw or compression type.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.
- F. Trapeze hangers shall be supported by 3/8" (minimum) diameter rods.

## 2.3 SURFACE RACEWAYS

- A. Surface Metal Raceways: Brushed Aluminum with snap-on covers.
  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. Mono Systems.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Hubbell Wiring Systems.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- F. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
  - a. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT except MC cable may be utilized in walls where routed vertically. (Provide homeruns in EMT to the center of rooms and utilize MC for vertical drops to receptacles/devices. No horizontal MC runs in walls except where run to devices below windows). FMC may be utilized in existing walls.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable: EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. EMT: Use all steel, compression type or all steel setscrew type, concrete tight.
3. Flexible conduit: Use malleable iron, "squeeze" type, non-insulated. (For lighting fixture whips only: Use all steel or die-cast screw-in connector).

4. Liquid-tight conduit: steel or malleable iron.

### 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. Generally run conduit and conductors as high as practicable against underside of floor slab in concrete construction or immediately below the **top chord** of bar joist construction unless otherwise shown or noted. This high level zone shall be used for running electrical raceways and shall be grouped or racked together wherever feasible. Runs at bottom chord level or ceiling grid level are not acceptable.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Where metal corrugated roof decking is utilized, raceways shall be located a minimum of 1-1/2" below the lowest surface of roof decking (unless RMC or IMC is utilized).
- D. Complete raceway installation before starting conductor installation. Plan raceway routing to minimize the number of offsets and junction boxes.
- E. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- 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, ceilings, and floors, unless otherwise indicated. All conduit shall parallel building lines.
- H. Conduit shall be run overhead and shall not be run below concrete slabs unless specifically indicated on the drawings and in the legend on the drawings.
- I. Conduit crossing building expansion joints shall have expansion provisions with grounding continuity, use special expansion fittings listed for the application. Refer to the Architectural and Structural floor plans and details for locations of expansion joints.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- L. Raceways for Data, Audio Visual and Communications Cable: Install as follows:
  1. 1-Inch Trade Size and Smaller: Install raceways in maximum lengths of 75 feet.
  2. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

3. Raceway shall be installed continuously from outlet box to above edge of nearest cable tray above accessible ceiling.
  4. Bond raceway to cable tray with approved grounding bushing, bonding jumper and necessary fittings.
- M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in all locations except MC may be used for lighting fixture whips.
- N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- O. Do not install wall-mounted boxes back-to-back in opposite sides of wall; in stud walls, boxes shall be on opposite side of studs.
- P. Provide access to all junction and pull boxes.
- Q. Set metal floor boxes level and flush with finished floor surface. Provide trim ring compatible with finish floor system.
- R. Pull mandrel or large swab thru conduit to assure freedom from debris before pulling wires. Use listed pulling lubricants where necessary.
- S. Provide four (4) 1 inch diameter spare conduits for each flush mounted branch circuit panelboard; extend from top of panelboard to above an accessible ceiling for future use.
- T. Contractor shall record carefully on a set of "as-built" prints, the exact location of all feeder conduits (100 amps and larger).
- U. Unless noted otherwise on the drawings, a maximum of 8 conductors shall be installed in a branch circuit conduit. This maximum is a count of all phase and neutral conductors only.

### 3.3 INSTALLATION OF EXPOSED CONDUIT OUTDOORS

- A. Only install conduit exposed outdoors when it is impossible to do otherwise, or only if specifically indicated for such installation case-by-case elsewhere in documents. Installation convenience, financial considerations, lack of coordination with other trades and similar rationale are not sufficient reasons for conduit sizes per NFPA 70 (National Electrical Code, NEC). Provide expansion fittings, which are Listed and labeled for the respective applications, at all building expansion joints and at maximum distances of 100 feet. Paint all such conduits with at least two coats of UV-resistant weatherproof paint. Provide colors to match respective surrounding surfaces; submit colors to Design Professional for review in advance of procuring paint.

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#### 3.4 INSTALLATION OF EXPOSED CONDUIT ON ROOFS

1. Only install conduit exposed on rooftops when it is impossible to do otherwise, or only if specifically indicated for such installation case-by-case elsewhere in documents. Installation convenience, financial considerations, lack of coordination with other trades and similar rationale are not sufficient reasons for doing so. In cases where conduits must be installed on rooftops, de-rate conductors and modify conduit sizes per NFPA 70 (National Electrical Code, NEC). Provide expansion fittings, which are Listed and labeled for the respective applications, at all building expansion joints and at maximum distances of 100 feet. Paint all such conduits with at least two coats of UV-resistant weatherproof paint. Provide white paint of flat rooftops that have finishes white in color, and for otherwise-colored roof finishes that are not visible from the building interior or from the ground outdoors. Elsewhere select colors to match surrounding surfaces; submit colors to Design Professional for review in advance of procuring paint.

END OF SECTION 26 0533

## SECTION 26 0543 –UNDERGROUND DUCTS AND RACEWAYS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.

#### 1.2 SUBMITTALS

A. Product Data: For accessories for handholes, and boxes.

B. Shop Drawings for Factory-Fabricated Handholes and Boxes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

C. Field quality-control test reports.

#### 1.3 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Utilize galvanized rigid steel for 90 degree bends (long sweep type) with proper adapters between PVC duct and galvanized steel.



## 2.2 NONMETALLIC DUCTS AND DUCT 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. Cantex, Inc.
  2. CertainTeed Corp.; Pipe & Plastics Group.
  3. Heritage Plastics.
  4. Carlon Electrical Products.
  5. Manhattan/CDT; a division of Cable Design Technologies.
  6. Spiraduct/AFC Cable Systems, Inc.
- B. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, to provide minimum duct spacings while supporting ducts during concreting or backfilling.

## 2.3 HANDHOLES AND BOXES

- A. Description: Comply with SCTE 77.
1. Color: Gray.
  2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
  3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  5. Cover Legend: Molded lettering, As indicated for each service.
  6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer Handholes and Boxes: Molded of fiberglass-reinforced polymer concrete, with matching covers.
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. Carson Industries LLC.
    - b. Quazite (Hubbell).
    - c. Highline Products, Inc.

## PART 3 - EXECUTION

### 3.1 EARTHWORK AND RESTORATION

- A. Refer to Division 26 Section "Excavation, Backfill and Surface Restoration".

### 3.2 DUCT INSTALLATION

- A. Slope: Pitch ducts toward handholes and away from buildings and equipment.
- B. Manufactured sweep bends in first paragraph below are available in various radii up to 25 feet (7.5 m) for 4- and 5-inch (100- and 125-mm) ducts, although a 48-inch (1220-mm) radius is the largest regularly stocked. To minimize pulling tensions, specify the largest radius possible, consistent with other Project requirements. See Editing Instruction No. 3 in the Evaluations. Coordinate with Drawings.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends at other locations, unless otherwise indicated.
- D. Joints: Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 2. Concreting Sequence: Pour each run of envelope between handholes or other terminations in one continuous operation.
    - a. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
  - 3. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

4. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
5. Identify Ductbank with one of the following methods:
  - a. Mark the top of all underground duct runs with concentrated red dye or powder on top.
  - b. Provide 6" wide yellow plastic tape, with black letters indicating "Electric"; place approximately 18" above and continuously along the centerline of duct bank.

### 3.3 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: Set covers of handholes 1 inch above finished grade and boxes with bottom below the frost line.
- D. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.4 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.5 CLEANING

- A. Pull mandrel through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 0543

## SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Identification for conductors and communication and control cable.
2. Wiring device circuit identification.
3. Warning labels and signs.
4. Equipment identification labels.

#### 1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

#### 1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

#### 1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, 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.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

#### 2.2 WIRING DEVICE CIRCUIT IDENTIFICATION

A. Marker Tape: Self-laminating, clear polyester, 3/8" high tape with black lettering.

- B. Provide label on every wiring device cover plate, indicating panel and circuit breaker fed from. Utilize 12 pt. font. Mount label on face of device cover plate, centered near the top .

## 2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."

## 2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Phenolic Label: Adhesive backed, with black letters on a white background. Minimum letter height shall be 3/8 inch.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Electrical and Auxiliary Systems Box, Conductor and Cable Identification: Use marker tape to identify field-installed branch circuit, alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
  - 2. Identify panel and branch circuit number(s) on all junction box covers permanently clearly printed with bold black indelible marker.
  - 3. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Conduit and junction boxes:

1. Color code or label all junction boxes and exposed conduit at 20 ft. intervals. Coding shall be painted or labels of the pre-manufactured type permanently mounted with metal or plastic band.
  2. Label panelboard and branch circuit number(s) on outside of junction box cover at all junction boxes containing branch circuit wiring. Labelling shall be neatly done utilizing black indelible ink markers.
  3. Paint all junction boxes and covers for fire alarm wiring red.
- C. Branch circuit panelboards:
1. Identify panel designation on directory card within the panel.
  2. Fill out branch circuit directory indicating circuit number and area served, rooms, group of rooms, lighting, convenience outlets, motors, etc. Card index shall be neatly typed.
  3. Replace branch circuit directory in existing panelboards in areas of alteration.
  4. Branch circuit phase conductor color format shall be permanently identified inside each panelboard.
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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, laminated phenolic label. Unless otherwise indicated, provide a single line of text with 1/4-inch- high letters on 5/8-inch- high label; where 2 lines of text are required, use labels 1 inch high.
  2. Equipment to Be Labeled:
    - a. Panelboards, electrical cabinets, and enclosures.
    - b. Transformers.
    - c. Disconnect switches.
    - d. Enclosed circuit breakers.
    - e. Motor starters.
    - f. Lighting Relay Panel(s).

3. Label shall include equipment name, voltage and where fed from. Where equipment is located in finished spaces, accessible to the public, in addition to adhesive, secure labels with screws, one on each end.

### 3.2 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. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
  1. Color shall be factory applied.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White
  3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow
    - d. Neutral: Grey.

END OF SECTION 26 0553

## SECTION 26 0563 – SPECIFIC WIRING APPLICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Various items of equipment require additional electrical connections, wiring and/or interlocks that are not specifically identified on the drawings or in the specifications. Included, but not limited to, are the following items:
  - 1. Laboratory and laundry equipment.
  - 2. Mechanical/HVAC Equipment and motors.
  - 3. Plumbing Equipment and Dental Equipment
  - 4. Exterior Lighting Control Equipment.
  - 5. Security/Access Control Equipment.
  - 6. Fire Protection/Suppression Equipment.

#### 1.2 COORDINATION

- A. Coordinate wiring requirements and interlocks for equipment provided by other Contractors. Obtain copies of approved Shop Drawings and/or manufacturer's wiring diagrams to determine exact wiring requirements.
- B. This Contractor shall inquire of the Engineer during bidding, or at the earliest practical date, any questions which may arise regarding the intention and scope of this work.

### PART 2 - PRODUCTS

- 2.1 Materials and equipment shall be as indicated on the drawings and in the specifications.

### PART 3 - EXECUTION

- 3.1 Final connections to fixture pigtails shall be made with approved pressure connectors such as IDEAL “Twister” or T&B “Freespring Winged”.
- 3.2 Miscellaneous Equipment Connections
  - A. Various items of equipment such as kitchen, laboratory, laundry, HVAC, Plumbing, etc. will be furnished and set in place by other trades. This equipment, unless otherwise shown on the drawings, will be furnished with necessary electrical outlets, operating and control switches, terminating in an electrical outlet box, or equivalent electrical connector located on the



equipment. This contractor shall furnish power wiring to these various items of equipment and connect them up complete for full operation.

- B. Where disconnect switches are indicated or where otherwise required, they shall be mounted in an accessible location. In the case of labs, kitchens, laundries and finished areas, provide NEMA 4X Stainless Steel enclosure and locate in as inconspicuous a place as possible. Locate disconnect switches under counters where feasible and accessible in lieu of above counter, however, this contractor shall ensure that the installation of equipment does not interfere with access and operation of such switches.
- C. Where necessary to expose conduit in finished spaces, rigid aluminum conduit and conduit body ("LB") fittings shall be utilized.
- D. Coordinate and provide any additional 120 volt power connections required for special low voltage systems devices or equipment panels such as Security System/Door Access System control panels, door strikes, surveillance cameras, security/fire shutters or doors, temperature control system panels/transformers, etc.
- E. Roughing-in drawings for equipment shall be obtained from the Architect or Contractor providing the equipment with substantial time prior to the installation of such equipment to enable proper electrical rough-in equipment.

### 3.3 Miscellaneous Wiring Interlocks

- A. Various items of work are required in connection with interlocking motor and starter/VFD operations and providing wiring to serve equipment which is furnished by other trades.
- B. Interlocks between motor controllers for purposes of accomplishing sequence control or simultaneous operation of motors are all to be included in the Electrical Contract. Requirements for a simple simultaneous motor operation interlock are indicated by a schedule on the drawings or by specific notes. These interlocks consist of auxiliary contacts on the starter/VFD of the lead motor wired in, according to standard diagrams of the motor starter/VFD manufacturer to energize the holding coil of the starter or VFD control input for the motor. These interlocks shall be thru the "automatic" position only of the starter/VFD where HOA switches are supplied. Furnish extra contacts on external relays as required for interlocks. Where interlocks, other than the simple sequence above, are required, they shall be as described as follows in this section.
- C. Air handling unit motors shall lead and exhaust fans and moving media air filters (if applicable) follow. Chiller pumps shall lead, followed by chiller, condenser pump and cooling tower, in that order. Condenser pumps shall lead and chemical feeder shall follow. Hot water pumps shall lead and boilers follow.
- D. All safeties, such as freezestats and firestats for air handling systems or high temperature/pressure switches for pumping systems, where required to be wired by the Electrical Contractor, shall be wired thru both the "Hand" and "Automatic" positions.
- E. The following is a list of equipment and systems requiring wiring. Note that these are in addition to standard interlocks scheduled on the drawings.

1. Exterior lighting shall be controlled via integral photocell in fixture(s).
2. Motorized backdraft dampers on exhaust fans and power roof ventilators shall be connected to their respective associated motor leads to energize the backdraft damper motor and open the damper when the fan operates. Dampers, operator and transformer, if required, will be furnished by the fan supplier, install transformer and wire to damper.
3. Independently mounted controllers furnished by others: Where starters/VFD's are furnished by other trades, and are required to be mounted remote from the motor, the Electrical Contractor shall accept and mount them and perform all power and control wiring between the controls and motors indicated. Motor controllers equipped with automatic alternators shall have two independent circuits and control sources to preclude loss of operation when one circuit fails.
4. Natural gas solenoid valve(s) will be provided by the Plumbing Contractor. This Contractor shall provide maintained contact emergency stop pushbutton(s), as indicated on the floor plan(s) and wire thru 120 volt power source to power solenoid valve(s) open. Wire pushbutton so that when depressed, solenoid is de-energized and gas valve is closed.

END OF SECTION 26 0563

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## SECTION 26 0923 - LIGHTING CONTROL DEVICES

### PART 1: GENERAL

#### 1.0 Section Includes

##### A. Lighting Control Components and Systems:

1. Line Voltage Wall Switches Low Voltage Wall Switches and Sensors
2. Occupancy / Vacancy Sensors Detection
3. Power Interfaces
4. Line Voltage Wall Switches and Sensors
5. Wireless Devices and Systems

#### 1.1 Related Requirements

- A. Section 262726 Wiring Devices
- B. Section 265113 Interior Lighting

#### 1.2 References

##### A. Underwriters Laboratories (UL):

1. UL 916- Energy Management Equipment
2. UL 924 - Emergency Lighting and Power Equipment
3. UL 1472 – Standard for Safety Solid-State Dimming Controls

##### B. National Fire Protection Association (NFPA):

1. NFPA 70 - National Electric Code

##### C. IEC 61000-4-2 Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques-Electrostatic Discharge Immunity Test; 2008

##### D. NEMA WD 7-2011: Occupancy Motion Sensors

##### E. NEMA SSL 7A: Phase Cut Dimming

##### F. FCC Part 15 and equivalent ISSED / NOM

#### 1.3 Administrative Requirements

##### A. Coordination

1. Coordinate placement of daylight and occupancy sensors to achieve optimum performance. Proper sensor placement should be coordinated with others to avoid obstructions that would interfere with maintaining prescribed light levels
2. Coordinate the work to provide luminaires and lamps that are compatible with the lighting controls to be installed
3. Notify architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work

#### 1.4 Submittals

##### A. Submit under provisions of Section 26 0001

##### B. Shop Drawings include

1. Floor Plan(s) showing device and accessories layout
2. System schematic/typical riser diagrams

##### C. Product Data Sheets

1.5 Project Closeout Documentation

- A. Provide a factory published manual
  - 1. Warranty
  - 2. Technical support contact
  - 3. Electronic manual on manufacturer's website for free download

1.6 Quality Assurance

- A. Manufacturer Qualifications:
  - 1. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues.
  - 2. On-Site Support: Manufacturer capable of providing on-site response time within the continental United States
  - 3. Service Contracts: Manufacturer capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion.
- B. All devices are 100% factory function tested prior to delivery
- C. Compliant with the requirements of NFPA 70
- D. All power components UL listed for required loads

1.7 Project Conditions

- A. Only install equipment after the following site conditions are maintained:
  - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C); unless specified extended temperature operation within the product specification sheet.
  - 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures are permanently installed
- C. Equipment is protected from dust, debris and moisture

1.8 Warranty

- A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace (same device or equivalent), materials, and devices that fail to perform as specified within extended warranty period.
- B. Five (5) years from the date of shipment

**PART 2: PRODUCT INFORMATION**

2.1 Manufacturers:

- A. Low Voltage
  - 1. Current (NX)
  - 2. Leviton
  - 3. Wattstopper
  - 4. Acuity-NLight
- B. Line Voltage
  - 1. Refer to "26 2726 Wiring Devices" section for acceptable Manufacturers

2.2 General:

- A. Provide system hardware that is designed, tested, manufactured, warranted by a single manufacturer
- B. Operational Life: At least 10 years expected life while operating within the specified ambient temperature and humidity range
- C. Power Failure Memory: automatically store system settings and recover from a power failure without requiring user input.

Occupancy Detection Technology Requirements:

- D. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
- E. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or based sensing technologies shall not be accepted.
- F. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
- G. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 10 minutes.
- H. Allow adjustments to the occupancy time delay based on owner preference, fixture life extension or increase energy savings. Should be done in consultation with the building owner and specifying engineer.
- I. Installer, in accordance with manufacturer's recommendation, shall determine final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens, and shall not require initial or subsequent field adjustment of detection sensitivity.
- J. All sensor setting adjustments shall be digital; comprising of a one or more user interfaces: Push-button, Visual Light Infrared, RFID or Bluetooth Programming methods
- K. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

## 2.3 Low Voltage Wall Switches

- A. Shall be capable of the following:
  - 1. Accept 12-24VAC/VDC
  - 2. Suitable for installation in a single-gang switch box
  - 3. Support On / Off / Dimming and 3-way Connection
  - 4. Single and dual pole options
  - 5. Programmable via push button programming with visual LED visual feedback

## 2.4 Line Voltage Wall Switches

- A. Shall be capable of the following:
  - 1. Shall accept Class 1 wiring directly.
  - 2. Devices will operate as On / Off and Dimming (pending model variant)
  - 3. Dimming devices shall be 0-10V sink devices
  - 4. Multi-way switches allow for 3-way, 4-way and up to 9 connections.

5. All Multi-Way devices On / Off loads will operate and respond in unison.
6. Multi-way devices with dimming loads will operate in unison when initiated by a dimming device
7. Multi-way device is a class 1 low voltage data bus and must not be used with a standard toggle switch.
8. Count down timer capabilities
9. Single and dual pole options

B. Phase Dimming Wall Switches;

Shall be capable of the following:

1. Shall accept Class 1 wiring directly.
2. Devices will operate on / off and dimming LED load types
3. Compatible with NEMA SSL 7A

C. Line Voltage Wall Switch with Occupancy Sensor

- A. Sensor shall provide wall-to-wall PIR occupant movement supporting small (hand motions) and large (walking motion) detection .
- B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology detection shall be used (as specified in above section 1.1, Occupancy Sensor Technology Requirements).
- C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
- D. Sensors shall be capable of switching both 120 VAC and 277 VAC (models allowing 120-277 VAC input) and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
- E. Light Commercial devices will be designated as 120 VAC and lower load rating compared to commercial based products.
- F. Sensor shall recess into single gang switch box and fit a standard GFI opening.
- G. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection internally and intrinsically through its mounting strap.
- H. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
- I. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology (only exception is versions with lighted push-buttons).
- J. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (off) condition. Sensor shall not require a minimum load to be connected to function.
- K. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation.
- L. All sensor settings, including time delay and photocell settings shall be digital and accessible for adjustment via one or more user interfaces.
- M. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.

- N. All models shall be capable of both Auto-On, Manual On, and Partial-On operation.
- O. All models shall be capable of a "Reduced Turn On" operation where the initial PIR turn on level is higher in order to eliminate PIR from reflective surfaces from being detected. PIR shall be returned to normal levels upon initial PIR detection.
- P. All models shall have a "Predictive Off" mode where user can manually turn the lights off when leaving the room and still have them come on automatically when they return to space.
- Q. All models shall be capable of disabling override switch.
- R. Multiple switches controlling the same load (3-way or 4-way applications) shall use multi-way based devices.

2.5 Wall Switch Occupancy Sensors – Large Areas

- A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 40 ft (12.19 m).
- B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology detection shall be used (as specified in above section 1.1, Occupancy Sensor Technology Requirements).
- C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
- D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz. Load ratings shall be 13A each pole, ¼ HP motor load.
- E. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
- F. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
- G. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.
- H. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (Off) condition. Sensor shall not require a minimum load to be connected in order to function.

2.6 Low Voltage Occupancy Sensors

- A. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
- B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology detection shall be used (as specified in above section 2.2, Occupancy Sensor Technology Requirements).
- C. Sensors shall interconnect with other sensors and power/relay packs with class 2, three-conductor wire.
- D. Sensors shall operate on 12 to 24 VAC or VDC and consume no more than 5 mA so that up to 14 sensors may be connected to a single power pack.
- E. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.
- F. Each designated zone shall contain one sensor with a SPDT class 2 auxiliary relay, providing an input to building automation system (BAS). All sensors in designated zone shall communicate to



- sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that power pack must be installed on the Line side of the local toggle switch for auxiliary relay to work properly.
- G. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
  - H. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
  - I. Sensors with a recessed profile are acceptable substitutes for above ceiling mount sensors

## 2.7 Power Packs

- A. Power packs shall accept and switch 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.
- B. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- C. When required by local code, power pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- D. Power pack shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for a minimum of 300,000 cycles.
- E. Power packs shall be single circuit, or two circuits. Slave packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.
- F. A dry contact relay to connect BMS, HVAC, Fan, etc., shall be provided.

## 2.8 Line Voltage Occupancy Sensors

- A. Sensors shall be self-contained and accept Class 1 wiring directly without the use of a power pack.
- B. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
- C. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology detection shall be used (as specified in above section 2.2, Occupancy Sensor Technology Requirements).
- D. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

- E. Multiple sensors controlling the same load shall be wired in parallel.
- F. For applications requiring independent control of two loads, a sensor with two dual relays shall be required. Each relay shall have independent programmable occupancy time delays.
- G. Dual relay sensors shall have an optional operational mode called "Alternating On" where when during unoccupied periods, one relay is always left closed (thus one load is always on). The particular relay that is left closed alternates each cycle so that the aging of the connected lamps is even.
- H. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
- I. Specific sensors capable of switching 5 Amps of two-phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.
- J. Wall mounted sensors must be installed at 7 to 8 feet above the floor. Single and two circuit units shall be available.
- K. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
- L. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
- M. Sensor settings may be programmed via pushbutton or via mobile application.
- N. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors.

## 2.9 Indoor Photocells and Daylight Harvesting Controls

- A. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.
- B. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
- C. Photocell set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Further adjustment may be made manually if needed.
- D. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
- E. Low voltage dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control 0 to 10 VDC dimmable drivers.
- F. Low voltage dimming sensor's set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
- G. Combination photocell/dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the on/off function as well as the dimming function of 0 to 10 VDC dimmable drivers.

- H. Combination photocell/dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set point may be manually entered.
- I. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.
- J. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
- K. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC.
- L. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 5 Amps of two phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.
- M. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors

#### 2.10 Wireless Devices and Systems

- A. Automatically sync for system operation
  - 1. Shall conform to SOC2 criteria
  - 2. Must not use a predefined PIN.
- B. Send and receive messages for real-time operation and feedback
- C. Use industry standard RF protocols (list is subject to change)
  - 1. Bluetooth Devices must be listed with the Bluetooth SIG organization
- D. All devices are FCC / Industry Canada compliant.
- E. Settings shall be programmable via push-button or mobile device application (Apple iOS and Android Operating Systems).

#### 2.11 Spare Parts/Devices

- A. A minimum of two spare devices of each type utilized shall be turned over to Owner as spare stock at project completion.

### PART 3: EXECUTION

#### 3.1 Installation

- A. Follow manufacturer's instructions for all installation steps
- B. Provide a complete installation per Contract Documents
- C. Where applicable provide FAQs and Quick Start Guides

#### 3.2 Startup and Programming

- A. Provide telephone support via toll free line
- B. Factory trained service available for purchase
- C. Where applicable training video and elearning content

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- 3.5 Maintenance
  - A. Factory trained service technicians available within the continental US
  - B. Offer integrated help on-screen and via online videos
  - C. Factory telephone support via toll free line

END OF SECTION

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## SECTION 26 2213 - LOW-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

#### 1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Indicate dimensions and weights.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

#### 1.3 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 IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ACME Electric Corporation; Power Distribution Products Division.
  - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Sola/Hevi-Duty.
  - 5. Square D; Schneider Electric.

6. ABB.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: ANSI 49 gray.
- F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  2. Indicate value of K-factor on transformer nameplate.
- K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
- L. Wall Brackets: Manufacturer's standard brackets.

#### 2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic nameplate. Nameplates are specified in Division 26 Section "Identification for Electrical Systems."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Furnish and install a vibration isolation pad at each corner of each transformer to isolate from structure or support frame. Vibration isolation pads shall be selected for appropriate weight and bearing area; by Mason or B-Line or equal.

#### 3.2 ADJUSTING

- A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 26 2200



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## SECTION 26 2416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Panelboard schedules for installation in panelboards.
- D. Operation and maintenance data.

#### 1.3 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. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and/or surface-mounted cabinets, as indicated on the drawings.
  - 1. Rated for environmental conditions at installed location.

- a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - b. Outdoor Locations: NEMA 250, Type 3R.
  - c. Kitchen/Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and/or bottom as Project condition dictates.
- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Hard-drawn copper, 98 percent conductivity.
  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.
  5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards 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.
- H. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cutler-Hammer.
  2. Siemens.
  3. Square D.
  4. ABB.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: Secured with vault-type 3 point latch with tumbler lock; keyed alike.
- C. Mains: Circuit breaker, Lugs only as identified on the drawings.

- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker and/or lugs only as identified on the drawings. Sized to have 225 amp bussing unless indicated otherwise on drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. Sized to accommodate 42 poles unless indicated otherwise on drawings. Furnish number of breakers shown.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents listed on the drawings.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 5. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles. Where more than one pole is used, they shall employ a common trip.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits. Type HACR for feeding heating, air conditioning and refrigeration equipment.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Shunt Trip: 120 -V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

- g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of lighting and appliance panelboard trim 72 inches above finished floor; distribution panelboard trim 90 inches 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 and ground fault settings as applicable.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from flush mounted panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

#### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Switchboards or panelboards containing a 4-wire, delta connected system where the midpoint of one phase winding is grounded shall be legibly and permanently field marked to indicate "high phase leg to ground" per (2017) NEC 408.3(F).
- C. Create a directory to indicate installed circuit loads and incorporating Owner's final room, area or equipment designations. Temporary conditions of occupancy shall not be utilized as circuit descriptions. Indicated spare circuits shall be specifically labeled as such. Obtain approval

before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. 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."

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 2416

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## SECTION 26 2726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall-box motion sensors.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and interior occupancy sensors.
6. Communications outlets.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

### 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 Eaton Industries, Inc. (Cooper/Arrow Hart).
  2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  3. Leviton Mfg. Company Inc. (Leviton).
  4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Legrand).

#### 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; 5361 (single), 5362 (duplex).
- c. Leviton; 5351 (single), 5352 (duplex).
- d. Pass & Seymour; 5361 (single), 5362 (duplex).

B. Hospital Grade Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. **To be utilized ONLY in Dental Lab.**

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 8300 (duplex).
- b. Hubbell; HBL8300 (duplex).
- c. Leviton; 8300 (duplex).
- d. Pass & Seymour; 8300 (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. All receptacles installed outdoors shall be weather resistant type.

C. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper.
- b. Pass & Seymour/Legrand.
- c. Leviton.
- d. Hubbell.

## 2.4 TAMPER RESISTANT STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, NEC 406.12 & 517.18(C) and UL 498.

B. Where indicated on plans to provide Tamper Resistant type receptacle, device shall have non-conductive dual mechanical shutter mechanisms on 120V connection ports, compliant with NEC requirements. This is in addition to required device configuration indicated (ie: Standard Straight Blade, Hospital Grade, GFCI, etc.).

## 2.5 USB CHARGING TYPE RECEPTACLES

- A. Convenience Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498.
- B. Where indicated on plans to include USB Type Charging ports, device shall include Dual-Port USB Type A-C charging ports with minimum 5 Amps combined charging power (minimum 25 watts), in addition to required device configuration indicated (ie: Standard Straight Blade, Hospital Grade, GFCI, Tamper-resistant, etc.).

## 2.6 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).

## 2.7 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, 0-10V, solid-state units with integral, quiet on-off switches. Unit listed and compatible for type of lighting controlled and rated for connected load unless larger rating is indicated for future capacity.
- B. Control: Continuously adjustable slider, with separate on-off switch; single-pole or three-way switching capability. Comply with UL 1472.

## 2.8 OCCUPANCY SENSORS

- A. Refer to Section 26 0923 Lighting Control Devices

## 2.9 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: Stainless Steel.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

1. Outdoor receptacle covers shall be "In Use" type rated "Extra Duty".

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Round, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, black finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: As noted on plans or as indicated in applicable specification section.

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices: White.

2. Device plates: Stainless Steel.

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 insure that 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.

5. All 15 or 20 amp-120V wiring devices located within 6 feet from the edge of a sink, located in Kitchens or Bathrooms or serving electric water cooler shall be GFCI protected type device.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
3. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtail 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. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
3. When there is a choice, use side wiring with binding-head screw terminals.
4. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
5. Tighten unused terminal screws on the device.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that controls used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

### 3.2 "PLUG CONNECT/PLUG TAIL" DEVICES

- A. In lieu of terminal screw connected receptacles and switches as specified above, specialized plug-in type devices may be provided as long as it is offered by the same manufacturer and

listed equivalent to the same product line specified. Permanent wiring pigtails shall be of sufficient length to enable replacement of device with standard terminal screw type device as required by Code.

- B. Where plug-in type wiring devices are provided, furnish a minimum of five (5) of each type and color device installed to the Owner as spares. Where more than one hundred (100) of any type is installed, provide a minimum of ten (10) spare devices.

### 3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

END OF SECTION 26 2726

## SECTION 26 2813 - FUSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in, enclosed switches, panelboards, enclosed controllers and motor-control centers.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Cooper Bussman, Inc.
  - 2. Mersen.
  - 3. Littelfuse.

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

### PART 3 - EXECUTION

#### 3.1 FUSE APPLICATIONS

- A. Feeders: Class RK1, time delay.

- B. Motor Branch Circuits: Class RK1, time delay.
- C. Other Branch Circuits: Class RK1, time delay.
- D. Control Circuits: Class CC, fast acting.

### 3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Provide a minimum of 3 spare fuses of each size/type installed and turn over to Owner.

### 3.3 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 and holder.

END OF SECTION 26 2813

## SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

#### 1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.3 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. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 FUSIBLE/NON-FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cutler-Hammer.
  2. Siemens.
  3. Square D.
  4. ABB.
- B. All starters and disconnect switches shall be of the same manufacturer unless otherwise approved.



- C. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses specified when so indicated on the drawings, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

## 2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cutler-Hammer.
2. ABB.
3. Siemens.
4. Square D.

- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
5. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

## 2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at 6'-0" A.F.F. unless otherwise indicated.
- B. Install fuses in fusible devices, coordinate sizing with Equipment Manufacturer.
- C. Coordinate location of devices to allow working clearances and to avoid interference with other equipment and trades.
- D. Comply with NECA 1.

#### 3.2 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 laminated-plastic nameplate.

#### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 2816

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## SECTION 26 4313 – SURGE PROTECTIVE DEVICES (SPD) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes SPD's for low-voltage power equipment.

#### 1.2 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer. Manufacturer shall have been engaged in the manufacture of SPD products specified and products shall have been in satisfactory service for not less than 5 years.
- 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 IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- E. Comply with UL 1283 5<sup>th</sup> Edition, "Electromagnetic Interference Filters," and UL 1449 3<sup>rd</sup> Edition, "Surge Protective Devices."

#### 1.3 PROJECT CONDITIONS

- A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
  - 2. Operating Temperature: 30 to 120 deg F.
  - 3. Humidity: 0 to 85 percent, non-condensing.
  - 4. Altitude: Less than 20,000 feet above sea level.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Protection Technologies, Inc. (ASCO)
  2. Current Technology, Inc. (ABB)
  3. Cutler-Hammer, Inc. (Clipper)
  4. Liebert Corporation.
  5. Thor Systems, Inc.
  6. Siemens Energy & Automation, Inc.
  7. Square D.
  8. LEA International.

### 2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
1. LED indicator lights for power and protection status.
  2. Audible alarm, with silencing switch, to indicate when protection has failed.
  3. Fuses/circuit breaker, rated at 200-kA interrupting capacity.
  4. Integral disconnect switch or circuit breaker to isolate entire suppressor components for repair/replacement.
  5. Redundant suppression circuits.
  6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 150kA per mode (300 kA per phase).
- C. Connection Means: Permanently wired.
- D. SPD and overcurrent/disconnect device shall have a short circuit current rating greater than that available on the electrical system.
- E. Protection modes and UL 1449 voltage protection rating compatible with system voltage and configuration as indicated on the drawings for complete protection as follows:
1. Line to Neutral.
  2. Line to Ground.
  3. Neutral to Ground.

### 2.3 PANELBOARD SUPPRESSORS

- A. Same characteristics and requirements as service entrance suppressors with the following exceptions:

- B. Surge-event operations counter not required.
- C. Peak Single-Impulse Surge Current Rating: 65kA per mode (130 kA per phase).

## 2.4 ENCLOSURES

- A. NEMA 250 (or better), with type matching the enclosure of panel or device being protected.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible (not to exceed 18 inches). Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground. Twist input conductors together to reduce system inductance.
  - 1. Provide multipole circuit breaker or fusible disconnect switch as a dedicated disconnect for suppressor, fuse size and type as recommended by SPD manufacturer.

### 3.2 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect service equipment to their sources until surge protection devices are installed and connected.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field tests and inspections and document on test reports:
  - 1. Complete startup checks according to manufacturer's written instructions.

END OF SECTION 26 4313

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## SECTION 26 5113 - INTERIOR LIGHTING FIXTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Interior lighting fixtures, light engines (LED's) and drivers.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.
- B. See Division 26 Section "Wiring Devices" for manual wall-box dimmers for LED fixtures or lamps.
- C. See Division 26 Section "Lighting Control Devices" for automatic control of lighting, including occupancy sensors, and multi-pole lighting relays and contactors.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes and photometric data.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. LED Fixtures: Fixtures with LED light source are noted on lighting fixture schedule with advertised lumen output of light source for fixture/manufacturer specified and color temperature. Listed equal manufacturer shall provide fixture with equivalent lumen output as listed product. If insufficient information is provided, the Engineer may require Project Specific, point-by-point photometric calculations of sample areas utilizing the submitted fixture to prove equivalent performance.
- D. Product Certificates: For each type of driver, signed by product manufacturer.
- E. Utility Company Energy Rebate Programs
  - 1. LED lighting fixtures shall be Energy Star or DLC listed to comply with local Utility Company Rebate Programs. Does not apply to track lighting fixtures. Fixture submittals that do not have either of these listings clearly indicated in the product data shall be rejected.
- F. Field quality-control test reports.



### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. All LED fixtures and components shall be tested and comply under the standards of IESNA LM-79-08, LM-80-08, LM-82-12 and TM-21-11 for measurement and publication of projected long term lumen maintenance, color stability, photometric performance and LED source operating lifetime. Fixture submitted shall meet the listed lifetime rating of the fixture specified, as a minimum.

### 1.4 WARRANTY

- A. Provide a written, five year replacement material warranty for defective or non-starting LED source assemblies. Warranty period shall begin on date of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In Lighting Fixture Schedule the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified on drawing schedule.

### 2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with UL 1598 and NEMA LE 4 for ceiling compatibility for recessed fixtures.
- 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. Polymer Components: Plastic or polymer housing/components of fixture assemblies shall be rated for the temperature (or plenum) environment installed and shall not degrade in structural integrity, shape, color or finish for a minimum of 10 years.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit servicing without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during servicing and when secured in operating position.
- 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 minimum unless different thickness is indicated.
    - b. UV stabilized.
  2. Glass: Tempered glass, unless otherwise indicated.
- G. Servicing Access: Fixtures specified for installation in inaccessible (gypsum/drywall) ceilings/walls, etc. shall be fully serviceable/accessible from the fixture aperture.
- H. Disconnecting Means:
1. Lighting fixtures with luminaires that utilize double-ended lamps and contain driver(s) that can be serviced in place or luminaires that are supplied from multi-wire branch circuits and can be serviced in place shall have a local disconnecting means at/within the fixture complying with NEC Article 410.75.

## 2.3 DRIVERS

- A. Drivers for LED Light Sources:
1. Driver shall be separate component from LED light source and shall be replaceable utilizing mounting screws, factory provided clips and electrical connector bodies.
  2. Dimming (When noted or indicated on Fixture Schedule): 100 to 1 percent of rated lumens via separate 0-10V input (Dimmer) control. Line voltage dimming acceptable when noted on plans.
  3. Level Control/Step-Dimming (When noted or indicated on Fixture Schedule): Minimum capability of bi-level control (100%-50%-Off) or 1/3-2/3-Full on, as noted.
  4. Voltage input: 120-277 Volt multi-volt capability.
- B. Internal-Type Emergency Fluorescent Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with driver. Comply with UL 924.
1. Emergency Connection: Operate light source continuously at a minimum output of 1000 lumens. 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. Voltage input: 120-277 Volt multi-volt capability.

- C. Where plans call for multi-level switching/lighting, provide appropriate driver in fixture as required to accommodate the switching level arrangement of fixture.

## 2.4 EXIT SIGNS

- A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

1. Light source for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Voltage input: 120-277 Volt multi-volt capability.

## 2.5 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns luminaire on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Luminaire automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects luminaire from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Voltage input: 120-277 Volt multi-volt capability.

## 2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- D. Recessed fixtures shall be supported at all 4 corners, independent of each other, from structure above with steel #12 single jack chains. Additionally, securely fasten each fixture to the ceiling framing member by mechanical means such as bolts, screws, rivets or approved clips; install a minimum of one on each four sides of fixture.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
  - 1. Single or Continuous Rows: Provide manufacturer required quantity of suspension cables at minimum intervals to support continuous row fixtures. The E.C. shall support suspended fixtures independently from the ceiling system and as specified by the fixture manufacturer.
- D. Surface or Flush Lighting Fixture Support:
  - 1. The E.C. shall coordinate fixture locations with the trade installing the ceiling system to assure support members are oriented and located to accommodate the lighting fixture layout.
  - 2. Surface or flush fixtures in ceilings of the suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support members of the ceiling system.
- E. Luminaires installed in exposed or concealed locations under metal corrugated sheet roof decking shall be installed and supported so there is not less than 1-1/2" measured from the lowest surface of the roof decking to the top of the luminaire.
- F. Adjust aimable lighting fixtures to provide required light intensities.
- G. Where fixtures are suspended in Mechanical/Electrical/Storage/Technology or Utility spaces with no suspended ceiling, coordinate mounting heights and locations with exposed ductwork, piping, conduit/data cabling racks, equipment, etc. to provide optimal and even light distribution to service equipment.
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Where applicable, verify transfer from normal power to battery and retransfer to normal.

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### 3.3 SPARE LAMPS/FIXTURES

- A. For LED fixtures with LED source integral to the fixture assembly, provide one spare fixture for each type as noted on lighting fixture schedule.
- B. For fixtures with separate/replaceable LED luminaire (retrofit lamp), provide 5 spare lamps of each type utilized.

END OF SECTION 26 5113

## SECTION 26 5600 – EXTERIOR AREA LIGHTING

### PART 1 - GENERAL

- 1.1 Work includes complete new exterior lighting including luminaires, poles, bases, conduit, conductors, fusing, control devices, etc. as shown on the drawings. Include all excavation, backfill, concrete bases and encasement of underground conduits as detailed on the drawings.

### PART 2 - PRODUCTS

- 2.1 Refer to data on the drawings for fixture details.
- 2.2 Aluminum poles, when specified, shall include a vibration dampener provided by the manufacturer.
- 2.3 Exterior building mounted lights utilized for emergency egress shall incorporate multiple drivers/LED sources where a single fixture is utilized at an exterior exit.
- 2.4 Where noted on plans, fixture poles shall have provisions for receptacle(s), security camera(s) and wireless access point(s). Mounting height and location determined at time of submittal review.

### PART 3 - EXECUTION

- 3.1 Concrete bases for standards shall be round extending above finish grade as detailed on the drawings with rounded corners and rubbed finish. Furnish anchor bolts as recommended by the manufacturer. Concrete bases shall be poured-in-place at the job site; steel reinforced concrete, minimum 3500 lb. test.
- 3.2 Provide a surge arrester behind the handhole in pole base of each lighting standard and connect to each phase conductor and 0.625" diameter by 10 ft. long copper clad driven ground rod providing a good grounding path. Connect the equipment grounding conductor to this grounding terminal. A separate ground rod is required for each lighting standard exceeding 15 ft. in height. Surge arresters shall be Square D Series SDSA, Joslyn Model Series 1250 or G.E. 9L15E and F Series. Install per NEC Article 280.
- 3.3 Provide Buss "KTK" fuses in HEB waterproof in-line holder ahead of the driver in each "hot" leg; locate behind handhole in pole base.
- 3.4 Consult manufacturer of pole and fixture(s) for recommended installation methods.

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| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
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- 3.5 Mount standards truly vertical. Shim and grout under fixture base to level standards, visible shims are not acceptable. Provide anchor bolt covers.
- 3.6 Splicing shall be made with approved and UL Listed, waterproof splicing kits and shall be located in base of poles behind handhole or in splice box if indicated on plans.
- 3.7 Install a green ground wire throughout the underground wiring system and bond to all standards.
- 3.7.1 Specified luminaires have adjustable lumen output, color temperature and light distribution type. For initial install, set lumen output to medium setting and light distribution to Type III. Set color temperature to match existing parking lot lighting. The E.C. shall review coverage with Owner after installation and anticipate changes to luminaire settings to optimize light levels and coverage.

END OF SECTION 26 5600

## SECTION 26 6103 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section covers fire alarm systems, including initiating devices, notification appliances, controls and supervisory devices.
- B. Work covered by this section includes the furnishing of labor, equipment and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
  - 1. Fire alarm and detection operations.
  - 2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems and other equipment as indicated in the drawings and specifications.
  - 3. One-way supervised automatic voice alarm operations.

#### 1.2 Acceptable Manufacturer

- A. Manufacturer: The equipment and service described in this specification are those supplied and supported by Johnson Controls (Simplex Grinnell).
- B. Provide main panel equal to Simplex Model 4100U network controller.
- C. Equipment manufacturer shall have a service organization within 60 miles of the project site and be a U.L. certified company. All equipment and materials necessary for proper operation of the system shall be deemed part of these specifications even if not specifically listed or described in this document.

#### 1.3 Related Documents

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 1 and 26 Specification Sections, apply to this section.
- B. The work covered in this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
  - 1. Division 26: "Common Work Results for Electrical."
  - 2. Division 26: "Control Voltage Electrical Power Cables."



- C. The system and all associated operations shall be in accordance with the following:
1. Guidelines of the following Building Code: BOCA
  2. NFPA 72, National Fire Alarm Code
  3. NFPA 70, National Electrical Code
  4. NFPA 101, Life Safety Code
  5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
  6. Other applicable NFPA standards
  7. Local Jurisdictional Adopted Codes and Standards
  8. ADA Accessibility Guidelines

1.4 System Description

- A. General: Provide a complete, non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download.
- C. History Logs: the system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
- D. Wiring/Signal Transmission:
1. Transmission shall be hardwired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.
  2. System connections for initiating circuits and notification appliance circuits shall be Class B.
  3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- E. Remote Access:

1. FACP shall have the capability to provide remote access thru a dial-up service modem using the public switched telephone system or a private switched telephone system.
2. A personal computer or laptop, configured with terminal emulation software shall have the ability to access the fire alarm control panel for diagnostics, maintenance reporting or information gathering.
3. FACP shall have the capability to provide Remote Access through a listed internet interface via a standard Web browser user interface

F. Required Functions:

1. Priority of Signals: Alarm events have the highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second, third and fourth level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even if the lower-priority condition occurs first. Annunciate all events regardless of priority or order received.
2. Non-interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
3. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciators and shall indicate the location and type of device.
4. General Alarm: A system general alarm shall include:
  - a) Indication of alarm condition at the FACP and annunciators.
  - b) Identification of the device or zone that is the source of the alarm at the FACP.
  - c) Operation of audible and visible notification devices throughout the building until silenced at FACP or annunciators.
  - d) Closing doors normally held open by magnetic door holders.
  - e) Unlocking designated doors.
  - f) Shutting down supply and return fans serving zone where alarm is initiated.
  - g) Closing smoke dampers on system serving zone where alarm is initiated.
  - h) Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.
5. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch and tamper switch, the system shall operate as follows:
  - a) Activate the system supervisory service audible signal and illuminate the LED (display) at the control unit and the graphic annunciator.
  - b) Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating abnormal condition.

- c) Record the event in the FACP historical log.
  - d) Transmission of supervisory signal to the GCC.
  - e) Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
- 6. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible devices shall cease operation and the visual devices will continue to flash until acknowledged.
- 7. System Reset:
  - a) The "system Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
  - b) Should an alarm condition continue, the system will remain in an alarmed state.
- 8. A manual evacuation switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
- 9. Walktest: the system shall have the capacity of eight (8) programmable, pass-code protected, one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
  - a) The city circuit connection and suppression release circuits shall be bypassed for the testing group.
  - b) Control relay functions associated to one of the 8 testing groups shall be bypassed.
  - c) The control unit shall indicate a trouble condition.
  - d) The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a voice announcement to identify the device or zone.
  - e) The unit shall automatically reset after signaling is complete.
  - f) Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to voice announce the trouble condition.
- 10. Automatic Voice Evacuation Sequence:
  - a) The audio alarm signal shall consist of an alarm tone for a maximum of 5 seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall stop.
  - b) All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

G. Analog Smoke Sensors:

1. Monitoring: The FACP shall individually monitor sensors for calibration, sensitivity and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a display monitor or printed for annual recording and logging of the calibration maintenance schedule.
5. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble is reported at the Campus Safety Department. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.
6. The FACP shall continuously perform an automatic self-test on each sensor, which will check sensor electronics to ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.
7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.
8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

H. Speaker: Speaker notification appliances shall be listed to UL 1480.

1. The speaker shall operate on a standard 70.7V RMS NAC using twisted/shielded wire.

2. The following taps are available: 0.25W, 0.5W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated sound pressure level of 84 dBA at 10 feet.
3. The speaker shall have a frequency response of 400 to 4000 Hz for fire alarm and 125 to 12kHz for general signaling.

I. Manual Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.
2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.
3. Features for total building paging shall be accomplished by the means of an "All Call" switch.

J. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
3. WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

K. Power Requirements:

1. The control unit shall receive AC power via a dedicated emergency circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.
5. The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

6. The system shall support NAC Lockout feature to prevent subsequent activation of NA Circuits after a depleted battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACP. The FACP shall indicate when the system is operating on an alternate (battery or generator) power supply.

#### 1.5 Submittals

A. General: Submit the following according to conditions of contract and Divisions 1, 26 and 28 Specifications sections.

1. Product data sheets for system components highlighted or marked to indicate the specific products, features or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds or does not comply with this specification.
2. Wiring diagrams from Manufacturer's Vendor.
3. Shop drawings showing system details including location of FACP, all devices, circuiting and details.
4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, sensor and auxiliary control circuits.
6. Operating instructions for FACP.
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses and telephone numbers of service organizations.
8. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with specified requirements.
9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of

shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval.

#### 1.6 Quality Assurance

- A. Installer Qualifications: A factory authorized installer with the appropriate NICET level certification for installation is required to perform the work of this section.
- B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by UL Inc. and shall bear the UL label.

#### 1.7 Extra Materials

- A. General: Furnish extra materials, packaged with protective covering for storage and identified with labels clearly describing contents as follows:
  - 1. Strobe units: Furnish quantity equal to ten (10) percent of the number of units installed, but not less than one (1).
  - 2. Speaker/Strobe units: furnish quantity equal to ten (10) percent of the number of units installed, but not less than one (1).
  - 3. Smoke Detectors or Sensors: Furnish quantity equal to ten (10) percent of the number installed, but not less than one (1) of each type.
  - 4. Detector or Sensor Base(s): Furnish quantity equal to two (2) percent of the number of units of each type installed but not less than one (1) of each type.

### PART 2 - PRODUCTS

#### 2.1 Fire Alarm Control Panel (FACP)

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
- B. The following FACP hardware shall be provided:
  - 1. Power limited base panel with beige cabinet and door, 120VAC input power.
  - 2. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
  - 3. 2,000 points of Network Annunciation at FACP display when applied as a Network Node.
  - 4. 2,000 points of annunciation where one (1) point of annunciation equals:
    - a) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
    - b) 1 LED on panel or 1 switch on panel.

5. Municipal City Circuit Connection with disconnect switch, 24 VDC Remote Station, local energy.
  6. One auxiliary electronically resettable fused 2A @ 24 VDC, programmable as a trouble relay, either as normally energized or as an auxiliary control.
  7. One auxiliary relay, SPDT 2A @ 32 VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
  8. Where required, provide intelligent remote battery charger for charging up to 110Ah batteries.
  9. Power supplies with integral intelligent Notification Appliance Circuit, Class B, for system expansion.
  10. Four (4) form "C" Auxiliary Relay Circuits (form C contacts rated 2A @ 24 VDC. Resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to 1/2A @ 120 VAC, inductive.
  11. The FACP shall support six (6) RS-232-C ports and one (1) service port.
  12. Remote Unit Interface: Supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory and component status messages and shall include a keypad for use in entering and executing control commands.
- E. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers and tone generators. Features include:
1. Amplifiers comply with UL 1771, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface.
  2. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.
  3. Emergency voice communication audi controller maodule shall provide up to 8 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.
  4. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.
  5. Panel shall contain campus standard pre-recorded messages on non-volatile chip.



- F. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):
1. Amplifiers, voice and telephone control circuits.
  2. Addressable Signaling Line Circuits.
  3. Initiating Device Circuits.
  4. Notification Appliance Circuits.
  5. Auxiliary Control Circuits.
- G. Fire Alarm Control Unit shall be capable of operating remote CRT's; output shall be ASCII from an RS-232-C connection with an adjustable baud rate.
- H. Fire Alarm Control Unit shall be capable of operating a PC Annunciator which provides status annunciation and limited system control using a convenient and familiar Microsoft Windows™ 2000 operating system based interface. PC Annunciator shall provide the following functions:
1. Login/logout password protection with time duration selectable automatic logout.
  2. Displays Alarm, Supervisory, Priority 2 and Trouble conditions with numerical tallies for each.
  3. Displays first and last alarms.
  4. Different event types have separate visible indicators with a common audible indicator.
  5. Event logs can be searched and printed.
  6. View and/or print True-Alarm status reports and service reports (printing requires an available local or network printer).
  7. Alarm Silence; System Reset and Priority 2 Reset.
  8. Global and individual point acknowledge
  9. Set system time and date; and clear event log
  10. Individual point access for control or parameter revisions

## 2.2 Remote LCD Annunciator

- A. Provide Remote LCD Annunciator with the same “look and feel” as the FACP operator interface. The remote LCD Annunciator shall use the same Primary Acknowledge, Silence and Reser Keys, Status LED’s and LCD Display as the FACP. Simplex 4806-9101.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LED’s.
- C. Under normal conditions the LCD shall display a “SYSTEM IS NORMAL” message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
  - 1. 40 character custom location label
  - 2. Type of device (e.g., smoke, pull station, waterflow).
  - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

## 2.3 Emergency Power Supply

- A. General: Components include battery, charger and an automatic transfer switch.
- B. Battery: Sealed lead-acid. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

## 2.4 Addressable Manual Pull Stations (Simplex 4099-9003)

- A. Description: Addressable single-action type, red LEXAN with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

- B. Protective Shield: Where indicated on plans, provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85 dB at 10 feet and shall be powered by a 9 VDC battery.

2.5 Smoke Sensors (Simplex 4098-9714)

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
1. Factory Nameplate: Serial number and type identification.
  2. Operating Voltage: 24 VDC, nominal.
  3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
  4. Plug-in Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
  5. Each sensor base shall contain an LED that will flash each time it is scanned by the control unit (once every 4 seconds). In an alarm condition, the sensor base LED shall be on steady.
  6. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
  7. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
  8. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
  9. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
  10. Removal of the sensor head for cleaning shall not require the setting of the addresses.
- B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric/heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.

- C. Bases: Relay output, sounder and isolator bases be supported alternatives to the standard base. (Simplex 4098-9791).
- D. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific size and installation conditions where applied. Sensor includes relay as required for fan shutdown. (Simplex 4098-9756).

1. Environmental compensation, programmable sensitivity settings, status testing and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
2. The duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A @ 28 VDC or 10A @ 120 VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
3. Duct Housing shall provide a relay control trouble indicator Yellow LED. (Simplex 2088-9021).
4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
6. Duct Housing shall provide a magnetic test area and Red sensor status LED.
7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch (Simplex 2098-9806).
9. Where indicated, a NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

#### 2.6 Heat Sensors (Simplex 4098-9733)

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design It shall be thermistor based, rate-compensated, self-restoring and shall not be affected by thermal lag.

- C. Sensor fixed-temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.7 Addressable Circuit Interface Modules (Simplex 4090-9001)

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices and for control of evacuation indicating appliances and HVAC systems.
- B. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include coverplates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two-wire pair running from an appropriate power supply as required. (Simplex 4090-9003).
- C. There shall be the following types of modules:

1. Type 1: Monitor Circuit Interface Module:

- a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B wiring supervision. The supervision of the zone will be Class B. This module will communicate status (normal, alarm, trouble) to FACP.
- b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

2. Type 2: Line Powered Monitor Circuit Interface Module:

- a) This type of module is an individually addressable module that has both its power and its communications supplied by the 2-wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
- b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate

four zone status conditions (open, normal, abnormal and short). The 2-wire signaling line circuit shall supply power and communications to the module.

3. Type 3: Single Address Multi-Point Interface Modules:

- a) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
- b) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited and short). The 2-wire signaling line circuit shall supply power and communications to the module.
- c) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The 2-wire signaling line circuit shall supply power and communications to the module.

4. Type 4: Line Powered Control Circuit Interface Module:

- a) This module shall provide control and status tracking of a Form "C" contact. The 2-wire signaling line circuit shall supply power and communications to the module.

5. Type 5: 4-20 mA Analog Monitor Circuit Interface Module:

- a) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

- D. All circuit interface modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LED's shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.8 Magnetic Door Holders

- A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 24 VDC source and develop a minimum of 25 lbs. holding force.
- B. Material and Finish: Match door hardware.

2.9 Standard Alarm Notification Appliances

- A. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with flash intensity of 110 Cd. Provide a label inside the strobe lens to indicate the candela rating setting of the specific appliance.
- B. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. (Simplex 4903-Series).
  - 1. Twisted/shielded wire is required for speaker connections on a standard 25 VRMS or NAC; and UTP conductors, having a minimum of 3 twists per foot, is required for addressable strobe connections.
  - 2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated SPL of 84 dBA at 10 feet.
  - 3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.
  - 4. The S/V shall install directly to a 4" square, 1 1/2 in. deep electrical box with 1 1/2 in. extension.
  - 5. All strobes shall be 110 candela rated.
- C. Speaker: Speaker notification appliances shall be listed to UL 1480. (Simplex 4903-Series).
  - 1. The speaker shall operate on a standard 25 VRMS or NAC using twisted/shielded wire.
  - 2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated SPL of 84 dBA at 10 feet.
  - 3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.
  - 4. The speaker shall install directly to a 4" square, 1 1/2 in. deep electrical box with 1 1/2 in. extension.

- D. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with an On Steady operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided. All building strobes shall be synchronized to each other, including all existing strobes.
- E. Accessories: The contractor shall furnish the necessary accessories.
- F. Alternate Notification Appliance devices and mounting. In lieu of wall mounted speakers/strobes, ceiling mounted devices may be provided if acceptable to the AHJ. Revise locations of ceiling devices to accommodate proper sound and visual coverage.

#### 2.10 NAC Power Extender (Simplex 4009)

- A. The IDNet NAC Pwer Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at 2 amps each.
- B. The internal power supply and battery charger shall be capable of charging up to 12.7 Ah batteries internally mounted or 18 Ah batteries mounted in an external cabinet.
- C. The NAC extender panel may be mounted close to the host control panel or can be remotely located. The IDNet Addressable NAC Extender Panel, when connected to an addressable panel, shall connect to the host panel via an IDNet communications channel. Via the IDNet channel, each output NAC can be individually controlled for general alarm or selective area notification.
- D. For IDNet connected NAC extender panels, up to five (5) panels can be connected on a single IDNet channel.
- E. When connected to a conventional (non-addressable) panel, one or two standard notification appliance circuits from the main control panel may be used to activate all the circuits on the NAC power extender panel.
- F. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

### PART 3 - EXECUTION

#### 3.1 Installation, General

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:



1. Factory trained and certified personnel.
  2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
  3. Personnel licensed or certified by state or local authority.
- C. Contractor shall provide updated graphic floor plans in the GCC in Allyn Hall with all required programming to make system fully operational to display and control all devices in Rike Hall.

### 3.2 Equipment Installation

- A. Furnish and install a complete Fire Alarm System to serve the building Addition as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes and all other necessary material for a complete operating system in the Addition.
- B. Existing Fire Alarm Equipment shall be maintained fully operational and shall be tied to the new fire alarm system provided to enable building-wide coverage and alarming. The two systems shall operate independently and alarm as one system. Provide new remote annunciators for new fire alarm panel and locate annunciators adjacent to existing (one at Main School Entry and one at rear Fire Dept. Access entry).
- C. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
- D. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

### 3.3 Wiring Installation

- A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electrical Code (NEC).
- B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- C. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuit wiring and a different color code for supervisory circuits. Color code notification appliance circuits differently from alarm initiating circuits. Paint fire alarm system junction boxes, conduit fittings and box covers red.

### 3.4 Field Quality Control

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing and adjustment of the system.
- B. Service personnel shall be qualified and experienced in the inspection, testing and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
  - 1. Factory trained and certified personnel.
  - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm certified.
  - 3. International Municipal Signal Association (IMSA) fire alarm certified.
  - 4. Certified by state or local authority.
  - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
- C. Pre-testing: Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests and detailed test results in the form of a test log.
- H. Final Test, Certificate of Completion and Certificate of Occupancy:
  - 1. Test the system as required by the Authority Having Jurisdiction (AHJ) in order to obtain a certificate of occupancy.

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| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
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### 3.5 Cleaning and Adjusting

- A. Cleaning: Remove paint splatters and other spots, dirt and debris. Clean unit internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Test fire-alarm system for compliance with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections. Provide up to three (3) visits to the site for this purpose.

### 3.6 Training

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel 4 hour training on-site.

END OF SECTION 26 6103

## SECTION 27 05 00

### COMMON WORK RESULTS FOR COMMUNICATIONS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 APPLICABLE CRITERIA / REFERENCES

- A. **ANSI/TIA-568.0-E**: Generic Telecommunications Cabling for Customer Premises.
- B. **ANSI/TIA-568.1-E**: Commercial Building Telecommunications Infrastructure Standard.
- C. **ANSI/TIA-568.2-E**: Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
- D. **ANSI/TIA-568.3-E**: Optical Fiber Cabling and Components Standard.
- E. **ANSI/TIA-569-E**: Commercial Building Standards for Telecommunications Pathways and Spaces.
- F. **ANSI/TIA-606-D**: Administration Standard for the Telecommunications Infrastructure.
- G. **ANSI/TIA-607-E**: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- H. **ANSI/TIA-758-B**: Customer Owned Outside Plant Telecommunications Infrastructure Standard.
- I. **BICSI TDMM**: BICSI Telecommunications Distribution Methods Manual, 15th Edition.
- J. **BICSI OSPDRM**: BICSI Outside Plant Design Reference Manual, 6th Edition.
- K. **BICSI ITSIMM**: BICSI Information Technology Systems Installation Methods Manual, 8th Edition.
- L. **NFPA 70**: National Electrical Code, 2026 Edition, as adopted by the Authority Having Jurisdiction.
- M. **IEEE C2**: National Electrical Safety Code.
- N. **ANSI/TIA TSB-184-A**: Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling.
- O. **IEEE 802.3bt**: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs (Types 3 and 4).
- P. **UL 1400-1 / UL 1400-2**: Outline of Investigation for Fault-Managed Power Systems (Transmitters/Receivers and Cables/Connecting Hardware).

##### 1.03 SUMMARY

A. Section Includes:

1. Definitions.
2. Communications equipment coordination and installation.
3. Quality Assurance.
4. Delivery, Storage, and Handling.
5. Warranty.
6. Occupational Health and Safety.
7. Leadership in Energy and Environmental Design (LEED®).
8. Performance Requirements for Communications Cabling and Infrastructure.
9. Remote Powering Over Communications Cabling (Power over Ethernet and Class 4 Fault-Managed Power).
10. Cybersecurity and Physical Security Coordination for Communications Spaces.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements."
2. Division 27 Section "Grounding and Bonding for Communications."
3. Division 27 Section "Pathways for Communications."
4. Division 27 Section "Underground Pathways and Structures for Communications."
5. Division 27 Section "Identification for Communications."
6. Division 27 Section "Communications Equipment Room Fittings."
7. Division 27 Section "Communications Backbone Cabling."
8. Division 27 Section "Communications Horizontal Cabling."
9. Division 27 Section "VoIP Telephone System."
10. Division 27 Section "Data Communications Network Equipment."
11. Division 27 Section "Data Communications Wireless Access Points."

#### 1.04 DEFINITIONS

- A. **Indicated:** Refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help locate the reference; no limitation on location is intended except as specifically noted.
- B. **Directed:** Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect," "requested by the Architect," and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.

- C. **Approve:** The term “approved,” where used in conjunction with the Architect's action on the contractor's applications and requests, is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
- D. **Regulation:** The term “Regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.
- E. **Furnish:** The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.”
- F. **Install:** The term “install” is used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- G. **Provide:** The term “provide” means “to furnish and install, complete and ready for the intended use.”
- H. **Installer:** An “Installer” is the Contractor engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged in performing.
- I. **Project Site:** The space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of the Project. The extent of the Project Site is shown in the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- J. **Testing Laboratories:** A “testing laboratory” is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

## 1.05 SUBMITTALS

- A. **Product Data:** For sleeve seals.
- B. **Material Safety Data Sheets:** For all hazardous materials.
- C. **Power Budget Calculations:** For communications cabling systems supporting IEEE 802.3bt Type 3 or Type 4 Power over Ethernet, or Class 4 Fault-Managed Power. Include device count per pathway, current per pair, bundle configuration, ambient temperature assumptions, cable temperature rating, and any length de-rating applied in accordance with ANSI/TIA TSB-184-A.
- D. **Sustainability Documentation:** Environmental Product Declarations (EPDs), Health Product Declarations (HPDs), recycled-content documentation, and embodied-carbon data for products proposed to support LEED certification credits.
- E. **Qualifications:** Contractor, installer, and project-management qualifications as required by the Quality Assurance article, including BICSI RCDD, RTPM, or equivalent credentials for design and project-management personnel where indicated.

## 1.06 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
  - 1. To allow maximum 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 being 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."

## 1.07 PERFORMANCE REQUIREMENTS

- A. **Minimum Cabling Performance:** Unless indicated otherwise on the Drawings or in related Division 27 Sections, balanced twisted-pair horizontal cabling shall meet or exceed ANSI/TIA-568.2-E Category 6A performance, and optical fiber cabling shall meet or exceed ANSI/TIA-568.3-E OM4 multimode and OS2 singlemode performance.
- B. **Remote Powering (Power over Ethernet):** Communications cabling and pathways shall be designed and installed to support IEEE 802.3bt Type 3 (up to 60 W) and Type 4 (up to 90 W) Power over Ethernet without exceeding cable temperature ratings or manufacturer de-rating limits. Installation shall comply with ANSI/TIA TSB-184-A.
- C. **Class 4 Fault-Managed Power:** Where indicated on the Drawings, Class 4 Fault-Managed Power (FMP) systems shall be installed in accordance with NFPA 70 Article 726, using transmitters, receivers, cable, and connecting hardware listed to UL 1400-1 and UL 1400-2 as a matched system by a single manufacturer.
- D. **Bonding and Grounding:** Communications bonding and grounding infrastructure shall comply with ANSI/TIA-607-E and NFPA 70. Provide a Telecommunications Bonding Backbone (TBB), Telecommunications Main Grounding Busbar (TMGB), and Telecommunications Grounding Busbars (TGB) as specified in Division 27 Section "Grounding and Bonding for Communications."
- E. **Applicability of NFPA 70:** In accordance with the 2026 NEC (or the NEC edition adopted by the Authority Having Jurisdiction, whichever is more stringent), the general requirements of Chapters 1 through 4 apply to communications systems. Communications installations shall comply with both the specific provisions of NEC Chapter 8 and the applicable general provisions of Chapters 1 through 4.

## 1.08 QUALITY ASSURANCE

### A. Regulatory Requirements:

1. The system shall be registered under the most current applicable rulings of the Federal Communications Commission (FCC). Provide the FCC registration number with the equipment submittal. All components and installations shall bear an Underwriters' Laboratories (UL) listing.
2. **Ordinances and Codes:** Perform all work in accordance with applicable Federal, State, and local ordinances and regulations and with the standards, codes, and manuals listed in the Applicable Criteria / References article of this Section.
3. **NECA:** National Electrical Contractors Association.
4. Notify the Engineer / Communications Designer before submitting this proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules, or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules, and regulations without additional expense to the Owner.
5. The code or standard establishing the more stringent requirement shall be followed where areas of conflict occur between codes and standards, or between codes and standards and specifications.
6. **Barrier-Free Regulations:** All materials and installations shall comply with the Americans with Disabilities Act (ADA) Standards for Accessible Design and with applicable State and local accessibility regulations having jurisdiction over the Project.
7. Comply with federal, state, and local labor regulations and applicable union regulations.

B. **Equipment Manufacturer Qualifications:** The equipment shall be built and tested by a manufacturer who has regularly engaged in the production of said equipment for a minimum of five (5) years to assure one source of supply and responsibility.

C. **Equipment Supplier Qualifications:** The supplier of the equipment shall maintain permanent service facilities within the area of the installation. The facilities shall include a permanent source of factory-trained service technicians on 24-hour call experienced in servicing this type of equipment and shall provide warranty and routine maintenance service to afford the Owner maximum coverage. The supplier shall also provide a central source of support to warranty immediate answers to Owner's problems resulting from misunderstanding of the operation of the equipment.

D. **Equipment Installer Qualifications:** Fully qualified personnel shall perform the installation of the equipment, having had experience on the installation of this type and able to certify that they have had no less than five (5) years of continuous experience in this area and have made installations similar to this and of this size or larger.

E. **Project Management Qualifications:** The Contractor Project Manager shall have a minimum of five (5) years of project management experience. Upon request, the contractor will provide a resume for all staff assigned to these positions.



F. Field Measurements:

1. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.

- G. Parts listed shall be complete, accurate part / model numbers, and equipment furnished shall conform to manufacturer's specifications.

- H. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.

**1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Store communications equipment, at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages until time of installation.
- B. If spare parts are specified, store spare parts at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages. Deliver spare parts as part of the project close-out procedure.
- C. Protect communications equipment from damage and theft.

**1.10 WARRANTY**

- A. **Warranty:** Refer to Communications sections for specific warranty requirements.

**1.11 COMMISSIONING AND TESTING**

- A. **General:** Comply with the commissioning requirements of Division 01 Section "General Commissioning Requirements." Individual communications system testing and acceptance requirements are specified in the related Division 27 Sections.
- B. **Cabling Certification:** 100% of installed horizontal and backbone cabling shall be tested and certified to the performance tier specified in the Performance Requirements article using a manufacturer-approved field tester with current calibration. Provide electronic test results for each cable in the manufacturer's native test format and as a consolidated PDF summary.
- C. **Remediation:** Any cable, termination, or connecting hardware that fails testing shall be repaired or replaced at no additional cost to the Owner and re-tested until compliance is demonstrated. Cables that fail after two remediation attempts shall be fully replaced.

**1.12 RECORD DOCUMENTS AND AS-BUILTS**

- A. **Record Drawings:** Maintain a redlined set of Contract Drawings on site throughout construction showing actual installed routing, cable identifiers, pathway fill, and space layouts. Submit final record drawings in both AutoCAD (.dwg) and PDF formats at Project closeout.
- B. **Administration Records:** Provide a complete telecommunications infrastructure administration record in accordance with ANSI/TIA-606-D, including labeling schedule, cable records, pathway records, space records, and bonding/grounding records.

- C. **Operation and Maintenance Manuals:** Submit three (3) printed copies and one (1) searchable PDF of a consolidated O&M manual containing product data, warranty documentation, test results, administration records, and contact information for warranty service.

### 1.13 OCCUPATIONAL HEALTH AND SAFETY

- A. Comply with 29 CFR 1910.1200 "Hazard Communication."
- B. Ensure that the hazards of all chemicals used, stored, produced, or imported are evaluated, and that information concerning their hazards is transmitted to employees by means of comprehensive hazard communication programs, which shall include:
1. Container labeling and other forms of warning.
  2. Material safety data sheets.
  3. Employee training.

### 1.14 LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN — U.S. GREEN BUILDING COUNCIL

- A. Provide material and installation in accordance with the U.S. Green Building Council's LEED® v5 BD+C rating system and support the Project's targeted LEED certification level. Submit Environmental Product Declarations (EPDs), Health Product Declarations (HPDs), and recycled-content documentation as required to support credits in the Materials and Resources and Quality of Life impact areas. Coordinate with construction manager, general contractor, and design firm to optimize potential LEED® points.

## PART 2 - PRODUCTS

### 2.01 MATERIAL SAFETY DATA SHEETS

- A. Provide and ensure that MSDS for all hazardous materials are readily accessible during each work shift to employees when they are in their work area.
- B. Provide copies of all MSDS to other trades, contractors, general contractor, construction managers, and owners as required.

### 2.02 LEED® CERTIFIED COMMUNICATIONS PRODUCTS

- A. Where practical, provide products that contribute to LEED® certification credits. Examples include material with recycled content, ENERGY STAR® compliant materials, products with published Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs), regionally sourced materials, low-embodied-carbon products, and halogen-free or low-smoke zero-halogen (LSZH) communications cables where compatible with fire and performance requirements.

### 2.03 SLEEVES FOR PATHWAYS AND CABLES

- A. **Steel Pipe Sleeves:** ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, reamed and bushed 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.

D. Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.04 SLEEVE SEALS

- A. **Description:** Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
- B. **Manufacturers:** Subject to compliance with requirements.
- C. **Sealing Elements:** EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
- D. **Pressure Plates:** Plastic, carbon steel, or stainless steel. Include two for each sealing element.
- E. **Connecting Bolts and Nuts:** Carbon steel with corrosion-resistant coating, or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.05 GROUT

- A. **Nonmetallic, Shrinkage-Resistant Grout:** ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1-2015, Standard for Good Workmanship in Electrical Construction, and install in a "neat and workmanlike manner" in accordance with NFPA 70 Section 110.12.
- 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 headroom consistent with these requirements.
- D. **Equipment:** Install to facilitate service, maintenance, and repair or replacement of components of both communications 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:** To Life Safety systems or piping installed at a required slope.

### 3.02 INSTALLATION OF CABLING FOR REMOTE POWERING

- A. **Bundle Size:** For balanced twisted-pair cabling supporting Power over Ethernet, limit maximum bundle size to 24 cables in typical pathway conditions (conduit, cable tray, or similar enclosed pathways without active cooling) in accordance with ANSI/TIA TSB-184-A. Where bundles exceeding 24 cables are required, coordinate with the cable manufacturer for written confirmation of suitability and any required de-rating.
- B. **Temperature Rise and Length De-Rating:** Manage cable bundle temperature rise to not exceed 15°C (27°F) above ambient. Apply channel length de-rating in accordance with the manufacturer's published values and ANSI/TIA TSB-184-A where ambient conditions or bundle size warrant.
- C. **Cable Temperature Rating:** Balanced twisted-pair cabling used for IEEE 802.3bt Type 3 (60 W) or Type 4 (90 W) Power over Ethernet shall have a minimum temperature rating of 60°C. Where installed in elevated ambient conditions or in bundles with limited heat dissipation, provide cabling rated 75°C or higher.
- D. **Class 4 Circuit Separation:** Install Class 4 Fault-Managed Power circuits in compliance with NFPA 70 Section 726.136, maintaining required separation from electric light, power, Class 1, and non-power-limited fire alarm circuits. Class 4 circuits may be installed in the same cable, enclosure, cable tray, raceway, or cable routing assembly with other Class 4 circuits and with optical fiber cables, except where otherwise indicated.

### 3.03 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.
  - 1. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. **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.
- D. Cut sleeves to length for mounting with bushings on both surfaces of walls.
- E. Extend sleeves installed in floors 3 inches (75 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- G. 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.
- H. **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."
- I. **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."

- J. **Roof-Penetration Sleeves:** Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. **Aboveground, Exterior-Wall Penetrations:** Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) 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 (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

### 3.04 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 them in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.05 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 27 05 00**

## SECTION 27 05 25

### FIRESTOPPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specifications Sections, apply to this Section.

##### 1.02 SECTION INCLUDES

- A. **General Firestopping:** For through-penetrations and joints in or between the following fire-resistance rated assemblies, including blank openings, linear openings, and openings containing penetrating items:
1. Floor-ceiling assemblies.
  2. Roof-ceiling assemblies.
  3. Walls and partitions.
  4. Smoke barriers.
  5. Vertical service shaft walls and partitions.
  6. Construction enclosing compartmentalized areas.
- B. **Fire-Resistive Joint Systems:** For linear voids within or between fire-resistance rated floor and roof-ceiling assemblies and walls and partitions, including the following types of joints:
1. Expansion joints and control joints or joints between floor structures.
  2. Floor-to-wall joints where a floor structure intersects a wall structure.
  3. Head-of-wall joints where a wall or partition intersects a roof or floor-ceiling assembly.
  4. Control joints within or between wall structures.
- C. **Perimeter Fire Containment Systems:** Consisting of a floor with an hourly fire-resistance rating, an exterior wall assembly with no hourly fire-resistance rating, and the fill and forming materials installed between the floor and curtain wall for preventing the spread of fire vertically in buildings.
- D. Firestopping, Smoke, and Acoustical Sealing of Telecommunications Data Cabling:
1. Firestopping of through-penetrations in fire-rated assemblies for communications cabling, including low-voltage, video, data, voice, and optical fiber raceways.
  2. Smoke and acoustical sealing in non-fire-rated assemblies.
- E. Scope Clarification: Firestopping of penetrations made by the communications and electronic safety and security work of Divisions 27 and 28 is the Work of this Section. Firestopping of penetrations made by other trades is specified in Division 07 Section

07 84 13 — Penetration Firestopping. Coordinate with Division 07 to prevent duplication of coverage and gaps in scope.

### 1.03 DEFINITIONS

- A. **Firestopping:** Material or combination of materials used to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire-rated wall and floor assemblies.
- B. **Fire-Rated Cable Pathway:** A maintenance-free, re-enterable device installed through a fire-rated assembly that provides a fire, smoke, and acoustical seal around telecommunications cabling and accommodates cable moves, adds, and changes (MAC) without removal or replacement of firestop material.
- C. **Maintenance-Free:** A device requiring no action by the cabling technician (such as opening or closing of doors, twisting closures, or adding or removing caulks, putties, pillows, foams, or plugs) to open or close the pathway for cable moves, adds, or changes.
- D. **Engineering Judgment (EJ):** A written recommendation from the firestop manufacturer, based on prior testing or similar tested assemblies, issued where no specifically tested UL or FM system exists for the field condition, prepared in accordance with International Firestop Council (IFC) guidelines.

### 1.04 RELATED SECTIONS

- A. Coordinate work of this Section with work of other Sections as required to properly execute the work and as necessary to maintain satisfactory progress, including:
  - 1. Section 07 84 13 — Penetration Firestopping (Division 07).
  - 2. Section 03 30 00 — Cast-In-Place Concrete.
  - 3. Section 04 20 00 — Unit Masonry.
  - 4. Section 09 25 00 — Gypsum Drywall Systems.
  - 5. Section 21 00 00 — Fire Suppression.
  - 6. Section 22 40 00 — Plumbing.
  - 7. Section 23 00 00 — HVAC.
  - 8. Section 26 05 00 — Common Work Results for Electrical.
  - 9. Section 27 00 00 — Communications.

### 1.05 REFERENCES

- A. American National Standards Institute (ANSI):
  - 1. ANSI/TIA-569-E — Commercial Building Standards for Telecommunications Pathways and Spaces.
- B. ASTM International (ASTM):
  - 1. ASTM C920 — Standard Specification for Elastomeric Joint Sealants.
  - 2. ASTM C1193 — Standard Guide for Use of Joint Sealants.

3. ASTM D6904 — Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry.
  4. ASTM E84 — Standard Test Method for Surface Burning Characteristics of Building Materials.
  5. ASTM E90 — Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  6. ASTM E119 — Standard Test Methods for Fire Tests of Building Construction and Materials.
  7. ASTM E814 — Standard Test Method for Fire Tests of Penetration Firestop Systems.
  8. ASTM E1725 — Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components.
  9. ASTM E1966 — Standard Test Method for Fire-Resistive Joint Systems.
  10. ASTM E2174 — Standard Practice for On-Site Inspection of Installed Firestop Systems.
  11. ASTM E2307 — Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus.
  12. ASTM E2393 — Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
  13. ASTM E2837 — Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
- C. FM Global (FM):
1. FM 4991 — Standard for Approval of Firestop Contractors.
- D. International Code Council (ICC):
1. International Building Code (IBC).
- E. National Fire Protection Association (NFPA):
1. NFPA 70 — National Electrical Code.
  2. NFPA 101 — Life Safety Code.
- F. Underwriters Laboratories, Inc. (UL):
1. UL 263 — Fire Tests of Building Construction and Materials.
  2. UL 723 — Surface Burning Characteristics of Building Materials.
  3. UL 1479 — Fire Tests of Through-Penetration Firestops.
  4. UL 1489 — Standard for Fire Tests of Fire Resistance Pipe Protection Systems Carrying Combustible Liquids.
  5. UL 2079 — Tests for Fire Resistance of Building Joint Systems.
  6. UL Fire Resistance Directory — Volume II.
- G. Underwriters Laboratories of Canada (ULC):



1. CAN/ULC-S115 — Standard Method of Fire Tests of Firestop Systems.

**1.06 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00 — Submittal Procedures.
- B. **Product Data:** For each firestopping product, submit manufacturer's specifications and technical data, including composition, limitations, documentation of UL firestop systems to be used, and manufacturer's installation instructions.
- C. **System Drawings:** Submit documentation from a qualified third-party testing agency applicable to each firestopping system configuration for the construction type, joint opening width, and/or penetrating items.
  - 1. **Schedule of UL System Drawings for Fire-Rated Construction:** Submit a schedule of all expected opening locations and sizes, penetrating items, and required listed design numbers to seal openings and maintain fire-resistance ratings.
  - 2. **UL System Drawings:** Furnish copies of all UL Systems identified in the schedule above, including any engineering recommendations.
- D. **Engineering Judgments:** Where no UL or FM tested system is available for a specific field condition, submit manufacturer's engineering judgment identification number and drawing details for review and approval by the authority having jurisdiction prior to installation. Engineering judgment drawings shall follow International Firestop Council (IFC) guidelines and shall include both the project name and the contractor's name who will install the firestop system.
- E. **Product Certificates:** Certificate of conformance signed by the manufacturer certifying that firestopping products comply with the requirements of this Section.
- F. **Installer Qualifications:** Submit documentation of installer certification and project experience as specified in Article 1.08.
- G. **Safety Data Sheets (SDS):** Submit SDS for each firestopping product delivered to the jobsite.
- H. **Installation Instructions:** Submit manufacturer's printed installation instructions for each system.

**1.07 QUALITY ASSURANCE**

- A. **Manufacturer Qualifications:** Company specializing in manufacturing firestopping products specified in this Section with a minimum of five (5) years documented experience.
- B. **Single-Source Responsibility:** Obtain firestop systems for each type of penetration, joint opening, or slab-edge configuration from a single manufacturer to the greatest extent possible.
- C. **Testing Agency Qualifications:** Firestop systems tested by UL or another qualified testing and inspection agency performing testing and follow-up inspection services acceptable to the authority having jurisdiction. Products shall bear the classification marking of the qualified testing and inspection agency.
- D. **Regulatory Compliance:** Firestop system installations shall meet the requirements of ASTM E814 or UL 1479 tested assemblies and shall provide a fire rating equal to

that of the construction being penetrated. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

- E. **Structural Limitations:** Firestop systems do not reestablish the structural integrity of load-bearing partitions or assemblies or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load-bearing assembly.
- F. **Manufacturer's On-Site Support:** A manufacturer's direct representative (not distributor or agent) shall be on-site during initial installation of firestop systems to train contractor personnel in proper selection and installation procedures, in accordance with the manufacturer's written recommendations and drawing details.
- G. **Pre-Installation Meeting:** Conduct a pre-installation meeting at the Project site with the Owner, Architect, and affected trades to review firestopping locations, applicable UL systems, substrate conditions, and coordination requirements before beginning firestopping work. Comply with requirements in Division 01 Section "Project Meetings."

#### 1.08 INSTALLER QUALIFICATIONS

- A. **Installer Certification:** Engage an experienced installer who is FM Approved in accordance with FM 4991, Certified by UL as a Qualified Firestop Contractor, or otherwise qualified by the firestopping manufacturer as having received the necessary training to install firestop products per specified requirements. Certification shall be current and shall include hands-on training for the specified firestop systems.
- B. **Experience Requirements:** Installer shall have a minimum of three (3) years of experience installing firestopping systems in commercial construction.
- C. **Project Training:** The manufacturer's representative shall provide on-site training for project personnel before commencement of firestopping work, covering the specific systems and project requirements.
- D. **Documentation:** Provide certificates of manufacturer training and recent project experience. A manufacturer's willingness to sell its firestopping products to the Contractor or installer does not, by itself, constitute installer qualification.

#### 1.09 DELIVERY, STORAGE, AND HANDLING

- A. **Delivery:** Deliver products to the Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying the product, manufacturer, date of manufacture, lot number, shelf life (where applicable), qualified testing agency's classification marking, and mixing instructions for multi-component materials.
- B. **Storage:** Store materials under cover and protect from weather and damage in compliance with the manufacturer's requirements, including temperature limitations. Coordinate delivery with the scheduled installation date to minimize jobsite storage time.
- C. **Handling:** Handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Comply with the recommended procedures, precautions, and remedies described in the Safety Data Sheets.

- D. **Rejected Materials:** Do not use damaged or expired materials. Remove from the Project site.

## 1.10 PROJECT CONDITIONS

- A. Do not install products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.
- B. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Do not use materials that contain flammable solvents.
- D. Do not install water-based products or products that are conductive when wet in contact with energized electrical conductors. Exercise care when energizing penetrants.

## 1.11 COORDINATION

- A. Coordinate the construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to the specified requirements.
- B. Coordinate the sizing of sleeves, openings, core-drilled holes, and cut openings to accommodate through-penetration firestop systems.
- C. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

## 1.12 WARRANTY

- A. Warrant firestopping systems for two (2) years from the Date of Substantial Completion.
- B. Warranty shall cover material defects and installation defects that compromise fire-rating performance.
- C. Furnish the manufacturer's standard limited warranty in addition to the warranty specified herein.

# PART 2 - PRODUCTS

## 2.01 MANUFACTURERS

- A. **Basis of Design Manufacturer:** Specified Technologies Inc. (STI), 210 Evans Way, Somerville, NJ 08876; Toll-Free: 800-992-1180; Phone: 908-526-8000; Email: [specseal@stifirestop.com](mailto:specseal@stifirestop.com); Web: [www.stifirestop.com](http://www.stifirestop.com).
- B. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, acceptable manufacturers include:
  - 1. Specified Technologies Inc. (STI).
  - 2. Hilti, Inc.
  - 3. 3M Fire Protection Products.
- C. Substitution requests shall be considered in accordance with contract provisions.

## **2.02 PERFORMANCE REQUIREMENTS — GENERAL FIRESTOPPING**

- A. Fire Test Requirements: Firestop systems shall be tested in accordance with the following standards:
1. UL 1479 / ASTM E814 — Fire Tests of Through-Penetration Firestops.
  2. UL 263 / ASTM E119 — Fire Tests of Building Construction and Materials.
  3. UL 723 / ASTM E84 — Surface Burning Characteristics of Building Materials.
  4. UL 1489 — Fire Resistance Pipe Protection Systems Carrying Combustible Liquids (where applicable).
  5. ASTM E1725 — Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components.
  6. CAN/ULC-S115 — Fire Tests of Firestop Systems.
- B. UL Fire Resistance Directory — Applicable Categories:
1. Through-Penetration Firestop Systems (XHEZ).
  2. Joint Systems (XHBN).
  3. Perimeter Fire Containment Systems (XHDG).
  4. Continuity Head-of-Wall Joint Systems (XHBO).
  5. Fill, Void, or Cavity Materials (XHHW).
  6. Firestop Devices (XHJI).
  7. Forming Materials (XHKU).
  8. Wall Opening Protective Materials (CLIV).
  9. Fire-Resistant Pipe Protection Systems (HNKJ).
- C. Material Performance Requirements:
1. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
  2. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
  3. Firestop products shall not contain ethylene glycol.
  4. Firestop sealants shall be sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage to the seal.
  5. Pipe insulation shall not be removed, cut away, or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
  6. Provide products with published L-Ratings, tested in accordance with UL 1479 (for penetrations) or UL 2079 (for joints), for both ambient and elevated temperatures, as evidence of the ability to restrict the movement of smoke.

7. Penetrants passing through fire-resistance-rated floor-ceiling assemblies contained within chase wall assemblies shall be protected with systems identified in the UL Fire Resistance Directory as "Chase Wall Optional."
8. Moisture-curing products shall be used where inclement weather or greater than transient water exposure is expected.

## 2.03 PERFORMANCE REQUIREMENTS — TELECOMMUNICATIONS CABLING

- A. **Fire-Rated Cable Pathway Devices:** Fire-rated cable pathway devices shall be installed in fire-rated construction for all low-voltage, video, data, voice cabling, optical fiber raceways, and certain high-voltage cabling where frequent cable moves, adds, and changes (MAC) may occur. Pathways required for high-voltage cabling shall be identified on the Drawings. Devices shall:
1. Meet the hourly fire rating of the fire-rated wall or floor penetrated.
  2. Be tested for the surrounding construction and cable types involved.
  3. Have UL Systems permitting cable loads from zero to 100 percent visual fill. This requirement eliminates the need for fill-ratio calculations by cable technicians to ensure cable load is within the maximum allowed by the UL System.
  4. Be Maintenance-Free, having a corresponding Evaluation Services Report (ESR) from a Nationally Recognized Third-Party Laboratory. Maintenance-Free means no action is required by the cabling technician to open and/or close the pathway for cable moves, adds, or changes, including but not limited to:
    - a. Opening or closing of doors.
    - b. Spinning rings to open or close a fabric liner.
    - c. Removal and/or replacement of any material such as firestop caulk, putty, pillows, bags, foam muffins, foam plugs, foam blocks, or foam closures of any sort.
  5. Be engineered such that two or more devices may be ganged together for larger cable capacities.
  6. Be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing.
  7. Have an adhesive wall label affixed immediately adjacent to the device to communicate to future cable technicians, authorities having jurisdiction, and others the manufacturer of the device and the corresponding UL System number installed.
- B. **Non-Rated (Smoke and Acoustical) Cable Pathway Devices:** Non-rated cable pathway devices shall be installed in non-fire-rated construction for all low-voltage, video, data, voice cabling, optical fiber raceways, and certain high-voltage cabling where frequent cable MAC may occur. Devices shall:
1. Limit the movement of smoke and sound through the wall or floor penetrated.
  2. Restore the STC rating of the penetrated assembly.
  3. Provide L-Ratings of less than 1 CFM when empty and less than 2.5 CFM at all other loading up to 100 percent visual fill.

4. Accommodate cable loads from zero to 100 percent visual fill.
  5. Not have an inner fabric liner that tightens around and compresses cables, which can cause cable damage or signal interference.
  6. Be Maintenance-Free (as defined above for fire-rated pathways).
  7. Be engineered such that two or more devices may be ganged together for larger cable capacities, and shall be re-enterable.
  8. Have an adhesive wall label affixed immediately adjacent to the device identifying the manufacturer and the UL System number (where applicable).
- C. **Fire-Rated Cable Grommets:** As an alternate to a cable pathway device for a single or two low-voltage cables (up to an aggregate cross-sectional area of 0.53 in. [14 mm] O.D.) penetrating one- or two-hour gypsum board/stud wall assemblies or non-rated assemblies (as a through-penetration or membrane-penetration), a fire-rated cable grommet may be substituted. The grommet shall be a molded, two-piece, plenum-rated product having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable, shall lock into place to secure the cable penetration within the wall assembly, and shall be UL Classified and tested to ASTM E814 (UL 1479) and CAN/ULC-S115.
- D. **Non-Mechanical Firestopping (Sealants):** Where non-mechanical pathways must be utilized, such as sealing around single or grouped conduits, provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during or after construction.
- E. **Cable Pathway Anchoring and Installation:**
1. Cable pathways shall replace conduit sleeves in walls and floors.
  2. When installed individually in floors, devices shall pass through a core-drilled or preformed opening utilizing tested floor plates.
  3. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
  4. When installed individually in walls, devices shall pass through a core-drilled opening utilizing tested wall plates or integrated flanges.
  5. When multiple units are ganged in walls, devices shall be anchored by means of a tested adjustable gang bracket.
  6. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

## 2.04 FIRESTOPPING MATERIALS AND DEVICES

- A. **General:** Provide firestopping composed of components that are compatible with each other, with the substrates forming openings, and with the items penetrating the firestopping, as demonstrated by the manufacturer based on testing and field experience. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

- B. Fire-Rated Cable Pathways:** Gangable device modules capable of being retrofitted around existing cables, comprised of a steel raceway with self-adjusting intumescent foam pads allowing zero to 100 percent cable fill, requiring no additional action in the form of plugs, twisting closures, putty, pillows, or sealant to achieve fire and leakage ratings.
1. Basis of Design: STI EZ-Path Series 22 Fire-Rated Pathway.
  2. Basis of Design: STI EZ-Path Series 33 Fire-Rated Pathway.
  3. Basis of Design: STI EZ-Path Series 44+ Fire-Rated Pathway.
  4. Basis of Design: STI EZ-Path Series 84+ Fire-Rated Pathway for high-capacity cable runs.
  5. Basis of Design: STI EZ-Path Retrofit Device (EZDR200 and EZDR400) for retrofit applications.
- C. Smoke and Acoustical Pathways:** Device module comprised of a nonmetallic pathway with an integral self-adjusting smoke and sound-sealing system for cable penetrations through non-fire-resistance-rated wall or floor assemblies.
1. Basis of Design: STI EZ-Path Series 44NEZ Smoke & Acoustical Pathway.
- D. Fire-Rated Cable Grommets:** Molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.
1. Basis of Design: STI EZ-Firestop Grommet.
- E. Intumescent Sealants:** Single-component intumescent latex formulations containing no water-soluble intumescent ingredients, capable of expanding a minimum of eight (8) times.
1. Basis of Design: STI SpecSeal Series SSS Intumescent Sealant.
  2. Basis of Design: STI SpecSeal Series LCI Intumescent Sealant.
- F. Endothermic Sealants:** Single-component latex formulations that, upon cure, do not re-emulsify during exposure to moisture.
1. Basis of Design: STI SpecSeal Series LC Endothermic Sealant.
- G. Elastomeric Sealants:** Single-component latex formulations that, upon cure, do not re-emulsify during exposure to moisture and accommodate a minimum of plus-or-minus 25 percent movement. Products shall be tested for use in construction joints incorporating floors and structural steel elements protected with spray-applied fire-resistive materials when present.
1. Basis of Design: STI SpecSeal Series AS Elastomeric Spray.
  2. Basis of Design: STI SpecSeal Series ES Elastomeric Sealant.
- H. Silicone Sealants:** Moisture-curing, single-component silicone elastomeric sealant for horizontal (pourable or non-sag) or vertical (non-sag) surfaces.
1. Basis of Design: STI SpecSeal SIL300 Silicone Firestop Sealant.
  2. Basis of Design: STI SpecSeal SIL300 SL Self-Leveling Silicone Firestop Sealant.

- I. **All-Weather Coatings:** Moisture-curing, single-component silicone copolymer elastomeric spray coating for horizontal surfaces where greater water resistance is required or inclement weather is anticipated. Coating shall meet ASTM D6904 early rain resistance test for a full 24-hour duration.
  - 1. Basis of Design: STI SpecSeal FT305 Firestop Spray.
- J. **Firestop Putty:** Intumescent, 100 percent solids, non-hardening, water-resistant, butyl-rubber-based putty containing no solvents or silicone compounds.
  - 1. Basis of Design: STI SpecSeal Series SSP Firestop Putty.
- K. **Firestop Collars:** Factory-assembled steel collars lined with intumescent material capable of expanding a minimum of 30 times, sized to fit the specific outside diameter of the penetrating item.
  - 1. Basis of Design: STI SpecSeal Series SSC Firestop Collars.
  - 2. Basis of Design: STI SpecSeal Series LCC Firestop Collars.
  - 3. Basis of Design: STI SpecSeal EXC Firestop Collars for non-metallic pipes up to 16 in. (406 mm) and 18 in. (457 mm) diameter.
- L. **Wrap Strips:** Single-component intumescent elastomeric strips faced on both sides with plastic film, capable of expanding a minimum of 30 times.
  - 1. Basis of Design: STI SpecSeal Series RED2 Wrap Strip.
  - 2. Basis of Design: STI SpecSeal Series BLU2 Wrap Strip.
- M. **Firestop Pillows:** Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides, contained in a flame-retardant poly bag.
  - 1. Basis of Design: STI SpecSeal Series SSB Firestop Pillows.
- N. **Firestop Mortar:** Portland-cement-based dry-mix product formulated for mixing with water at the Project site to form a non-shrinking, water-resistant, homogeneous mortar.
  - 1. Basis of Design: STI SpecSeal Series SSM Firestop Mortar.
- O. **Silicone Foam:** Multi-component, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
  - 1. Basis of Design: STI Pensil 200 Silicone Foam.
- P. **Composite Sheet:** Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil, capable of sustaining a minimum 2,500 lb (1,134 kg) load.
  - 1. Basis of Design: STI SpecSeal CS Composite Sheet.
- Q. **Cast-In Firestop Devices:** Pre-installed firestop devices with a polypropylene shell and intumescent core for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls.
  - 1. Basis of Design: STI SpecSeal Cast-In Firestop Device.



- R. **Wall Opening Protective Materials:** Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24 in. (610 mm).
1. Basis of Design: STI SpecSeal Series SSP Firestop Putty Pads.
  2. Basis of Design: STI SpecSeal Series EP PowerShield Insert Pads.
- S. **Protective (Endothermic) Wrap:** Endothermic wrap incorporating a foil scrim, evaluated for protection of cable pathways, liquid fuel lines, and through-penetration and membrane-penetration firestopping. Testing shall include protection of Electrical Metallic Tubing (EMT), Rigid Metallic Conduit (RMC), cable trays, and single- and/or multi-containment liquid fuel lines. Wrap shall have a maximum weight of 1.4 lb/ft<sup>2</sup> and shall allow the use of steel tie wire when installed around piping, conduits, or cable trays.
1. Basis of Design: STI E-Wrap Endothermic Wrap.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Before beginning installation, verify that substrate conditions previously installed under other Sections are acceptable for installation of firestopping in accordance with the manufacturer's installation instructions and technical information.
- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 INSTALLATION

- A. **General:** Install systems in accordance with the performance criteria and the conditions of testing and classification as specified in the published design.
- B. **Manufacturer's Instructions:** Comply with the manufacturer's instructions for installation of products, including temperature, substrate, and geometry limitations.
- C. Coordinate installation with adjacent work, as well as with other trades whose work may be affected or whose work must precede or follow firestopping.

#### 3.03 FIELD QUALITY CONTROL

- A. **Inspection:** Keep areas of work accessible until inspection by the authorities having jurisdiction. Where required, engage an independent third-party special inspector to inspect firestop installations in accordance with ASTM E2174 (through-penetrations) and ASTM E2393 (joint systems and perimeter fire barriers).
- B. **Repair of Deficiencies:** Where deficiencies are found, repair firestopping products so they comply with requirements.

#### 3.04 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris, leaving the area in an undamaged, clean condition.

- B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

### 3.05 IDENTIFICATION AND DOCUMENTATION

- A. **System Labels:** Affix a permanent adhesive identification label on each side of each wall penetration or floor penetration. Label shall identify the firestop manufacturer, the UL System number, the installation date, the installer, and the hourly fire-resistance rating.
- B. **UL System Documentation:** Place a reproduction (photocopy) of the UL System description in a document protector and mount to the wall next to the wall penetration. Highlight the section of the system description listing the allowed cable types or penetrant types.
- C. **Electronic Documentation:** Where required by the Contract Documents, provide electronic firestop documentation using a manufacturer-provided firestop locator or documentation system (e.g., STI Firestop Locator System) for tracking and reporting of installed firestop systems.

### 3.06 SCHEDULES

- A. **UL System Schedule:** The following schedule identifies representative UL Through-Penetration Firestop Systems (XHEZ) for common penetration types. Final system selection shall be based on the specific field condition, penetrant type, and fire-rating of the barrier.

| Penetrant Type              | Concrete Floor                                      | Concrete Wall                                                          | Gypsum Board Wall                                                              |
|-----------------------------|-----------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Blank Opening               | C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116          | C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116                             | W-L-0020, W-L-0034                                                             |
| Metal Conduits              | C-AJ-1080, C-AJ-1240, C-AJ-1353                     | C-AJ-1080, W-J-1098, W-J-1100                                          | W-L-1049, W-L-1222, W-L-1168                                                   |
| Plastic Conduits / Raceways | C-AJ-2140, C-AJ-2292, F-A-2186, F-A-2210, F-A-2225  | C-AJ-2038, C-AJ-2108, C-AJ-2578, C-AJ-2586, W-J-2018, W-J-2076         | W-L-2059, W-L-2074, W-L-2093, W-L-2241                                         |
| Cables                      | C-AJ-3214, C-AJ-3231, F-A-3015, F-A-3021, F-A-3054  | C-AJ-3214, C-AJ-3231, W-J-3098, W-J-3099, W-J-3124, W-J-3150, W-J-3180 | W-L-3219, W-L-3248, W-L-3287, W-L-3356, W-L-3377, W-L-3378, W-L-3379, W-L-3390 |
| Cable Trays                 | C-AJ-3317, C-AJ-8181, C-AJ-4029, F-A-3015, F-A-3037 | C-AJ-8181, W-J-4021, W-J-4022, W-J-4033, W-J-3098, W-J-3145, W-J-3158  | W-L-3218, W-L-3271, W-L-3286, W-L-3306, W-L-4008, W-L-4029, W-L-4043, W-L-8073 |
| Cable Pathways (Device)     | STI EZ-Path Series 22, 33, 44+, 84+                 | STI EZ-Path Series 22, 33, 44+, 84+                                    | STI EZ-Path Series 22, 33, 44+, 84+                                            |

END OF SECTION 27 05 25

## SECTION 27 05 26

### GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding labeling.

##### 1.03 DEFINITIONS

- A. **BCT:** Bonding conductor for telecommunications (referred to as TBC, Telecommunications Bonding Conductor, in ANSI/TIA-607-D and later editions).
- B. **TGB:** Telecommunications grounding busbar (referred to as SBB, Secondary Bonding Busbar, in ANSI/TIA-607-D and later editions).
- C. **TMGB:** Telecommunications main grounding busbar (referred to as PBB, Primary Bonding Busbar, in ANSI/TIA-607-D and later editions).
- D. **NRTL:** Nationally Recognized Testing Laboratory.
- E. **TBB:** Telecommunications bonding backbone. A conductor that interconnects all SBBs (TGBs) with the PBB (TMGB).
- F. **BBC:** Backbone bonding conductor. Bonds two or more TBBs together per ANSI/TIA-607-E; replaces the legacy "grounding equalizer conductor."
- G. **RBB:** Rack bonding busbar. A busbar mounted on or in an equipment rack or cabinet that supports multiple unit bonding conductors per ANSI/TIA-607-E.
- H. **TEBC:** Telecommunications equipment bonding conductor. Bonds the PBB (TMGB) or SBB (TGB) to equipment racks and cabinets, or to an RBB, per ANSI/TIA-607-E.
- I. **Mesh-BN:** Mesh bonding network. A supplementary bonding network consisting of multiple interconnected conductors forming a mesh pattern, used in computer rooms and data centers per ANSI/TIA-607-E.
- J. **Service Provider:** The operator of a service that provides telecommunications transmission delivered over access provider facilities.

##### 1.04 ACTION SUBMITTALS

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

- B. **Shop Drawings:** For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

### 1.05 INFORMATIONAL SUBMITTALS

- A. **As-Built Data:** Plans showing as-built locations of grounding and bonding infrastructure, including the following:
1. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. **Qualification Data:** For Installer, installation supervisor, and field inspector.
- C. **Qualification Data:** For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

### 1.06 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For grounding to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

### 1.07 QUALITY ASSURANCE

- A. **Installer Qualifications:** Cabling Installer must have personnel certified by BICSI on staff in accordance with current BICSI credentials (e.g., RCDD, INST1, INST2, or TECH).
- B. **Installation Supervision:** Installation shall be under the direct supervision of a BICSI-credentialed Technician (TECH) or higher, who shall be present at all times when Work of this Section is performed at Project site.
- C. **Field Inspector:** Currently registered by BICSI as a Registered Communications Distribution Designer (RCDD) to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.01 SYSTEM DESCRIPTION

- A. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70 (edition adopted by the Authority Having Jurisdiction), by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with ANSI/TIA-607-E (or latest published edition) and ISO/IEC 30129.

### 2.02 CONDUCTORS

- A. Comply with UL 486A-486B.

- B. **Insulated Conductors:** Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
- C. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- D. **Cable Tray Equipment Grounding Wire:** No. 6 AWG.
- E. **Cable Tray Grounding Jumper:**
  - 1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- F. **Bare Copper Conductors:**
  - 1. **Solid Conductors:** ASTM B 3.
  - 2. **Stranded Conductors:** ASTM B 8.
  - 3. **Tinned Conductors:** ASTM B 33.
- G. **Bonding Cable:** 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
- H. **Bonding Conductor:** No. 4 or No. 6 AWG, stranded conductor.
- I. **Bonding Jumper:** Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

## 2.03 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. **Compression Wire Connectors:** Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  - 1. Electroplated tinned copper, C and H shaped.
- C. **Signal Reference Grid Connectors:** Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. **Busbar Connectors:** Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- E. **Welded Connectors:** Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.04 GROUNDING BUSBARS

- A. **Telecommunications Main Grounding Busbar (TMGB / Primary Bonding Busbar [PBB]):** Solid copper busbar, hard-drawn, wall-mounted, listed for use as a telecommunications bonding busbar and complying with ANSI/TIA-607-E (or latest published edition) and UL 467.

1. **Minimum cross-sectional area:** 750 sq. mm (approximately 1/4 by 4 inches [6.3 by 100 mm]). Length as indicated on Drawings, sized to accommodate all required connections plus a minimum of 25 percent spare capacity for future connections.
  2. **Surface finish:** Unpainted, unplated copper. Do not use tin- or nickel-plated busbars unless specifically indicated; antioxidant compound shall be applied at each connection point at installation.
  3. **Hole pattern:** Predrilled for two-hole compression lug connections on NEMA standard hole spacing (5/8 inch or 1 inch [15.8 or 25.4 mm] on centers). Quantity and spacing of holes as indicated on Drawings.
  4. **Identification:** Permanently marked with manufacturer's name, model number, and listing mark. Additional field labeling per Identification article in this Section.
  5. Predrilling shall be with holes for use with lugs specified in this Section.
  6. **Mounting Hardware:** Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  7. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. Telecommunications Grounding Busbar (TGB / Secondary Bonding Busbar [SBB]):** Solid copper busbar, hard-drawn, wall-mounted, listed to UL 467 and complying with ANSI/TIA-607-E (or latest published edition).
1. **Minimum cross-sectional area:** 375 sq. mm (approximately 1/4 by 2 inches [6.3 by 50 mm]). Length as indicated on Drawings, sized to accommodate all required connections plus a minimum of 25 percent spare capacity for future connections.
  2. **Surface finish:** Unpainted, unplated copper. Antioxidant compound shall be applied at each connection point at installation.
  3. **Hole pattern:** Predrilled for two-hole compression lug connections on NEMA standard hole spacing (5/8 inch or 1 inch [15.8 or 25.4 mm] on centers). Quantity and spacing of holes as indicated on Drawings.
  4. **Identification:** Permanently marked with manufacturer's name, model number, and listing mark. Additional field labeling per Identification article in this Section.
  5. Predrilling shall be with holes for use with lugs specified in this Section.
  6. **Mounting Hardware:** Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  7. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. Rack and Cabinet Grounding Busbars (Rack Bonding Busbars, RBBs, per ANSI/TIA-607-E):** Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with ANSI/TIA-607-E (or latest published edition). Minimum cross-sectional area shall be equivalent to a No. 6 AWG conductor. Predrilling shall be with holes for use with lugs specified in this Section.

1. **Cabinet-Mounted Busbar:** Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. **Rack-Mounted Horizontal Busbar:** Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. **Rack-Mounted Vertical Busbar:** 72 or 36 inches (1827 or 914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

## 2.05 IDENTIFICATION

- A. Comply with requirements for identification products in Division 27 "Identification for Communications Systems."

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with ANSI/TIA-607-E (or latest published edition) and ISO/IEC 30129.

### 3.03 APPLICATION

- A. **Conductors:** Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. **Underground Grounding Conductors:** Install bare tinned-copper conductor, No. 2 AWG minimum.
- 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 Structural Steel:** Welded connectors.

**D. Conductor Support:**

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

**E. Grounding and Bonding Conductors:**

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor (minimum bend radius and included-angle requirements per ANSI/TIA-607-E). No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

**3.04 GROUNDING ELECTRODE SYSTEM**

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

**3.05 GROUNDING BUSBARS**

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

**3.06 CONNECTIONS**

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  1. Use crimping tool and the die specific to the connector.
  2. Pre-twist the conductor.
  3. Apply an antioxidant compound to all bolted and compression connections.



- D. **Primary Protector:** Bond to the TMGB with insulated bonding conductor.
- E. **Interconnections:** Install one or more telecommunications bonding backbones (TBBs) originating at the TMGB (PBB) and extending, via the telecommunications backbone pathways, to each TGB (SBB) in the building. The TBB shall be a single continuous conductor and shall not be daisy-chained or segmented between busbars. Where multiple TBBs are installed in a multi-story building, bond them together using a backbone bonding conductor (BBC) at the top floor and at minimum every third floor. Where multiple TGBs are installed on the same floor, bond them together using a BBC. The BBC shall be, at a minimum, the same size as the largest TBB it interconnects.
- F. **TBB and BBC conductor sizing:** Size each TBB and BBC per ANSI/TIA-607-E Table 1, based on the total TBB linear length. Minimum size shall be No. 6 AWG. Conductors shall be stranded copper with green (or green with yellow stripe) insulation rated 600 V, continuous without splices. Where Drawings indicate a specific size, the size indicated shall govern provided it is not smaller than the TIA-607-E minimum for the installed length.
- G. **Telecommunications Enclosures and Equipment Racks:** Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted or vertically mounted rack grounding busbar (Rack Bonding Busbar, RBB, per ANSI/TIA-607-E) unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB (SBB) using a Telecommunications Equipment Bonding Conductor (TEBC) terminated with listed irreversible two-hole compression lugs; conductor shall be No. 2 AWG bonding conductors. Cabinets and racks shall not be bonded serially; each shall have its own dedicated bonding conductor to the TEBC, RBB, PBB (TMGB), or SBB (TGB).
- H. **Structural Steel:** Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- I. **Electrical Power Panelboards:** Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- J. **Shielded Cable:** Bond the shield of shielded cable to the TGB (SBB) in communications rooms and spaces. Comply with ANSI/TIA-568.1-E and ANSI/TIA-568.2-E (or latest published editions) when grounding shielded balanced twisted-pair cables.
- K. **Rack- and Cabinet-Mounted Equipment:** Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- L. **Access Floors:** Bond all metal parts of access floors to the TGB.
- M. **Equipment Room Signal Reference Grid** (mesh bonding network, Mesh-BN, per ANSI/TIA-607-E where a supplementary bonding network is required in computer rooms and data centers): Provide a low-impedance path between

telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
2. Bond the TGB of the equipment room to the reference grid at two or more locations.
3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

**N. Towers and Antennas:**

1. **Ground Ring:** Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
5. **Roof Ring:** Meet requirements for the ground ring except the conductors shall comply with requirements in Section 26 41 13 "Lightning Protection for Structures."
6. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
7. Connect roof ring to the perimeter conductors of the lightning protection system.

**O. Waveguides and Coaxial Cable:**

1. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
2. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

**3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. **Duct-Bank Grounding Conductor:** Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 (National Electrical Safety Code, current edition) grounding requirements.
- C. **Grounding Manholes and Handholes:** Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.

- D. **Grounding Connections to Manhole Components:** Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields per written instructions by manufacturer of splicing and termination kits.

### 3.08 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
- B. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
- C. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
- D. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.09 FIELD QUALITY CONTROL

- A. **Testing Agency:** Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. **Tests and Inspections:**
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench per manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by the BICSI Telecommunications Distribution Methods Manual (TDMM), 15th Edition (or latest published edition). Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- D. **Excessive Ground Resistance:** If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

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- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 27 05 26**

**SECTION 27 05 28**

**PATHWAYS FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Ladder cable trays.
  - 2. Wire-basket cable trays.
  - 3. Metal conduits and fittings.
  - 4. Nonmetallic conduits and fittings.
  - 5. Metal wireways and auxiliary gutters.
  - 6. Nonmetallic wireways and auxiliary gutters.
  - 7. Metallic surface pathways.
  - 8. Nonmetallic surface pathways.
  - 9. Hooks.
  - 10. Boxes, enclosures, and cabinets.

**1.03 DEFINITIONS**

- A. **ARC:** Aluminum rigid conduit.
- B. **RMC:** Rigid metal conduit (galvanized steel), per UL 6.
- C. **IMC:** Intermediate metal conduit.
- D. **RTRC:** Reinforced thermosetting resin conduit.

**1.04 ACTION SUBMITTALS**

- A. Product data for the following:
  - 1. Surface pathways.
  - 2. Wireways and fittings.
  - 3. Boxes, enclosures, and cabinets.
- B. **Shop Drawings:** For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

**1.05 INFORMATIONAL SUBMITTALS**

- A. **Coordination Drawings:** Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. **Qualification Data:** For professional engineer.
- C. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. If cable trays are identified for use via listing, then follow listing requirements. This may require that all interconnected cable trays be from single manufacturer. Some tray types may not be capable of being interconnected.
- B. **Cable Trays and Accessories:** Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
- C. **Source Limitations:** Obtain cable trays and components from single manufacturer.
- D. **Sizes and Configurations:** See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- E. Wire-basket cable trays cannot support the concentrated loads imposed on other tray types and can only support spans of 72 to 96 inches (1800 to 2400 mm) maximum.
- F. **Structural Performance:** See articles for individual cable tray types for specific values for the following parameters:
  - 1. **Uniform Load Distribution:** Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1-2017/CSA C22.2 No. 126.1-17.
  - 2. **Concentrated Load:** A load applied at midpoint of span and centerline of tray.
  - 3. **Load and Safety Factors:** Applicable to both side rails and rung capacities.

### 2.02 LADDER CABLE TRAYS

- 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. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Chalfant Manufacturing Company.
  - 3. Cooper B-Line, Inc.
  - 4. Mono-Systems, Inc.
  - 5. MP Husky.
- B. Description:

1. **Configuration:** Two I-beam side rails with transverse rungs welded to side rails.
  2. **Rung Spacing:** 9 inches o.c.
  3. **Radius-Fitting Rung Spacing:** 9 inches (225 mm) at center of tray's width.
  4. **Minimum Cable-Bearing Surface for Rungs:** 7/8-inch (22-mm) width with radius edges.
  5. No portion of the rungs shall protrude below the bottom plane of side rails.
  6. **Structural Performance of Each Rung:** Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1-2017/CSA C22.2 No. 126.1-17.
  7. **Straight Section Lengths:** 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
  8. **Width:** 12 inches (300 mm) unless otherwise indicated on Drawings.
- C. The maximum uniform load and the support span are indicated by the cable tray class.
- D. **Class Designation:** Comply with NEMA VE 1-2017/CSA C22.2 No. 126.1-17.
- E. **Splicing Assemblies:** Bolted type using serrated flange locknuts.
- F. **Hardware and Fasteners:** Steel, zinc plated according to ASTM B 633.
- G. **Splice Plate Capacity:** Splices located within support span shall not diminish rated loading capacity of cable tray.

## 2.03 WIRE-BASKET CABLE TRAYS

- 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. Allied Tube & Conduit; a Tyco International Ltd. Co.
  2. Cablofil/Legrand (Basis of Design — Cablofil CF54 series wire-mesh cable tray).
  3. Chalfant Manufacturing Company.
  4. Cooper B-Line, Inc.
  5. Enduro Systems, Inc.
  6. Mono-Systems, Inc.
  7. MP Husky.
  8. Niedax-Kleinhuis USA, Inc.
  9. Snake-tray.
  10. Wiremaid Products Division; Vutec Corporation.
- B. Description:
1. **Configuration:** Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.

2. **Materials:** High-strength-steel longitudinal wires with no bends.
3. **Safety Provisions:** Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
4. **Sizes:**
  - a. Straight sections shall be furnished in standard 118-inch lengths.
  - b. Wire-Basket Depth: 4-inch usable loading depth by 12 and 24 inches wide.
5. **Connector Assemblies:** Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. **Connector Assembly Capacity:** Splices located within support span shall not diminish rated loading capacity of cable tray.
7. **Hardware and Fasteners:** Steel, zinc plated according to ASTM B 633.

## 2.04 METAL CONDUITS AND FITTINGS

- A. **Description:** Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. **General Requirements for Metal Conduits and Fittings:**
  1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  2. Comply with ANSI/TIA-569-E (2019).
- C. **RMC:** Comply with ANSI C80.1 and UL 6.
- D. **ARC:** Comply with ANSI C80.5 and UL 6A.
- E. **IMC:** Comply with ANSI C80.6 and UL 1242.
- F. **PVC-Coated Steel Conduit:** PVC-coated RMC or IMC.
  1. Comply with NEMA RN 1-2018.
  2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. **EMT:** Comply with ANSI C80.3 and UL 797.
- H. **Fittings for Metal Conduit:** Comply with NEMA FB 1 and UL 514B.
- I. **Conduit Fittings for Hazardous (Classified) Locations:** Comply with UL 1203 and NFPA 70.
- J. **Fittings for EMT:**
  1. Material: Steel or die cast.
  2. Type: Set screw or compression.
- K. **Expansion Fittings:** PVC or steel to match conduit type, complying with UL 651 (for PVC) or UL 514B (for steel), rated for environmental conditions where installed, and including flexible external bonding jumper.
- L. **Coating for Fittings for PVC-Coated Conduit:** Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.



- M. **Joint Compound for IMC, RMC, or ARC:** Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.05 NONMETALLIC CONDUITS AND FITTINGS

- A. **Description:** Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  2. Comply with ANSI/TIA-569-E (2019).
- C. **RNC:** Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. **Rigid HDPE:** Comply with UL 651A.
- E. **Continuous HDPE:** Comply with UL 651A.
- F. **RTRC:** Comply with UL 2515A and NEMA TC 14-2017.
- G. **Fittings:** Comply with NEMA TC 3-2021; match to conduit or tubing type and material.
- H. **Solvents and Adhesives:** As recommended by conduit manufacturer.

## 2.06 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. **Description:** Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. General Requirements for Metal Wireways and Auxiliary Gutters:
1. Comply with UL 870 and ANSI/NEMA 250-2024, Type 1 unless otherwise indicated, and sized per the current edition of NFPA 70 (NEC).
  2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  3. Comply with ANSI/TIA-569-E (2019).
- C. **Fittings and Accessories:** Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. **Wireway Covers:** Screw-cover type unless otherwise indicated.
- E. **Finish:** Manufacturer's standard enamel finish.

## 2.07 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. **Description (Fiberglass):** Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

- B. **Description (PVC):** PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with ANSI/TIA-569-E (2019).
- D. **Fittings and Accessories:** Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. **Solvents and Adhesives:** As recommended by conduit manufacturer.

## 2.08 SURFACE METAL PATHWAYS

- A. **Description:** Galvanized steel with snap-on covers, complying with UL 5.
- B. **Finish:** Manufacturer's standard enamel finish in color selected by Architect.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with ANSI/TIA-569-E (2019).

## 2.09 SURFACE NONMETALLIC PATHWAYS

- A. **Description:** Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
- B. **Finish:** Texture and color selected by Architect from manufacturer's standard colors.
- C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with ANSI/TIA-569-E (2019).

## 2.10 HOOKS

- 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. nVent Caddy (Basis of Design — Cat HP J-Hook series for Category 6A and higher cabling).
  - 2. Panduit Corp.
  - 3. Eaton B-Line.
  - 4. Arlington Industries, Inc.
  - 5. Chatsworth Products, Inc. (CPI).
- B. **Description:** Prefabricated sheet metal cable supports for telecommunications cable, with rounded, large-radius support surfaces sized to accommodate Category 6A and higher cabling without exceeding the cable's minimum bend radius. J-hooks

- shall be UL Listed and labeled per UL 2239 as cable support equipment. Bridle rings (split rings) shall not be used to support Category 6A or higher data cabling; use only J-hooks with engineered support surfaces (e.g., nVent Caddy Cat HP series or equal) for high-performance horizontal cabling.
- C. Approved for use in limited applications to support Horizontal cabling. Bundle sizes shall not exceed 24 Category 6A or higher cables, and shall comply with TIA TSB-184-A recommendations for remote powering (PoE/PoE+/PoE++) heat dissipation. Where cabling supports Type 3 or Type 4 remote powering, reduce bundle size accordingly.
  - D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - E. Comply with ANSI/TIA-569-E (2019).
  - F. Galvanized or stainless steel.
  - G. J shape.
  - H. Accept 3/8" (9.5 mm) threaded rod for attachment to building structure or sub-structure.
  - I. Holes for easy attachment to wall surfaces, beams, trusses, and direct attachment to cable trays and rack systems. Can be tiered in a single column, as well as back-to-back.
  - J. White, red, green, yellow, or blue color identifiers for content designation of segregated cables.
  - K. Maximum spacing between supports shall not exceed 60 inches (1.5 m) per ANSI/TIA-569-E. Provide additional supports at all changes of direction, within 12 inches of any junction box or termination, and at intervals required to prevent cable sag exceeding 12 inches between supports.
  - L. Cables shall be secured to J-hooks using hook-and-loop fastener wraps (e.g., Velcro). Cinch wraps snugly to keep bundles routed neatly through the hooks but not so tight as to deform cable jackets or affect electrical performance. Plastic cable ties shall not be used to bundle Category 6A or higher data cabling.
  - M. Center Hanger Connector Plate:
    - 1. Bracket that allows for back-to-back non-continuous open top cable support mounting.
    - 2. Continuous cable division shall be fully maintained within each open top cable support.
    - 3. Fittings shall be manufactured of galvanized steel or stainless steel.
  - N. Multi-tier Assembly:
    - 1. Bracket that allows for top-to-bottom non-continuous open top cable support mounting.
    - 2. Continuous cable division shall be fully maintained within each open top cable support.
    - 3. Fittings shall be manufactured of galvanized steel.

## 2.11 BOXES, ENCLOSURES, AND CABINETS

- A. **Description:** Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with ANSI/TIA-569-E (2019).
  - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
  - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- C. **Device Box Dimensions:** 4 inches square by 2-1/4 inches deep (100 mm square by 65 mm deep).
- D. Gangable boxes are prohibited.
- E. **Sheet Metal Outlet and Device Boxes:** Comply with NEMA OS 1 and UL 514A.
- F. **Cast-Metal Outlet and Device Boxes:** Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- G. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. **Nonmetallic Floor Boxes:** Nonadjustable, round or rectangular.
  - 1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. **Small Sheet Metal Pull and Junction Boxes:** NEMA OS 1.
- J. **Cast-Metal Access, Pull, and Junction Boxes:** Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- K. **Nonmetallic Outlet and Device Boxes:** Comply with NEMA OS 2 and UL 514C.
- L. **Hinged-Cover Enclosures:** Comply with UL 50 and ANSI/NEMA 250-2024, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.
- M. **Metal Enclosures:** Steel, finished inside and out with manufacturer's standard enamel.
- N. Nonmetallic Enclosures:
  - 1. Material: Plastic.
  - 2. Finished inside with radio-frequency-resistant paint.
- O. **Interior Panels:** Steel; all sides finished with manufacturer's standard enamel.
- P. Cabinets:

1. ANSI/NEMA 250-2024, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.
- Q. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **PART 3 - EXECUTION**

### **3.01 RACEWAY INSTALLATION REQUIREMENTS**

- A. Minimum conduit size shall be 1" for serving one outlet box. Series-connected outlet boxes are not permitted. Each outlet shall be home-run from an appropriately sized junction box. The conduit feeding the junction box shall be sized as follows:
1. 1-1/4" for serving two outlet boxes.
  2. 1-1/2" for serving three outlet boxes.
  3. Two (2) 1-1/4" for serving floor boxes.
  4. 1-1/4" for serving up to three outlets in a surface raceway.
- B. Communications ducts and conduits entering the building from the outside shall transition to galvanized rigid steel conduit or intermediate metal conduit at the building wall, and shall continue as galvanized rigid steel conduit or intermediate metal conduit until entering the Entrance Facility (EF) or Telecommunications Room (TR). Maximum conduit length to meet Code shall be 50'. Notify the Project Manager if this length is exceeded.
- C. Riser conduits and sleeves connecting Entrance Facilities (EFs) and Telecommunications Rooms (TRs) shall be 4". Install conduits and sleeves as close as possible to the walls, at the locations shown. Stub up floor conduits and sleeves 4" AFF. Stub wall conduits and sleeves 4" into the room, and cable trays 6" into the room.
- D. When conduits are needed to bypass a large interference in a cable tray run, the cross-sectional area of the conduits shall equal or exceed the cross-sectional area of the cable tray. These bypass conduits shall have sweeps and bends as noted below and shall be braced well to allow pulling of communication cables.
- E. Conduit bends and offsets shall be made with sweeps or manufactured elbows. Conduits shall not have more than the equivalent of 2 ninety-degree bends between pull points. Pull boxes shall not be used to make directional changes. Provide pull boxes in straight sections of conduit only.
- F. Provide insulated bushings on both ends of conduits.
- G. Provide double gang sheet metal outlet boxes 2-1/8" deep and provide double gang plaster rings.

- H. Bond the entire raceway system together and connect it to the ground system.
- I. Provide nylon pull strings in conduits and sleeves. Label pull strings with room number and wall (N, S, E, or W) of the outlet.

### 3.02 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: RMC.
  - 2. Concealed Conduit, Aboveground: RMC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried or concrete encased.
  - 4. Boxes and Enclosures, Aboveground: ANSI/NEMA 250-2024, Type 3R or Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT or RNC.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT or RNC identified for such use.
  - 3. Exposed and Subject to Severe Physical Damage: RMC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
  - 5. Damp or Wet Locations: RMC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type optical-fiber-cable pathway, plenum-type communications-cable pathway, or EMT.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type optical-fiber-cable pathway, riser-type communications-cable pathway, or EMT.
  - 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, riser-type, or plenum-type optical-fiber-cable pathway; general-use, riser-type, or plenum-type communications-cable pathway; or EMT.
- C. **Boxes and Enclosures:** ANSI/NEMA 250-2024, Type 1, except use ANSI/NEMA 250-2024, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.
- D. **Minimum Pathway Size:** 1-inch (25-mm) trade size for copper, aluminum cables, and optical-fiber cables.

- E. **Pathway Fittings:** Compatible with pathways and suitable for use and location.
- F. **Rigid and Intermediate Steel Conduit:** Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
- G. **PVC Externally Coated, Rigid Steel Conduits:** Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- H. **EMT:** Use set-screw or compression, steel fittings. Comply with NEMA FB 2.10.
- I. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- J. Install surface pathways only where indicated on Drawings.
- K. Do not install nonmetallic conduit where ambient temperature exceeds 120°F (49°C).

### 3.03 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. ANSI/BICSI N1-2019 (Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure).
  - 3. NEMA VE 2-2017 (Cable Tray Installation Guidelines), for shipping, handling, storage, and installation of metallic cable tray systems.
  - 4. BICSI ITSIMM (Information Technology Systems Installation Methods Manual), 8th Edition, as a reference for workmanship and installation methodology.
  - 5. IEC 61537 (Cable management — Cable tray systems and cable ladder systems), for cable tray systems tested to international load and continuity standards.
  - 6. ANSI/TIA-569-E (2019).
  - 7. NECA 101.
  - 8. NECA 102.
  - 9. NECA 105.
  - 10. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors. Confirm compliance with NFPA 70-2026 (NEC 2026), including the restructured Chapter 8 (Communications Systems) and new Article 750 (Grounding and Bonding for Limited-Energy Systems), where adopted by the authority having jurisdiction.
- C. Comply with requirements in Section 07 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. **Cable Tray Installation:** Install per NEMA VE 2-2017, ANSI/BICSI N1-2019, and the cable tray manufacturer's published installation instructions. Maintain a minimum 6-inch (150 mm) clearance between cable tray and parallel piping runs, and a

- minimum 12-inch (300 mm) clearance from heat sources including flues, steam or hot-water pipes, and heating appliances. Run cable tray parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- E. **Cable Tray Support Spacing:** Position supports at intervals not exceeding the cable tray manufacturer's published maximum support span (typically 5 ft for wire-basket trays at full rated load, or up to 8 ft where the system is tested per NEMA VE 1 and the manufacturer permits). Place a support at the start and end of every 90-degree bend, and a support at the midpoint of any large-radius bend. Do not position supports directly under a coupler or splice; locate couplers approximately at the quarter-span point between supports.
- F. **Cable Tray Splices and Bonding:** Use manufacturer-supplied splice plates (fast-splice type for wire-basket cable tray) to maintain electrical continuity throughout the cable tray run. Provide bonding jumpers at expansion joints, sleeves, and any other locations where electrical continuity is interrupted. Bond cable tray to the nearest Telecommunications Grounding Busbar (TGB) per Section 27 05 26 "Grounding and Bonding for Communications Systems." Ensure that bonding contacts break through any paint or coating to bare metal.
- G. **Field-Fabricated Fittings (Wire-Basket Tray):** Where bends, reductions, or tees are field-fabricated from straight sections, use only manufacturer-approved tools (side-action bolt cutter or equivalent) to maintain the integrity of the galvanic protective coating. Coat any exposed cut wire ends with a zinc-rich touch-up compound recommended by the manufacturer.
- H. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- I. Complete pathway installation before starting conductor installation.
- J. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- K. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- L. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- M. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- N. Pathways 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. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
  2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.



4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to RMC and fittings before rising above floor.
- O. Stub-ups to Above Recessed Ceilings:
  1. Use EMT, IMC, or RMC for pathways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- P. **Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions:** Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- Q. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- R. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- S. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- T. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- U. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- V. Install pull wires in empty pathways. 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. Secure pull wire so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- W. Surface Pathways:
  1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway per manufacturer's written instructions. Tape and glue are not acceptable support methods.
- X. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  1. 4-Inch (100-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
  3. Install pathway-sealing fittings at accessible locations per NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish like that of adjacent plates or surfaces. Install pathway-sealing fittings per NFPA 70.
  4. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
    - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    - b. Where an underground service pathway enters a building or structure.
    - c. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Z. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30°F (17°C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100°F (55°C), and that has straight-run length that exceeds 100 feet (30 m).
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125°F (70°C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155°F (86°C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125°F (70°C) temperature change.
    - d. Attics: 135°F (75°C) temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per °F (0.06 mm per meter of length of straight run per °C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per °F (0.0115 mm per meter of length of straight run per °C) of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected per manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA.Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.
5. Provide a hook at each change in direction.

BB.Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. **Recessed Boxes in Masonry Walls:** Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE.Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

FF.Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS**

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### **3.05 FIRESTOPPING**

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### **3.06 PROTECTION**

A. Protect coatings, finishes, and cabinets from damage or deterioration.

B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

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- C. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 27 05 28**

## SECTION 27 05 53

### IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 REFERENCES

- A. Abbreviations and Acronyms:
  - 1. **ANSI:** American National Standards Institute.
  - 2. **ASTM:** ASTM International.
  - 3. **BICSI:** Building Industry Consulting Service International.
  - 4. **NFPA:** National Fire Protection Association.
  - 5. **TIA:** Telecommunications Industry Association.
  - 6. **UL:** Underwriters Laboratories.
- B. Reference Standards:
  - 1. ANSI Z535.1-2022 — Safety Colors.
  - 2. ANSI Z535.2-2023 — Environmental and Facility Safety Signs.
  - 3. ANSI Z535.3-2022 — Criteria for Safety Symbols.
  - 4. ANSI Z535.4-2023 — Product Safety Signs and Labels.
  - 5. ANSI/TIA-606-D — Administration Standard for Telecommunications Infrastructure.
  - 6. ASTM D638 — Standard Test Method for Tensile Properties of Plastics.
  - 7. ASTM D882 — Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - 8. BICSI ITSIMM — Information Technology Systems Installation Methods Manual, 8th Edition.
  - 9. NFPA 70 — National Electrical Code.
  - 10. UL 94 — Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
  - 11. UL 969 — Standard for Marking and Labeling Systems.

##### 1.03 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for labels and signs.

2. Labels.
3. Bands and tubes.
4. Underground-line warning tape.
5. Signs.
6. Cable ties.
7. Fasteners for labels and signs.

#### 1.04 ACTION SUBMITTALS

- A. **Product Data:** For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.
- B. **Samples:** For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule:
  1. **Outlets:** Scaled drawings indicating location and proposed designation.
  2. **Patch Panels:** Enlarged scaled drawings showing rack row, number, and proposed designations.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and ANSI/TIA-606-D.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- D. **Thermal Movements:** Allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: 120°F (66.7°C), ambient; 180°F (100°C), material surfaces.

#### 2.02 COLOR AND LEGEND REQUIREMENTS

- A. Equipment Identification Labels:
  1. Black letters on a white field.
- B. **Termination Field Color-Coding:** Color-code termination fields in accordance with ANSI/TIA-606-D as follows:
  1. **Orange:** Demarcation point, central office terminations.
  2. **Green:** Network connection on customer side of demarcation point.
  3. **Purple:** Common equipment (PBX, LAN, multiplexer terminations).
  4. **White:** First-level backbone terminations (MC to IC).

5. **Gray:** Second-level backbone terminations (IC to TR).
  6. **Blue:** Horizontal cable terminations (work area outlets).
  7. **Brown:** Inter-building backbone terminations.
  8. **Yellow:** Auxiliary circuits (alarms, security, energy management).
  9. **Red:** Key telephone systems.
- C. **Machine-Readable Identifiers:** Where indicated or required by Owner, provide labels with machine-readable identifiers (QR code, data matrix, or RFID) in addition to human-readable text. Identifiers shall link to records maintained in accordance with ANSI/TIA-606-D and, where applicable, an Automated Infrastructure Management (AIM) system complying with ANSI/TIA-5048.

## 2.03 LABELS

- A. **Vinyl Wraparound Labels:** Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. **Snap-Around Labels:** Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.
- C. **Self-Adhesive Wraparound Labels:** Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
  1. **Self-Lamination:** Clear; UV-, weather-, and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
- D. **Marker for Labels (Hand-Lettered):** Permanent, waterproof black ink marker recommended by tag manufacturer.
- E. **Marker for Labels (Machine-Printed):** Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- F. **Self-Adhesive Labels:** Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches (38 by 150 mm) for raceway and conductors.
    - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
    - c. As required by authorities having jurisdiction.

## 2.04 BANDS AND TUBES

- A. **Snap-Around, Color-Coding Bands:** Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

## 2.05 UNDERGROUND-LINE WARNING TAPE

- A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground 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 degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
  2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE."
- C. Tag — Type I:
1. Pigmented polyolefin, bright colored, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Thickness: 4 mils (0.1 mm).
  4. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
  5. Tensile per ASTM D882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
- D. Tag — Type II:
1. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Thickness: 12 mils (0.3 mm).
  4. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
  5. Tensile per ASTM D882: 400 lbf (1780 N) and 11,500 psi (79.2 MPa).
- E. 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, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Overall Thickness: 5 mils (0.125 mm).
  4. Foil Core Thickness: 0.35 mil (0.00889 mm).
  5. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
  6. Tensile per ASTM D882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).
- F. Tag — Type IID:
1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows



inspection of the continuity of the conductive core; bright-colored, compounded for direct-burial service.

2. Width: 3 inches (75 mm).
3. Overall Thickness: 8 mils (0.2 mm).
4. Foil Core Thickness: 0.35 mil (0.00889 mm).
5. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
6. Tensile per ASTM D882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

## 2.06 SIGNS

### A. Baked-Enamel Signs:

1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

### B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches (250 by 360 mm).

### C. Laminated-Acrylic or Melamine-Plastic Signs:

1. Engraved legend.
2. Thickness:
  - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
  - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
3. Engraved legend with black letters on white face.
4. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
5. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.07 CABLE TIES

### A. **General-Purpose Cable Ties:** Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73°F (23°C) per ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185°F (Minus 40 to plus 85°C).
4. Color: Black, except where used for color-coding.

- B. **UV-Stabilized Cable Ties:** Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73°F (23°C) per ASTM D638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185°F (Minus 40 to plus 85°C).
  4. Color: Black.
- C. **Plenum-Rated Cable Ties:** Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73°F (23°C) per ASTM D638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284°F (Minus 46 to plus 140°C).
  5. Color: Black.

## 2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. **Paint:** Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. **Fasteners for Labels and Signs:** Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. **Self-Adhesive Identification Products:** Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.

- G. **Elevated Components:** Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- H. Vinyl Wraparound Labels:
1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
  3. Provide label 6 inches (150 mm) from cable end.
- I. Snap-Around Labels:
1. Secure tight to surface at a location with high visibility and accessibility.
  2. Provide label 6 inches (150 mm) from cable end.
- J. Self-Adhesive Wraparound Labels:
1. Secure tight to surface at a location with high visibility and accessibility.
  2. Provide label 6 inches (150 mm) from cable end.
- K. Self-Adhesive Labels:
1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (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.
- L. **Snap-Around, Color-Coding Bands:** Secure tight to surface at a location with high visibility and accessibility.
- M. Underground-Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches 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.
  2. Limit use of underground-line warning tape to direct-buried cables.
  3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- N. Cable Ties: General purpose, except as listed below:
1. Outdoors: UV-stabilized nylon.
  2. In Spaces Handling Environmental Air: Plenum rated.

### 3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. **Accessible Fittings for Raceways and Cables within Buildings:** Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.
- D. System legends shall be as follows:
  - 1. Telecommunications.
  - 2. Security.
  - 3. Audio Visual.
  - 4. Distributed Antenna System (DAS).
  - 5. Wireless / Wi-Fi.
  - 6. Paging.
  - 7. Clock.
  - 8. AV Control.
  - 9. BAS Network.
- E. **Faceplates:** Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:
  - 1. Wiring closet designation.
  - 2. Colon.
  - 3. Faceplate number.
- F. Equipment Room Labeling:
  - 1. **Patch Panels:** Label individual rows and outlets, starting at top left and working down, with self-adhesive labels.
- G. **Data Outlets:** Label each outlet with a self-adhesive label indicating the following, in the order listed:
  - 1. Room number being served.
  - 2. Colon.
  - 3. Faceplate number.
- H. **Horizontal Cables:** Label each cable with a vinyl-wraparound label indicating the following, in the order listed:
  - 1. Room number.
  - 2. Colon.
  - 3. Faceplate number.
- I. **Locations of Underground Lines:** Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

- J. **Instructional Signs:** Self-adhesive labels.
- K. **Warning Labels for Indoor Cabinets, Boxes, and Enclosures:** Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
- L. Equipment Identification Labels:
  - 1. **Indoor Equipment:** Self-adhesive label.
  - 2. **Outdoor Equipment:** Laminated-acrylic or melamine-plastic sign.
- M. Equipment to Be Labeled:
  - 1. Communications cabinets.
  - 2. Uninterruptible power supplies.
  - 3. Computer room air conditioners.
  - 4. Fire-alarm and suppression equipment.
  - 5. Egress points.
  - 6. Power distribution components.

**END OF SECTION 27 05 53**

## SECTION 27 11 00

### COMMUNICATIONS EQUIPMENT ROOM FITTINGS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Backboards.
  - 2. Racks.
  - 3. Cabinets.
  - 4. Power strips.
  - 5. UPS.

##### 1.03 DEFINITIONS

- A. **Access Provider:** An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. **RCDD:** Registered Communications Distribution Designer.
- C. **Service Provider:** The operator of a telecommunications transmission service delivered through access provider facilities.
- D. **TGB:** Telecommunications Grounding Busbar (referred to as the Secondary Bonding Busbar [SBB] in ANSI/TIA-607-E).
- E. **TMGB:** Telecommunications Main Grounding Busbar (referred to as the Primary Bonding Busbar [PBB] in ANSI/TIA-607-E).

##### 1.04 ACTION SUBMITTALS

- A. **Product Data:** For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. **Shop Drawings:** For communications equipment room fittings. 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. **Equipment Racks and Cabinets:** Include workspace requirements and access for cable connections.
3. **Grounding:** Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

## 1.05 INFORMATIONAL SUBMITTALS

- A. **Qualification Data:** For Installer, qualified layout technician, installation supervisor, and field inspector.

## 1.06 QUALITY ASSURANCE

- A. **Installer Qualifications:** Cabling installer must have personnel certified by BICSI on staff.
- B. **Layout Responsibility:** Preparation of Shop Drawings shall be under direct supervision of Technician.
- C. **Installation Supervision:** Installation shall be under direct supervision of Technician, who shall always be present when Work of this Section is performed at Project site.
- D. **Field Inspector:** Currently registered by BICSI as Technician to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.01 BACKBOARDS

- A. **Backboards:** A/C grade, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) plywood, fire-retardant treated, comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

### 2.02 RACKS

- A. **Manufacturers:** Subject to compliance with requirements.
- B. General Frame Requirements:
  1. **Distribution Frames:** Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  2. **Module Dimension:** Width compatible with ANSI/EIA-310-E standard, 19-inch (480-mm) panel mounting.
  3. **Finish:** Manufacturer's standard, baked powder coat.
- C. Floor-Mounted Racks:
  1. 84" high, modular-type, steel construction.
  2. 6 inch (150 mm) wide vertical cable management with metal hinged covers. Plastic removable covers are prohibited.
  3. Baked powder coat finish, black in color.

### 2.03 MODULAR WALL CABINETS

- A. Minimum 24" overall high x 24" wide x 24" deep, with 19-inch (482-mm) EIA-standard mounting rails. Cabinet capacity and depth shall be coordinated with active equipment to be housed.
- B. Steel construction.
- C. Treated to resist corrosion.
- D. Lockable front door and rear pivot frame.
- E. Louvered side panels.
- F. Cable access provisions top and bottom.
- G. Horizontal optical fiber cable management.
- H. Grounding lug.
- I. Roof-mounted, 250-cfm (118-L/s) fan.
- J. Horizontal power strip.

#### **2.04 MODULAR FREESTANDING CABINETS**

- A. Cabinet shall have overall dimension of 83-1/2" H x 30" W x 36" D.
- B. Welded or bolted heavy-gauge steel construction with minimum static load rating of 2,500 lbs.
- C. 14-gauge steel top and bottom panels.
- D. 19-inch (482-mm) wide 11-gauge adjustable rack-rails.
- E. 10-32 threaded holes on EIA standard spacing.
- F. Removable and lockable steel side panels.
- G. Hinged and lockable front Plexiglas and vented rear steel doors.
- H. Built-in 4.25-inch (108-mm) front vertical cable management with hinged covers.
- I. Adjustable feet for leveling.
- J. Cable access and conduit provisions in the roof and base.
- K. Grounding bus bar.
- L. Four (4) roof-mounted 4.5-inch (114-mm) fans.
- M. Vertical 20A power strip.
- N. Baked-polyester powder coat black finish.
- O. All cabinets keyed alike.

#### **2.05 OPTICAL FIBER HORIZONTAL CABLE MANAGEMENT FOR RACKS AND CABINETS**

- A. Metal, 3.5-inch-high (89-mm) (2RU) front, integral wire retaining fingers and hinged front cover. Plastic removable covers are prohibited.
- B. Baked-polyester black powder coat finish.
- C. Provide one (1) 2RU horizontal cable manager below each optical patch panel.



## 2.06 POWER STRIPS

- A. **Power Strips:** Equipment rack power strips shall be 125-volt, 20-amp, 3-wire, single-circuit type with 10 NEMA 5-20R single receptacle outlets on 6" centers.
1. Horizontal rack mounting.
  2. Ten, 20-A, 120-VAC, NEMA WD 6, Configuration 5-20R receptacles.
  3. LED indicator lights for power and protection status.
  4. LED indicator lights for reverse polarity and open outlet ground.
  5. **Circuit Breaker and Thermal Fusing:** When protection is lost, circuit opens and cannot be reset (or, where indicated, unit continues to supply power if protection is lost).
  6. Cord connected with 15-foot (4.5-m) line cord.
  7. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
  8. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449, 5th Edition, clamping voltage (VPR) for all 3 modes shall be not more than 330 V.

## 2.07 RACK MOUNT UPS

- A. **UPS:** Equipment UPS shall be Smart-UPS, Lithium-Ion, 3000VA, 120V with SmartConnect Port.
1. Horizontal rack mounting.
  2. Output power capacity: 2.7 kW / 2.88 kVA.
  3. Rack Height: 2U.
  4. Output Connections: (2) NEMA 5-20R (Battery Backup); (6) NEMA 5-15R (Battery Backup).
  5. Nominal Output Voltage: 120 V.
  6. Nominal Input Voltage: 120 V.
  7. Input Connections: NEMA L5-30P.
  8. Cord Length: 8.01 ft (2.4 m).

## 2.08 GROUNDING

- A. Comply with requirements in Division 27 Section "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Telecommunications Main Grounding Bus Bar:
1. **Connectors:** Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt non-twisting connection to ground bus bar.
  2. **Main Telecommunications Grounding Busbar (TMGB) [Primary Bonding Busbar (PBB) per ANSI/TIA-607-E]:** Copper, minimum 1/4-inch-thick by 4 inches wide (6 mm thick by 100 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.

3. **Telecommunications Grounding Busbar (TGB) [Secondary Bonding Busbar (SBB) per ANSI/TIA-607-E]:** Copper, minimum 1/4-inch-thick by 2 inches wide (6 mm thick by 50 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.
4. **Stand-Off Insulators:** Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Provide a TMGB (PBB) in the Main Equipment Room and a TGB (SBB) in each Telecommunications Room.
- D. Comply with ANSI/TIA-607-E.
- E. Comply with ANSI/NECA/BICSI-607-2011.

## 2.09 LABELING

- A. Comply with ANSI/TIA-606-D and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers. Reference sheet T-601 for Owner-approved labeling standard.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with NECA 1-2023.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual (TDMM), 15th Edition" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
  1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
  2. Record agreements reached in meetings and distribute them to other participants.
  3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
  4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

**G. Backboards:**

1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition" and ANSI/TIA-569-E.

**3.02 EQUIPMENT ROOM AND TR REQUIREMENTS**

- A. Provide ceiling-hung lighting with a wall switch at the door.
- B. Provide power to HVAC equipment.
- C. Provide dedicated 120-volt, 20-ampere circuits to duplex receptacles 48" AFF and 10' apart on the plywood backboards. Plywood backboards are by others.
- D. Provide dedicated 120-volt, 30-ampere circuits to NEMA L5-30R receptacles and provide dedicated 120-volt, 20-ampere circuits to power strips on the telecom equipment racks. See Standard Details.
- E. In rooms with DAS, ERRC, and Security equipment plywood backboards, provide two dedicated 120-volt, 20-ampere circuits to quad receptacles on each DAS backboard.
- F. Provide one 120-volt, 20-ampere normal power circuit to a duplex receptacle on the wall near the door.
- G. Coordinate all receptacle locations with Owner.
- H. Provide a copper ground bus bar where shown. Connect it to the unit substation room ground bus bar and to the ground bus bars in the receptacle panels feeding the telecom room receptacles. Ground cables shall be No. 6 AWG green insulated, stranded, copper. The resistance to building ground shall be 1 ohm maximum.

**3.03 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

**3.04 FIRESTOPPING**

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- B. Comply with ANSI/TIA-569-E, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition," "Firestopping Practices" chapter.

**END OF SECTION 27 11 00**

## SECTION 27 13 00

### COMMUNICATIONS BACKBONE CABLING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. Singlemode (OS2) 8.3/125-micrometer optical fiber cabling.
  - 3. Cable connecting hardware, patch panels, and cross-connects.
  - 4. Cabling identification products.

##### 1.03 DEFINITIONS

- A. **Cross-Connect:** A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. **EMI:** Electromagnetic interference.
- C. **IDC:** Insulation displacement connector.
- D. **LAN:** Local area network.
- E. **RCDD:** Registered Communications Distribution Designer.

##### 1.04 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.

##### 1.05 PERFORMANCE REQUIREMENTS

- A. **General Performance:** Backbone cabling system shall comply with transmission standards in ANSI/TIA-568.0-E, ANSI/TIA-568.1-E, and ANSI/TIA-568.3-E, when tested according to test procedures of this standard.

##### 1.06 ACTION 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, that are part of the cabling and asset identification system of the software.
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.

C. Sustainable Design Submittals.

**1.07 INFORMATIONAL SUBMITTALS**

- A. **Qualification Data:** For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. **Maintenance Data:** For splices and connectors to include in maintenance manuals.

**1.08 CLOSEOUT SUBMITTALS**

- A. Software and Firmware Operational Documentation:
  1. Software operating and upgrade manuals.
  2. **Program Software Backup:** On USB flash drive or via secure electronic delivery (cloud storage or SFTP) in a format specified by Owner, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.

**1.09 QUALITY ASSURANCE**

- A. **Installer Qualifications:** Cabling Installer must have personnel certified by BICSI on staff.
- B. **Layout Responsibility:** Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
- C. **Installation Supervision:** Installation shall be under the direct supervision of Level 2 Installer, who shall always be present when Work of this Section is performed at Project site.
- D. **Testing Supervisor:** Currently certified by BICSI as an RCDD to supervise on-site testing.
- E. **Testing Agency Qualifications:** An NRTL.

- F. **Testing Agency's Field Supervisor:** Currently certified by BICSI as an RCDD to supervise on-site testing.
- G. **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.
- H. **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.
- I. **Telecommunications Pathways and Spaces:** Comply with ANSI/TIA-569-E.
- J. **Grounding:** Comply with ANSI/TIA-607-E.

#### 1.10 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.

#### 1.11 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.

#### 1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### PART 2 - PRODUCTS

#### 2.01 PATHWAYS

- A. **General Requirements:** Comply with ANSI/TIA-569-E.
- B. **Cable Support:** NRTL labeled for support of 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.

#### 2.02 OPTICAL FIBER CABLE

- A. Singlemode Cable Elements (OS2) shall conform to the following specification:
1. 8.3-micron core diameter, 125-micron cladding diameter ( $\pm 1$  micron).
  2. Mode field diameter of between 8.7 and 9.3 (with  $\pm 0.5$  micron tolerance) at 1310 nm.
  3. Attenuation coefficient at 1310 nm of 1.0 dB/km or less.
  4. Attenuation coefficient at 1550 nm of 1.0 dB/km or less.
  5. Cladding non-circularity of  $\pm 1\%$ .
  6. Core to cladding concentricity error of no more than 0.8 micron.
  7. Maximum dispersion rate of 2.80 ps/nm-km at 1300 nm.
  8. Maximum dispersion rate of 17.00 ps/nm-km at 1550 nm.
  9. Individual glass elements proof tested at 100 kpsi (100,000 lb per square inch).
  10. Number of elements as indicated on the Drawings.
- B. **Backbone Optical Fiber Cable:** Cable shall be plenum rated (OFNP) for use as an internal cable in a plenum environment. The cable shall be tight-buffered construction with optical fibers contained within 900-micron color-coded buffers. The cable will be an all-dielectric construction, with a central strength member.
- C. **Internal/External Cable:** Provide internal/external optical fiber cable. The cable shall be riser rated (OFNR) for use as an internal cable in a non-plenum environment. The cable shall also be recommended by the manufacturer for use as an external cable suitable for installation in an underground duct. Optical fibers shall be contained within loose buffer tubes utilizing water blocking tapes or compounds surrounding these tubes. The cable will be an all-dielectric construction, with a central strength member.
- D. **External Cable:** Provide external optical fiber cable. The cable shall be recommended by the manufacturer for use as an external cable suitable for installation in an underground duct. Optical fibers shall be contained within loose buffer tubes utilizing water blocking tapes or compounds surrounding these tubes. The cable will be an all-dielectric construction, with a central strength member.
- E. Multimode Cable Elements (OM4) shall conform to the following specification:
1. 50/125-micrometer laser-optimized multimode optical fiber, compliant with ANSI/TIA-492AAAD and ISO/IEC 11801 OM4 classification.
  2. Effective Modal Bandwidth (EMB): Minimum 4700 MHz-km at 850 nm.
  3. Overfilled Launch Bandwidth: Minimum 3500 MHz-km at 850 nm; minimum 500 MHz-km at 1300 nm.
  4. Maximum attenuation: 3.0 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
  5. Aqua-colored outer jacket per ANSI/TIA-598-D.
  6. Cable shall support 10 Gigabit Ethernet to 550 m, 40/100 Gigabit Ethernet to 150 m, and Fibre Channel applications per ANSI/TIA-568.3-E.
- F. Multimode Cable Elements (OM5) shall conform to the following specification:

1. 50/125-micrometer wideband multimode optical fiber, compliant with ANSI/TIA-492AAAE and ISO/IEC 11801 OM5 classification.
  2. Effective Modal Bandwidth (EMB): Minimum 4700 MHz-km at 850 nm; minimum 2470 MHz-km at 953 nm.
  3. Maximum attenuation: 3.0 dB/km at 850 nm; 1.5 dB/km at 953 nm; 1.0 dB/km at 1300 nm.
  4. Lime-green colored outer jacket per ANSI/TIA-598-D.
  5. Cable shall support Shortwave Wavelength Division Multiplexing (SWDM) applications and shall be backward-compatible with OM4 system requirements per ANSI/TIA-568.3-E.
- G. LC/APC Connectors shall conform to the following specification:
1. Single-fiber LC connector with 8-degree angled physical contact (APC) endface for singlemode (OS2) applications, compliant with ANSI/TIA-604-10-D (FOCIS 10).
  2. Maximum insertion loss: 0.30 dB (typical 0.20 dB).
  3. Minimum return loss: 60 dB (APC).
  4. Connector body and boot color: Green, per ANSI/TIA-568.3-E identification scheme for APC connectors.
  5. Compatible with corresponding LC/APC adapters; shall not be intermateable with LC/UPC connectors.

## 2.03 OPTICAL FIBER CABLE HARDWARE

- A. Rack Mounted optical fiber patch panel, conforming to the following specification:
1. Each panel shall be suitable for installation in EIA 19" mounting frame.
  2. Provide strain relief for each cable at the rear of the patch panel.
  3. Allow for labeling of each individual connector.
  4. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.
  5. Each panel shall provide fiber handling for fiber elements, including 36" fiber reserve (service loop) inside the patch panel with no bends sharper than 2" bend radius.
  6. Provide blanking adapter plates to cover all unused spaces as necessary.

## 2.04 OPTICAL FIBER CONNECTORS

- A. **Singlemode Optical Fiber Connectors:** Provide singlemode duplex LC or SC optical fiber connectors as indicated on the Drawings, conforming to the following specifications. Where polarity is critical for inter-building or campus links, APC (angled physical contact, 8-degree polish) connectors shall be specified; UPC (ultra physical contact) connectors are acceptable for intra-building backbone where return-loss requirements permit. Mixing of UPC and APC mating ends is prohibited.



1. **Connector type:** Small form factor LC (preferred for high-density patch panels) or SC (acceptable where larger form factor is required for legacy compatibility), as indicated on the Drawings. Both shall comply with TIA-604-3 (FOCIS-3) for SC and TIA-604-10 (FOCIS-10) for LC.
2. Duplex, handling one pair (two elements) per connector.
3. Connector body color shall comply with TIA-598-D: blue for singlemode UPC; green for singlemode APC. Housing color shall match polish type to prevent inadvertent UPC/APC cross-mating.
4. Compatible with both 900-micron buffered strands and 250-micron loose tube strands.
5. Maximum insertion loss, of mated pair, less than 0.5 dB at acceptance.
6. Minimum return loss: 50 dB for singlemode UPC connectors; 60 dB for singlemode APC connectors. Multimode UPC connectors shall meet a minimum return loss of 20 dB.
7. Durability better than 500 matings, with a maximum increase in insertion loss of not more than 0.2 dB.
8. Meets ANSI/TIA-568.3-E and ISO/IEC 11801-1 standards.

## 2.05 PATCH CORDS

- A. **Optical Fiber:** Provide one optical fiber patch cord per optical fiber pair installed. These shall be sourced from the same manufacturer as the optical fiber connectors provided as a part of this project. Each cord shall meet or exceed the optical fiber performance specifications in this document.
1. 20% of the patch cords shall be 3 feet in length and yellow in color.
  2. 60% of the patch cords shall be 7 feet in length and yellow in color.
  3. 20% of the patch cords shall be 11 feet in length and yellow in color.
- B. The patch cords are to be passed to the Owner on completion of the project. Each cord is to have a manufacturer's certificate of conformance and shall be in its original, unopened packaging.

## 2.06 GROUNDING

- A. Comply with ANSI/TIA-607-E.

## 2.07 MPO/MTP ARRAY CONNECTORS AND POLARITY

- A. Where 12-fiber or 24-fiber array (MPO/MTP) connectivity is indicated on the Drawings, provide pre-terminated trunk cables, cassettes, and adapter panels conforming to TIA-604-5 (FOCIS-5) and the polarity requirements of ANSI/TIA-568.3-E. Array connectors shall be female (no pins) on trunks and male (with pins) on patch cords unless otherwise indicated.
- B. **Polarity Method:** System polarity shall be Method A, Method B, or Method C per ANSI/TIA-568.3-E, as indicated on the Drawings. Polarity method shall be uniform throughout the cabling system; mixing of polarity methods within a single channel is prohibited.

- C. Maximum mated-pair insertion loss for MPO/MTP connectors: 0.50 dB (standard loss) or 0.35 dB (low-loss) at acceptance, as required to meet the link loss budget.
- D. All MPO/MTP terminations shall be factory-terminated. Field termination of array connectors is not permitted.

## **2.08 OPTICAL SPLICES**

- A. Splices, where required, shall be fusion splices. Mechanical splices are not permitted unless approved in writing by the Owner for emergency restoration only.
- B. Maximum fusion splice insertion loss: 0.30 dB per splice for both singlemode and multimode fiber, measured bidirectionally per ANSI/TIA-568.3-E. Average splice loss across the project shall not exceed 0.10 dB.
- C. Splice closures and trays shall accommodate the cable diameter and fiber count specified, provide sufficient slack storage to permit re-splicing, and conform to Telcordia GR-771-CORE for outside plant applications.

## **2.09 OPTICAL FIBER LINK LOSS BUDGET**

- A. Calculate maximum permissible link attenuation per ANSI/TIA-568.3-E using:  $\text{Link Loss} = (\text{Cable Attenuation Coefficient} \times \text{Length}) + (\text{Number of Connector Pairs} \times 0.75 \text{ dB}) + (\text{Number of Splices} \times 0.30 \text{ dB})$ . Submit calculated link-loss budgets for each backbone link prior to installation. Cable attenuation coefficients used in the calculation shall be:
  - 1. Singlemode (OS2): 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm (inside plant); 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm (outside plant).
  - 2. Multimode OM4/OM5: 3.0 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
- B. Installed link attenuation, when measured per ANSI/TIA-526-7 (singlemode) and ANSI/TIA-526-14 (multimode), shall not exceed the calculated link loss budget.

## **2.10 IDENTIFICATION PRODUCTS**

- A. Comply with ANSI/TIA-606-D and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## **2.11 SOURCE QUALITY CONTROL**

- A. **Testing Agency:** Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to ANSI/TIA-568.3-E.
- C. Factory test singlemode optical fiber cables.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### **3.01 ENTRANCE FACILITIES**

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.02 WIRING METHODS

- A. **Wiring Method:** Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. 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 Section 26 05 33 "Raceway and Boxes for Electrical Systems."
- B. 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.

### 3.03 INSTALLATION OF PATHWAYS

- A. **Cable Trays:** Comply with NEMA VE 2 and ANSI/TIA-569-E.
- B. **Pathway Fill:** Limit conduit fill to 40 percent of internal cross-sectional area per ANSI/TIA-569-E. Limit cable tray fill to 50 percent of internal cross-sectional area, calculated based on cable diameters, and reserve a minimum of 25 percent additional capacity for future moves, adds, and changes.
- C. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 27 11 00 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- D. Comply with ANSI/TIA-569-E for pull-box sizing and length of conduit and number of bends between pull points.
- E. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- F. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- G. 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.
- H. **Backboards:** Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.04 INSTALLATION OF CABLES

- A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with ANSI/TIA-568.0-E and ANSI/TIA-568.1-E.
  2. Comply with BICSI ITSIMM, 8th edition, Ch. 6, "Cable Termination Practices."
  3. Install 110-style IDC termination hardware unless otherwise indicated.
- C. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
- D. 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.
- E. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- F. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, 8th edition, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
- G. 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.
- H. **Cold-Weather Installation:** Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
- I. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
- J. **Pulling Cable:** Comply with BICSI ITSIMM, 8th edition, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- K. Optical Fiber Cable Installation:
1. Comply with ANSI/TIA-568.3-E.
  2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- L. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- M. 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.
- N. Group connecting hardware for cables into separate logical fields.

O. Separation from EMI Sources:

1. Comply with BICSI TDMM, 15th edition, and ANSI/TIA-569-E 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).

**3.05 FIRESTOPPING**

- A. Comply with ANSI/TIA-569-E, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, 15th edition, "Firestopping Systems" Article.

**3.06 GROUNDING**

- A. Install grounding per BICSI TDMM, 15th edition, "Grounding, Bonding, and Electrical Protection" Chapter.

- B. Comply with ANSI/TIA-607-E.
- 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.

### 3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with ANSI/TIA-606-D.
- B. **Administration Class:** Class 2 or Class 3 per ANSI/TIA-606-D, as applicable to the Project scope. Class 2 administration applies to premises served by a single equipment room or main distributor and includes identification of telecommunications spaces, cabling, pathways, grounding/bonding, and firestopping. Class 3 administration applies to premises served by multiple buildings on a single site (campus) and includes all Class 2 elements plus identification of buildings and outside plant elements.
- C. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- D. Comply with requirements in Section 09 91 23 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- E. Paint and label colors for equipment identification shall comply with ANSI/TIA-606-D for the Class of administration specified for the Project (Class 2 or Class 3).
- F. **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.
- G. **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, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- H. 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.

5. 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.
6. Label each unit and field within distribution racks and frames.
- I. **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.
- J. 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 ANSI/TIA-606-D. Cable labels use flexible vinyl or polyester that flexes as cables are bent.

### 3.08 FIELD QUALITY CONTROL

- A. **Testing Agency:** Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Visually inspect 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 ANSI/TIA-568.3-E.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568.3-E, ANSI/TIA-526-14 (multimode), and ANSI/TIA-526-7 (singlemode). Perform tests with a tester that complies with performance requirements in the "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in the "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- D. General Instructions:
  1. The testing is to show beyond reasonable doubt that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled, and that all the installed components meet or exceed the criteria detailed in these specifications and applicable standards. Any test that does not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modification shall be submitted for approval of the Owner's Representative, prior to the tests being conducted.
  2. Following optical fiber and data cable installation, including labeling and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Installer shall carry out any additional tests that the Installer

deems necessary to ensure the satisfactory operation of the telephone and data systems. The costs of these additional tests shall be borne by the Installer.

3. All outlets, cables, patch panels, and associated components shall be fully assembled and labeled prior to testing. Any testing performed on incomplete systems shall be redone on completion of the work.
4. Provide the Owner's Representative with the opportunity to witness all testing. On reasonable request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.
5. Complete and record all of the tests identified in these specifications.
6. Notify the Owner's Representative ten working days before the date of commencement of the cable tests. Provide details in writing, on that advance date, of proposed tests, the test schedule, equipment to be used, its certification and calibration, and the names and qualifications of test personnel.
7. The Owner and Owner's Representative shall be invited to the first instance of each type of test conducted. In the event of a number of tests being conducted by the Installer prior to this first inspection, the Owner's Representative reserves the right to reject these tests as non-compliant and to require them to be repeated at the Installer's cost.
8. Personnel shall be competent in and qualified by experience or training for comprehensive OTDR operation and troubleshooting, for both copper and optical fiber testing.
9. Include the cost of obtaining, calibrating, and maintaining test equipment and the cost of carrying out and recording the tests detailed in this specification, including labor costs, in the bid sum. No extra costs will be entertained.
10. Ensure that all test equipment is in calibration before delivery to site and throughout the testing period. The Installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's calibration status is carried out. Any tests performed on uncalibrated test equipment shall be repeated at the Installer's cost.
11. The test documentation shall be available for inspection by the Owner's Representative during the installation period and copies shall be passed to the Owner's Representative within five working days of completion of tests on cables in each area. The Installer shall retain a copy to aid preparation of as-built information.
12. Failures detected during the testing shall be noted on the test results schedule, rectified, and re-tested. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.
13. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs, replacing damaged connectors, or remaking poor terminations. In-line cable joints, splices, or distribution points will not be acceptable except where specified in this document. All damaged cables shall be removed from site.
14. If on submittal of the As-Built documentation there are any missing test results or incorrectly named files, the test shall be repeated at the Installer's expense.



- E. Test Report Format and Deliverables:** Submit all test results in the test instrument manufacturer's native electronic format (such as Fluke Networks LinkWare, VIAVI FiberChekPRO, or EXFO FastReporter) on USB flash drive or via secure electronic delivery, accompanied by a PDF summary report. Each record shall include the cable identifier per ANSI/TIA-606-D, test date, technician name, instrument make/model and calibration date, reference method used, wavelength tested, measured length, measured insertion loss, calculated link loss budget, and pass/fail result. Retain native files for the duration of the cabling system warranty period.
- F. Optical Fiber Cabling:**
1. Test each Optical Fiber Cable and its associated connectors. Carry out the following tests on every element of every optical fiber cable:
    - a. Length.
    - b. End-to-End Attenuation.
    - c. Connector Loss.
    - d. Splice Loss.
    - e. Power Loss.
  2. The tester shall have the following parameters:
    - a. Optical Time Domain Reflectometer (OTDR) shall be used to test every optical fiber cabling.
    - b. OTDR shall be used to test optical in both directions and take the average. Provide a launch lead and far-end drop-off lead.
    - c. Singlemode optical fibers shall be tested at 1310 nm and 1550 nm.
  3. Test each optical fiber cable element and its associated connectors. Carry out the following test on every element of every optical fiber cable:
    - a. Visually check optical connectors using microscope (minimum magnification  $\times 200$ ) to ensure that no physical damage has occurred during the installation process. There are to be no scratches on the core of the fiber or pits on the core or cladding. If any defect cannot be rectified with polishing, the connector is to be replaced.
    - b. Carry out OTDR tests on all elements at 1310 nm for singlemode. These tests shall be carried out from both ends using a near-end launch lead and a far-end drop lead.
    - c. The number of samples (averages) for each OTDR test shall be such that the noise amplitude is significantly less than the smallest loss of any component under test. This may vary for different cable runs; for shorter runs and fusion splices, it may be necessary to run many samples.
    - d. Record the length and loss of each mated connector pair on the test results schedule for all elements.
    - e. Verify the labeling of the cable and connectors is correct.
    - f. If an element has an excessive attenuation coefficient, a sudden step in attenuation coefficient (greater than 0.2 dB) or back scatter, losses due to

micro bending or macro bending, or has any other fault, then the fault on that element shall be rectified.

- G. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted like Table 10.1 in BICSI TDMM, 15th edition, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- H. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- I. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- J. Prepare test and inspection reports.
- K. The attenuation of each singlemode connector shall be measured in both directions.
- L. Each fusion splice shall be tested in both directions for singlemode elements. The measurements for each direction shall be averaged for the final attenuation figure for each fusion splice.
- M. The return loss must be measured in both directions for singlemode connectors. The return loss shall be greater than or equal to the value shown in the project pass/fail table.
- N. Any failures shall be recorded (including value of excessively lossy terminations) and the results obtained after rectification of the fault shall be recorded.
- O. Graphical printouts shall be taken of OTDR tests for each element. These printouts shall be stapled or otherwise attached to 11" × 8.5" size sheets. They shall be printed at an appropriate scale, such as 0.5 dB per division for the attenuation axis. Provide diskette copies of the OTDR traces to the Owner on completion of the testing. Provide a copy of the emulation software and the appropriate license to the client.

**END OF SECTION 27 13 00**

## SECTION 27 15 00

### COMMUNICATIONS HORIZONTAL CABLING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
  - 1. Section 27 05 26 — Grounding and Bonding for Communications Systems.
  - 2. Section 27 05 28 — Pathways for Communications Systems.
  - 3. Section 27 11 00 — Communications Equipment Room Fittings.
  - 4. Section 07 84 13 — Penetration Firestopping.

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Category 6/6A unshielded twisted-pair (UTP) horizontal cabling.
  - 2. Optical fiber horizontal/zone cabling: singlemode (OS2) and, where indicated on Drawings, multimode (OM4) for in-building runs.
  - 3. Multiuser Telecommunications Outlet Assemblies (MUTOA).
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Telecommunications outlets/connectors.
  - 6. Modular Plug Terminated Link (MPTL) assemblies for direct-connect devices.
  - 7. Cabling system identification and labeling products.
  - 8. Cable management products supporting the horizontal cabling system.

##### 1.03 DEFINITIONS

- A. **Consolidation Point (CP):** A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- B. **Cross-Connect:** A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. **DCRU:** DC Resistance Unbalance, a parameter measured within and between pairs to confirm balanced power delivery for PoE applications, per ANSI/TIA-568.2-E.
- D. **EMI:** Electromagnetic interference.
- E. **HCP:** Horizontal Connection Point, an optional interconnection point for non-work-area devices (e.g., wireless access points, surveillance cameras, building system devices) per ANSI/TIA-568.0-E.

- F. **IDC:** Insulation Displacement Connector.
- G. **LAN:** Local Area Network.
- H. **MPTL:** Modular Plug Terminated Link, a horizontal cable terminated to a field-terminable modular plug on one end, connecting directly to a powered or data device, recognized in ANSI/TIA-568.2-E.
- I. **MUTOA:** Multiuser Telecommunications Outlet Assembly, a grouping in one location of several telecommunications outlets/connectors.
- J. **Outlet/Connector:** A connecting device in the work area on which horizontal cable or outlet cable terminates.
- K. **Permanent Link:** The horizontal cable and its connecting hardware between the patch panel/cross-connect and the work-area outlet, used as the test reference per ANSI/TIA-568.2-E.
- L. **PoE:** Power over Ethernet, delivery of DC power over balanced twisted-pair cabling concurrent with data, per IEEE 802.3af, 802.3at, and 802.3bt (Types 1 through 4, up to 90 W at the Powered Device).
- M. **RCDD:** Registered Communications Distribution Designer (BICSI).
- N. **TR:** Telecommunications Room (current ANSI/TIA-568/606-D term; replaces legacy terms “telecommunications closet” and “wiring closet,” and the historical IDF designation).
- O. **UTP:** Unshielded Twisted Pair.

#### 1.04 REFERENCE STANDARDS

- A. Comply with the latest editions of the following at the time of bid:
  - 1. ANSI/TIA-568.0-E — Generic Telecommunications Cabling for Customer Premises.
  - 2. ANSI/TIA-568.1-E — Commercial Building Telecommunications Infrastructure Standard.
  - 3. ANSI/TIA-568.2-E — Balanced Twisted-Pair Telecommunications Cabling and Components Standard (Oct 2024; consolidates D-1 balun requirements and D-2 power-delivery / Annex H content).
  - 4. ANSI/TIA-568.3-E — Optical Fiber Cabling and Components Standard.
  - 5. ANSI/TIA-569-E (and Addendum 1) — Telecommunications Pathways and Spaces.
  - 6. ANSI/TIA-598-D (and Addenda 1, 2) — Optical Fiber Cable Color Coding (including OM5 jacket color).
  - 7. ANSI/TIA-606-D — Administration Standard for Telecommunications Infrastructure.
  - 8. ANSI/TIA-607-E — Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
  - 9. ANSI/TIA-862-C — Structured Cabling Infrastructure Standard for Intelligent Building Systems (where applicable to building-system devices).

10. BICSI Telecommunications Distribution Methods Manual (TDMM), 15th Edition.
11. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.
12. NECA/BICSI 568 — Standard for Installing Commercial Building Telecommunications Cabling.
13. NECA 1 — Standard for Good Workmanship in Electrical Construction.
14. NFPA 70 — National Electrical Code (NEC).
15. NFPA 262 — Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
16. UL 444 — Communications Cables; UL 1666 — Riser Test; UL 969 — Marking and Labeling Systems; UL 1651 — Optical Fiber Cable.
17. IEEE 802.3af / 802.3at / 802.3bt — Power over Ethernet, Types 1 through 4.
18. IEC 60512-99-002 — Connector Test for Un-mating Under Electrical Load (PoE arc).
19. ASTM E 84 — Surface Burning Characteristics of Building Materials.
20. ANSI/NEMA WC 66 (ICEA S-116-732) — Performance Standard for Category 6 and 6A Premise Telecommunications Cables.
21. ICEA S-83-596 — Standard for Optical Fiber Premises Distribution Cable.

#### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications, network, security, and audiovisual stakeholders, and with service providers terminating at the entrance facility.
- B. Coordinate telecommunications outlet/connector locations with the location of power receptacles at each work area; provide one duplex receptacle within 12 inches (300 mm) of each outlet location unless Drawings indicate otherwise.
- C. **Pre-Installation Conference:** Schedule prior to commencing Work to review cable routing, pathway separation from EMI sources, fire-stop methods, labeling scheme, and field-test plan.

#### 1.06 ACTION SUBMITTALS

- A. **Product Data:** For each type of product, including cable, connecting hardware, faceplates, jacks, patch panels, MPTL plugs, fiber connectors, and labeling products. Include manufacturer's component- and channel-level performance data demonstrating compliance with ANSI/TIA-568.2-E and ANSI/TIA-568.3-E.
- B. Shop Drawings:
  1. Cabling administration drawings showing TR locations, backbone pathways, horizontal pathways, work-area outlet locations, and labeling convention per ANSI/TIA-606-D.
  2. Rack and patch-panel elevations indicating mounting positions, port assignments, and cable management.

3. Wiring schematics including cross-connects, patch panels, MPTL device end-points, and consolidation/horizontal connection points.
  4. MPTL schedule listing each device served, cable ID, plug type, PoE class served, and tested permanent-link length.
- C. **System Labeling Schedules:** Electronic copies, in software and format selected by Owner, that match the cable and asset identification system used by the cable management software in Part 2.

#### 1.07 INFORMATIONAL SUBMITTALS

- A. **Qualification Data:** For Installer, layout RCDD, installation supervisor, and field-testing supervisor.
- B. **Manufacturer Certifications:** Documentation that the Installer is currently certified by the system manufacturer (e.g., Legrand/Ortronics or Siemon) at the level required to issue the manufacturer's 25-year system performance warranty.
- C. Source quality-control reports for cable received at the Project site.
- D. Field quality-control reports, including the complete field-test record (electronic and printed) and DCRU test results for PoE-served links.

#### 1.08 CLOSEOUT SUBMITTALS

- A. **Maintenance Data:** For splices, connectors, patch panels, fiber hardware, and labeling products, to include in maintenance manuals.
- B. **Manufacturer's System Performance Warranty:** Executed warranty document(s) from the cabling system manufacturer covering products, performance, and applications assurance for a minimum of twenty-five (25) years from the date of Substantial Completion. Warranty registration number and certificate to be transmitted to Owner.
- C. As-Built Cabling Administration Drawings and final labeling schedules in electronic form, with the cable and asset-management software reflecting installed conditions.
- D. Software and Firmware Operational Documentation:
  1. Operating and upgrade manuals for any cable-management software provided.
  2. Program software backup delivered electronically (USB flash drive or Owner-designated cloud storage) in a non-proprietary format with data files.
  3. Device address list and printout of software application and graphic screens.

#### 1.09 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials matching products installed, packaged with protective covering and identified with labels describing contents:
  1. **Patch-Panel Units:** Quantity equal to 5 percent of each type installed, but not less than one of each type.
  2. **Connecting Blocks, Jacks, and Modular Inserts:** Quantity equal to 10 percent of each type installed, but not less than five of each type.
  3. **Device Plates and Blanking Inserts:** Quantity equal to 5 percent of each type installed, but not less than five of each type.

4. **Multiuser Telecommunications Outlet Assemblies:** One of each type per 25 installed, but not less than one of each type.
5. **Patch Cords:** 10 percent of each length and color installed, but not less than ten of each.
6. **Fiber Connectors:** 5 percent of each type installed, but not less than five of each type.

#### 1.10 QUALITY ASSURANCE

- A. **Installer Qualifications:** A firm with documented experience in projects of comparable size and scope, and that holds current manufacturer certification at the level required to issue the manufacturer's 25-year system performance warranty (e.g., Legrand Certified Installer / Siemon Certified Installer or approved equal).
- B. **Installation Personnel:** Installation shall be under the direct supervision of a BICSI-credentialed Technician (TECH) or, at minimum, a BICSI Installer 2 (Copper and/or Optical Fiber, as applicable to the media being installed), present on site whenever Work of this Section is being performed.
- C. **Layout Responsibility:** Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program by a BICSI Registered Communications Distribution Designer (RCDD).
- D. **Testing Supervisor:** Currently certified by BICSI as an RCDD or DCDC to supervise on-site testing.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at the Project site:
  1. Test each pair of UTP cable for opens and shorts.
  2. Verify factory test results on optical fiber cable; reject reels that exhibit damage or fail attenuation requirements.
- B. Store cable indoors in original packaging; protect from moisture, dirt, and physical damage. Maintain cable temperature within manufacturer's recommended range prior to installation.
- C. **Cold-Weather Handling:** Bring cable to a minimum of 50°F (10°C) for at least 24 hours before installation. Heat lamps or open flame shall not be used for warming cable.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS / SYSTEM REQUIREMENTS

- A. **Single-Source Responsibility:** All Category 6 copper components (and the Category 6A components serving wireless access points) (cable, jacks, patch panels, patch cords, MPTL plugs, and accessories) and all optical fiber connectivity components (cable, connectors, panels, patch cords) shall be supplied by a single end-to-end system manufacturer to qualify the installation for the manufacturer's 25-year system performance warranty. Mixing of manufacturers within a channel is not permitted.

B. Acceptable System Manufacturers (Basis-of-Design):

1. Legrand / Ortronics — Clarity 6 Category 6 UTP system; Clarity Cat 6 patch panels (e.g., PHA66U24/PHA66U48 angled, PHD66U24/PHD66U48 flat); Clarity 6 jacks (TJ600/HDJ6 series); Clarity 6A Category 6A UTP cable and TJ6A00/HDJ6A jacks for wireless access point drops only; Infinium / Clarity fiber panels; Field Term plugs for MPTL, with Legrand 25-year System Performance Warranty.
2. Siemon — Z-MAX 6 UTP system (Z6 jacks, Z6 patch panels, Z-MAX 6 modular cords); MAX 6 (MX6-F02 outlets, HD6 patch panels) as an alternative; Z-MAX 6A UTP (Z6A-02 outlets) for wireless access point drops only; Z-PLUG field-terminable plug for MPTL; LightSystem / XGLO fiber connectivity, with Siemon 25-year Cabling System Warranty.
3. Approved equal end-to-end manufacturer (e.g., Panduit TX6 PLUS / Mini-Com, CommScope SYSTIMAX GigaSPEED XL, Belden REVConnect 2400) submitted in accordance with Section 01 60 00.

- C. All components shall be Category 6 performance level (or higher) and shall be center-tuned by the manufacturer to deliver matched channel performance. Category 6A cable and connecting hardware shall be used for wireless access point drops only; all other horizontal drops shall be Category 6.

## 2.02 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cabling and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect in the Telecommunications Room. This combination is referred to as the “permanent link” and is the basis for field testing.
- B. Per ANSI/TIA-568.1-E, provide a minimum of two telecommunications outlet/connectors at each work area unless otherwise indicated. Per ANSI/TIA-568.0-E, provide a minimum of two Category 6A horizontal cable runs to each wireless access point.
- C. **Topology:** Star, with each work-area outlet served by a single horizontal cable from the serving TR.
- D. Horizontal cabling shall contain no more than one transition point, consolidation point, or horizontal connection point between the cross-connect and the outlet/connector. Bridged taps and splices shall not be installed in horizontal cabling.
- E. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components from the outlet/connector to the station equipment.
- F. **Maximum allowable horizontal copper cable length:** 295 ft (90 m) for the permanent link, with up to 33 ft (10 m) total of patch/equipment cords for a 328 ft (100 m) channel. Lengths shall be derated per ANSI/TIA-568.2-E, Annex H, for elevated ambient temperature and bundle size when carrying PoE.

## 2.03 PERFORMANCE REQUIREMENTS

- A. **General Performance:** Horizontal cabling system shall comply with the transmission performance of ANSI/TIA-568.2-E and ANSI/TIA-568.3-E, including DC resistance



unbalance (DCRU) requirements newly extended to Category 5e, 6, and 6A links and channels.

- B. **Surface-Burning Characteristics:** ASTM E 84, tested by a qualified 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. **Bonding and Grounding:** Comply with ANSI/TIA-607-E and Section 27 05 26.

## 2.04 UTP CABLE (CATEGORY 6 AND CATEGORY 6A)

- A. Category 6 UTP cable shall be used for all data, voice (VoIP), IP surveillance camera, and IP-based building system drops, including drops served via MPTL. Category 6A UTP cable shall be used for wireless access point drops only.
- B. **Construction:** 100-ohm, four-pair, 23 AWG (typical) solid bare copper conductors, individually twisted and surrounded by an overall jacket; pair separator (cross-web/spline) sized for Category 6 performance; Category 6A cable for wireless access point drops shall additionally be constructed for alien-crosstalk control.
- C. Performance and Standards Compliance:
  - 1. ANSI/TIA-568.2-E, Category 6 (component- and channel-rated), including DCRU specifications for PoE; Category 6A for wireless access point drops.
  - 2. ANSI/NEMA WC 66 (ICEA S-116-732) for mechanical properties.
  - 3. ISO/IEC 11801, Class E equivalent (Class EA for wireless access point drops).
- D. **Listing:** Listed and labeled by an NRTL acceptable to authorities having jurisdiction (AHJ) as complying with UL 444 and NFPA 70 for the following types:
  - 1. Communications Plenum (CMP), complying with NFPA 262, in all environmental air-handling spaces and plenum ceilings.
  - 2. Communications Riser (CMR), in vertical riser pathways where plenum is not required.
  - 3. Communications General-Purpose (CM/CMG), only where neither plenum nor riser ratings are required by NFPA 70 and the AHJ.
- E. **Jacket Color:** Coordinate with Owner. Suggested service-based color scheme (subject to Owner approval):
  - 1. White
- F. **Modular Plug Terminated Link (MPTL):** Where installation of an outlet, faceplate, and equipment cord at a device (e.g., wireless access point, surveillance camera, digital signage, ceiling- or wall-mounted IoT/BAS device) is impractical, an MPTL configuration per ANSI/TIA-568.2-E is acceptable, subject to the following:
  - 1. MPTL plugs shall be the system manufacturer's field-terminable plug rated for solid-conductor 22–23 AWG cable and rated for the highest IEEE 802.3bt PoE

class served (Type 3 / Type 4 capable, including IEC 60512-99-002 un-mating-under-load compliance).

2. Test MPTL links per the Permanent Link configuration of ANSI/TIA-568.2-E, Annex F, using a Permanent Link Adapter at the near end and a single Patch Cord test adapter at the far end.
3. Coordinate all MPTL device locations with Owner and indicate on Drawings.

## 2.05 UTP CABLE HARDWARE

### A. General Requirements for Connecting Hardware:

1. Comply with ANSI/TIA-568.2-E. IDC-type terminations, with modules designed for punch-down using the manufacturer's specified tool.
2. Cables shall be terminated only with connecting hardware of the same category or higher.
3. Connecting hardware serving PoE devices shall comply with the un-mating-under-load requirements of IEC 60512-99-002 to prevent contact damage from arcing under Type 3 and Type 4 PoE loads.

### B. **Patch Panels:** Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups.

1. Mount in standard EIA 19-inch racks; 24- or 48-port density (1 RU and 2 RU respectively typical).
2. ETL Verified to ANSI/TIA Category 6 component specification (Category 6A for panels serving wireless access point drops).
3. Universal T568A/T568B wiring; either the T568A or T568B pinout may be used as selected per Article 2.05.C below.
4. Center-tuned to manufacturer's patch cords for matched channel performance.
5. Provide rear cable management bar and strain relief at each cable termination.
6. Each port shall be labelable; ports shall be individually replaceable without disturbing adjacent terminations.
7. Number of jacks per field: one for each four-pair UTP cable indicated, plus spares and blank positions adequate for indicated expansion.
8. Acceptable products include Legrand Clarity 6 (PHA66U\_\_\_/PHD66U\_\_\_ series), Siemon Z-MAX 6 (Z6 panels) UTP, or approved equal. For wireless access point terminations, provide Legrand Clarity 6A (PHA6AU\_\_\_/PHD6AU\_\_\_ series) or Siemon Z-MAX 6A (Z6A panels) UTP, or approved equal.

### C. Jacks and Jack Assemblies:

1. Modular, color-coded, eight-position (8P8C) modular receptacles with integral IDC terminals.
2. Performance: Component-compliant Category 6 per ANSI/TIA-568.2-E. Jacks serving wireless access point drops shall be component-compliant Category 6A, alien-crosstalk verified.

3. Pinout: Either the T568A or T568B wiring scheme is acceptable per ANSI/TIA-568.2-E. Obtain written direction from the Owner selecting the scheme prior to first termination; the selected scheme shall be applied consistently throughout the Project.
4. Jack body color shall be coordinated with Owner; jacks shall accept manufacturer's standard icon/label inserts.
5. Acceptable products include Legrand Clarity 6 jacks (TJ600/HDJ6 series), Siemon Z-MAX 6 UTP outlet (Z6-02 or equivalent), or approved equal. For wireless access point drops, provide Legrand Clarity 6A jacks (TJ6A00/HDJ6A series), Siemon Z-MAX 6A UTP outlet (Z6A-02 or equivalent), or approved equal.

D. Patch Cords:

1. Factory-terminated, factory-tested, manufacturer-matched Category 6 patch cords (Category 6A for wireless access point ports) with stranded conductors and snag-resistant boots.
2. Lengths: 3, 5, 7, 10, and 14 ft as required; furnish 100% port population at completion plus 10% spares.
3. **PoE Conductor Sizing:** For devices operating above 30 W (IEEE 802.3bt Type 3 or Type 4), patch cords shall be 22 AWG to 26 AWG. 28 AWG patch cords, although recognized by ANSI/TIA-568.2-E, shall not be used for PoE Type 3 or Type 4 service unless coordinated in writing with Owner and applied within the bundle-size and ambient-temperature derating limits of ANSI/TIA-568.2-E, Annex H.
4. Field-terminated patch cords are not acceptable.

## 2.06 POWER OVER ETHERNET (POE) REQUIREMENTS

- A. **General:** All Category 6 and Category 6A horizontal channels shall support IEEE 802.3bt Types 1 through 4 (up to 90 W at the Powered Device). Components and installation methods shall meet the remote-powering requirements of ANSI/TIA-568.2-E, Annex H, including:
1. DC Resistance Unbalance (DCRU) within pairs and between pairs.
  2. Connector un-mating-under-load performance per IEC 60512-99-002.
  3. Cable bundle size and ambient-temperature derating per Annex H.
- B. **Cable Bundling and Heat Dissipation:** Bundle sizes, pathway fill, and ambient conditions shall comply with ANSI/TIA-568.2-E, Annex H, and ANSI/TIA-569-E. Where high-density PoE (Type 3 or Type 4) is deployed:
1. Bundle sizes shall not exceed 24 cables, or shall be verified for the PoE load and ambient temperature per Annex H.
  2. Maintain spacing between bundles to promote heat dissipation.
  3. Reduce maximum permanent-link length in accordance with the Annex H derating tables for ambient temperatures above 20°C (68°F).
- C. **Field Testing:** In addition to standard permanent-link transmission tests, perform DCRU testing within and between pairs, per ANSI/TIA-568.2-E, on every horizontal

link intended to carry PoE Type 3 or Type 4 loads. Include results in the field quality-control report.

## 2.07 OPTICAL FIBER CABLE

- A. **Singlemode (OS2):** 9/125- $\mu$ m tight-buffered, dielectric (nonconductive), with a minimum 2-fiber count (coordinate final fiber count with Owner). Bend-insensitive (G.657.A1 or A2) where indicated.
- B. **Multimode (OM4):** 50/125- $\mu$ m laser-optimized, where indicated on Drawings for in-building runs. Aqua jacket per ANSI/TIA-598-D.
- C. Standards Compliance:
  - 1. ICEA S-83-596 for mechanical properties.
  - 2. ANSI/TIA-568.3-E for transmission performance.
  - 3. ANSI/TIA-598-D for color coding.
- D. **Listing:** Listed and labeled by an NRTL acceptable to AHJ as complying with UL 444, UL 1651, and NFPA 70 for the following types as applicable:
  - 1. General Purpose, Nonconductive: OFN or OFNG.
  - 2. Plenum Rated, Nonconductive: OFNP, complying with NFPA 262.
  - 3. Riser Rated, Nonconductive: OFNR, complying with UL 1666.
  - 4. Conductive cable shall be steel-armored type, listed as OFC, OFCG, OFCP (NFPA 262), or OFCR (UL 1666) as applicable.
- E. Jacket:
  - 1. Color per ANSI/TIA-598-D: yellow for OS2 singlemode, aqua for OM4, lime green for OM5 (where indicated).
  - 2. Imprinted at intervals not exceeding 40 in. (1000 mm) with fiber count, fiber type, and aggregate length.

## 2.08 OPTICAL FIBER CABLE HARDWARE

- A. **Cross-Connects and Patch Panels:** Modular rack-mount panels housing duplex (or higher density) fiber connectors. Provide fiber-management features including bend-radius control, splice-tray accommodation, and pull-out service trays.
- B. Connectors:
  - 1. Comply with ANSI/TIA-568.3-E and applicable Fiber Optic Connector Interchangeability Standards (FOCIS).
  - 2. Type LC quick-connect, simplex and duplex; insertion loss not to exceed 0.75 dB per mated pair (coordinate with Owner if lower-loss SMF connectors, including SC/APC, are required for outside-plant or PON applications).
  - 3. Type SFF connectors may be used in high-density termination panels and equipment housings.
- C. **Patch Cords:** Factory-made, dual-fiber jumpers, manufacturer-tested, in 36-inch (900-mm) lengths typical; coordinate other lengths with Owner. Fiber type and connector type to match panel and equipment.

## 2.09 WORK AREA FACEPLATES

- A. **Wall-Mounted Faceplate:** Flush modular faceplate to house work-area jacks, capable of housing a minimum of four jacks; fits over a standard NEMA 2-gang outlet box with single-gang plaster-ring cover; white unless otherwise directed by Owner.
- B. **Blanking Inserts:** Matching blank inserts to fill all unused jack openings.
- C. **Stainless Steel Wall-Phone Faceplate:** Stainless steel flush modular faceplate sized for a single jack and configured to mount a wall telephone directly over the plate.
- D. **Furniture Faceplate:** Flush-mounted modular plate sized for the modular raceway provided in the furniture system.
- E. **Stainless Steel Decorative Faceplate:** Provide stainless steel covers in locations where decorative wall outlets are required, including all locations where stainless steel power receptacles are provided.
- F. **Floor-Box Faceplate:** Internal modular bracket from the floor-box manufacturer, designed to fit the flush floor box installed under this Project, and configured to house the indicated combinations of work-area connectors.

## 2.10 GROUNDING

- A. Comply with Section 27 05 26 "Grounding and Bonding for Communications Systems."
- B. Comply with ANSI/TIA-607-E for telecommunications bonding and grounding (earthing).

## 2.11 IDENTIFICATION PRODUCTS

- A. Comply with ANSI/TIA-606-D and UL 969 for labeling materials, label stocks, laminating adhesives, and inks.
- B. Provide labels for all connectors, cables, outlets, termination frames, patch panels, cabinets, and racks.
- C. Label characteristics:
  - 1. Machine-printed; hand-written labels are not acceptable.
  - 2. Lettering as large as practical for the field of application; high-contrast text per ANSI/TIA-606-D.
  - 3. Robust and durable: abrasion-resistant, UV-inhibiting, indelible, and rated for service to 140°F (60°C).
  - 4. Cable labels shall be flexible vinyl or polyester capable of flexing as cables are bent; orientation shall be uniform throughout the Project.
- D. Outlet, Jack, and Patch-Panel Labeling Convention:
  - 1. Format: TRX-PPY-ZZ (Telecommunications Room – Patch Panel – Port).
  - 2. Example: TR4-PPC-29 (TR 4, Patch Panel C, Port 29).
  - 3. TR identifier may be omitted only where a single TR serves a given floor.

4. Cable jacket label and outlet label shall match the assigned port label at the TR end.

## **2.12 SOURCE QUALITY CONTROL**

- A. UTP cables shall be 100% factory-tested by the manufacturer for compliance with ANSI/TIA-568.2-E, Category 6 (Category 6A for wireless access point cable).
- B. Optical fiber cables shall be 100% factory-tested for attenuation per ANSI/TIA-568.3-E.
- C. Cable that does not pass tests and inspections is considered defective. Prepare and submit test and inspection reports.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine pathways, telecommunications rooms, and work-area conditions for compliance with the requirements of ANSI/TIA-569-E and Section 27 05 28. Verify that pathway temperature, humidity, EMI separation, fill, and bend-radius conditions support the cabling specified.
- B. Proceed only after deficiencies have been corrected.

### **3.02 ENTRANCE FACILITIES**

- A. Coordinate horizontal cabling with the protectors and demarcation point provided by the communications service provider.

### **3.03 WIRING METHODS**

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
- B. Install plenum-rated cable in environmental air-handling spaces, including plenum ceilings.
- C. Comply with Section 27 05 28 "Pathways for Communications Systems."
- D. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- E. Wiring within Enclosures:
  1. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's bend-radius limitations.
  2. Install lacing bars and distribution spools to organize cable.
  3. Run conductors parallel with or at right angles to the sides and back of the enclosure.

### **3.04 INSTALLATION OF CABLES**

- A. Comply with NECA 1, NECA/BICSI 568, and the BICSI ITSIMM, 8th Edition.
- B. General Requirements for Cabling:

1. Comply with ANSI/TIA-568.0-E, ANSI/TIA-568.1-E, ANSI/TIA-568.2-E, and ANSI/TIA-568.3-E.
2. Comply with the BICSI ITSIMM 8th Edition "Cable Termination Practices" chapter.
3. **Termination Method:** For Category 6 and Category 6A data cabling, terminate horizontal cables directly to modular (8P8C) jacks and patch panels using the system manufacturer's specified IDC termination method (110-style or manufacturer's proprietary lacing system, e.g., Siemon Z-Tool / Legrand 110 IDC) and termination tool. Maintain cable geometry and pair twist per ANSI/TIA-568.2-E. Do not mix termination systems within a single cross-connect field; coordinate with Owner prior to installation.
4. **Untwist Limit:** Do not untwist UTP cables more than 1/2 inch (13 mm) from the point of termination.
5. **Jacket Strip:** Strip back outer jacket only the minimum required by the manufacturer's termination instructions; do not nick or score conductor insulation.
6. **Bend Radius:** Maintain a minimum bend radius of 4 times the cable outer diameter for unloaded UTP cable and 8 times the OD when subjected to pulling tension. For optical fiber, maintain manufacturer's minimum bend radius (loaded and unloaded).
7. **Pulling Tension:** Do not exceed 25 lbf (110 N) for four-pair UTP cable; monitor pull tension on long pulls. Comply with the BICSI ITSIMM "Pulling Cable" chapter.
8. **Splices:** Cables may not be spliced. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels. No cable shall contain unterminated elements.
9. **Support and Suspension:** Support open cables at intervals not exceeding 60 in. (1524 mm) using J-hooks, bridle rings, or cable trays designed for low-voltage cable. Use no support method that compresses or distorts the cable jacket. Cable supports shall be independent of ceiling support wires, ductwork, piping, conduit, and electrical raceways.
10. **Distance from Ceiling:** Suspend UTP cable not in a wireway or pathway a minimum of 8 in. (200 mm) above accessible ceilings.
11. Secure cables at intervals not exceeding 30 in. (760 mm) and not more than 6 in. (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
12. **Lacing Bars:** Install lacing bars and distribution spools to restrain cables, prevent strain on connections, and prevent over-bending.
13. **Service Loops:** In each TR, leave a 10-foot (3 m) service loop on each end of cable, neatly coiled in cable management or above the rack.
14. **Damaged Cable:** Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable damaged during installation; replace with new cable.
15. **Cold-Weather Installation:** Bring cable to room temperature before dereeling. Heat lamps shall not be used.

- C. MUTOA shall not be used as a cross-connect point.
- D. Consolidation Points (CP) and Horizontal Connection Points (HCP):
1. CPs may be used only for direct connection to telecommunications outlets/connectors. Do not use a CP as a cross-connect, patch connection, or direct connection to workstation equipment.
  2. Locate CPs for UTP at least 49 ft (15 m) from the communications equipment room.
  3. HCPs may be used in lieu of CPs to support Cabling Subsystem 1 topologies for non-work-area devices (wireless access points, surveillance cameras, digital signage, BAS devices) per ANSI/TIA-568.0-E and ANSI/TIA-862-C. HCPs are subject to the same restrictions as CPs and shall not be used for cross-connection.
  4. Coordinate CP and HCP locations and the count of devices served from each with Owner; show on Drawings.
- E. Optical Fiber Cable Installation:
1. Comply with ANSI/TIA-568.3-E.
  2. Terminate fiber on rack- or cabinet-mounted connecting hardware. Provide bend-radius protection at all panel entries and exits, and within fiber-management raceway.
  3. Inspect every connector end-face under a 200X (or higher) fiber inspection scope and clean using approved dry/wet-dry cleaners until all end-faces meet IEC 61300-3-35 acceptance criteria before mating.
- F. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in TRs with terminating hardware and interconnection equipment.
  2. Cable shall not be run through structural members or in contact with pipes, ducts, or other items that may damage the cable.
- G. Cable Routed Exposed Under Raised Floors:
1. Install plenum-rated cable only.
  2. Install cabling after the access-floor system is installed.
  3. Coil cable 6 ft (1800 mm) long not less than 12 in. (300 mm) in diameter below each feed point.
  4. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
1. Comply with the BICSI TDMM, 15th Edition, and ANSI/TIA-569-E for separation of unshielded copper communication cabling from potential EMI sources, including electrical power lines and equipment.
  2. Open Cabling vs. Unshielded Power Conductors / Equipment:
    - a. < 2 kVA: minimum 5 in. (127 mm).
    - b. 2 to 5 kVA: minimum 12 in. (300 mm).



- c. > 5 kVA: minimum 24 in. (610 mm).
- 3. Communications Cabling in Grounded Metallic Raceway vs. Unshielded Power:
  - a. < 2 kVA: minimum 2-1/2 in. (64 mm).
  - b. 2 to 5 kVA: minimum 6 in. (150 mm).
  - c. > 5 kVA: minimum 12 in. (300 mm).
- 4. Communications Cabling in Grounded Metallic Raceway vs. Power in Grounded Metallic Conduit/Enclosure:
  - a. < 2 kVA: no requirement.
  - b. 2 to 5 kVA: minimum 3 in. (76 mm).
  - c. > 5 kVA: minimum 6 in. (150 mm).
- 5. Maintain a minimum 48 in. (1200 mm) separation from electric motors and transformers rated 5 kVA / HP and larger.
- 6. Maintain a minimum 5 in. (127 mm) separation from fluorescent or LED-driver fixtures and ballasts.

### 3.05 FIRESTOPPING

- A. Comply with Section 07 84 13 "Penetration Firestopping."
- B. Comply with ANSI/TIA-569-E, Annex A "Firestopping," and the BICSI TDMM, 15th Edition, "Firestop Systems" chapter, for all penetrations of fire-rated walls, floors, and ceilings by communications cabling and pathways.
- C. Use only listed firestop systems matching the rated assembly being penetrated; document each penetration with location and UL System number on the as-built drawings.

### 3.06 GROUNDING

- A. Install grounding per the BICSI TDMM, 15th Edition, "Bonding and Grounding (Earthing)" chapter, and ANSI/TIA-607-E.
- B. Locate the grounding busbar (TGB/TBB) to minimize the length of bonding conductors. Mount with at least 2-in. (50 mm) clearance from the wall. Connect the busbar to suitable building electrical ground using not smaller than No. 4 AWG grounding electrode conductor.
- C. Bond all metallic equipment (racks, cabinets, cable trays, ladder rack, sleeves) to the grounding busbar using not smaller than No. 6 AWG equipment grounding conductor.

### 3.07 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with ANSI/TIA-606-D.
- B. **Administration Class:** Class 2 per ANSI/TIA-606-D, appropriate for a single building served by multiple TRs. Coordinate with Owner if a higher class is required for campus or multi-site integration.
- C. Color-code cross-connect fields. Apply colors to voice/data backboards, connections, covers, and labels.

- D. Develop Cabling Administration Drawings using the cable-management software specified in Part 2; assign a unique alphanumeric designation to each cable and label cables, jacks, connectors, and terminals to which they connect with the same designation. At completion, the cable- and asset-management software shall reflect as-built conditions.
- E. Comply with Section 09 91 23 "Interior Painting" for backboard finishes; do not paint over fire-rating labels on plywood.
- F. **Cable Schedule:** Post in a prominent location in each TR, listing incoming and outgoing cables with designations, origins, and destinations. Protect with a rigid frame and clear plastic cover. Furnish electronic copies of all final schedules.
- G. **Cabling Administration Drawings:** Show building floor plans with cabling administration-point labeling. Identify the labeling convention and show labels for TRs, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding busbars and pathways, and equipment grounding conductors.
- H. Cable and Wire Identification:
  - 1. Label each cable within 4 in. (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - 3. Individually number wiring conductors connected to terminal strips; identify each cable or wiring group extending from a panel or cabinet to a building-mounted device with the name and number of the device(s) shown.
  - 4. Label each unit and field within distribution racks and frames.
  - 5. Where similar jacks and plugs are used for both voice and data communication cabling, use a different jack/plug color for each service.
  - 6. Uniquely identify and label work-area cables extending from a MUTOA to the work area; cable length shall not exceed the length stated on the MUTOA label.

### 3.08 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency or factory-authorized service representative to perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. Visually inspect UTP materials for NRTL listing markings.
  - 2. Visually inspect cabling terminations for compliance with the selected pinout (T568A or T568B, as selected for the Project) and ANSI/TIA-568.2-E.
  - 3. Visually confirm Category 6 markings (Category 6A at wireless access point drops) of outlets, cover plates, jacks, and patch panels.
  - 4. Visually inspect cable placement, terminations, grounding/bonding, equipment, patch cords, and labeling of all components.
- C. Test Instruments:

1. Field testers shall be Level IIIe (or higher) accuracy, currently calibrated by the manufacturer (within 12 months), and shall implement the test-instrument requirements of ANSI/TIA-568.2-E.
  2. Use only test cords and adapters qualified by the test-equipment manufacturer for permanent-link or channel testing.
  3. MPTL links shall be tested per ANSI/TIA-568.2-E, Annex F, using a Permanent Link Adapter at the near end and a single Patch Cord test adapter at the far end.
- D. UTP Performance Tests — test 100% of links per ANSI/TIA-568.2-E:
1. Wire map.
  2. Length (physical and electrical).
  3. Insertion loss.
  4. Near-end crosstalk (NEXT) loss and Power Sum NEXT (PSNEXT).
  5. Equal-level far-end crosstalk (ELFEXT) and Power Sum ELFEXT (PSELFEXT).
  6. Return loss.
  7. Propagation delay and delay skew.
  8. DC Resistance Unbalance (DCRU) within and between pairs, on every horizontal link intended to carry IEEE 802.3bt PoE Type 3 or Type 4 loads.
  9. Alien-crosstalk (PSANEXT and PSAACRF) sample testing on a minimum of 1% of installed links (or 6 links per TR, whichever is greater) where 10GBASE-T is to be supported, in accordance with ANSI/TIA-568.2-E.
- E. Optical Fiber Performance Tests — per ANSI/TIA-568.3-E:
1. **Tier 1:** Bidirectional insertion-loss (Optical Loss Test Set, encircled-flux compliant for multimode), length, and polarity verification on every fiber.
  2. **Tier 2 (where indicated):** Bidirectional OTDR traces of every fiber.
  3. Singlemode fibers: test at 1310 nm and 1550 nm in both directions.
  4. Multimode fibers (where present): test at 850 nm and 1300 nm in both directions.
  5. Connector end-face inspection per IEC 61300-3-35 prior to mating; documented before final acceptance.
- F. Final Verification Tests:
1. **Voice (VoIP/SIP):** Verify as part of Data Tests below: register a test handset or softphone with the call-control platform, place a test call, and verify two-way audio. Where legacy analog (POTS) lines are retained at the demarcation point, connect to the network interface device, verify dial tone, and complete a test call where a test number is available. Coordinate scope of voice testing with Owner based on services provisioned.
  2. **Data:** Coordinate with Owner's IT staff for connectivity to a live switch port. For a representative sample of outlets directed by Owner, verify: (a) link establishment at the negotiated speed (up to 10GBASE-T where Category 6A is specified); (b) assignment to the correct VLAN(s); (c) DHCP address acquisition or static addressing per Owner's plan; (d) LLDP/CDP neighbor discovery where

supported; and (e) for PoE-served devices (wireless access points, surveillance cameras, IP phones, sensors), successful power negotiation at the required IEEE 802.3bt Type/Class and stable device operation under load.

G. Documentation:

1. Submit complete test results in both electronic native-format files (e.g., .flw, .lts, or equivalent) and printed summary reports.
2. Reports shall identify the tested link by its ANSI/TIA-606-D label, include date, technician, instrument serial number, calibration date, and PASS/FAIL status with margin to the worst-case parameter.
3. Failed links shall be repaired and retested until they pass; document corrective action.

H. End-to-end cabling that does not pass tests and inspections is considered defective.

### **3.09 CLEANING AND PROTECTION**

- A. Clean fiber connector end-faces using approved dry- or wet-dry-clean processes, and inspect with a fiber scope per IEC 61300-3-35 before each mating.
- B. Remove dust, debris, and packaging materials from racks, cabinets, and TRs at completion of work and prior to Owner walk-through.
- C. Protect installed cabling, racks, and patch panels from damage by other trades until Substantial Completion.

### **3.10 DEMONSTRATION AND TURNOVER**

- A. Provide a project closeout walk-through with Owner reviewing as-built drawings, labeling, test results, and the manufacturer's warranty registration.
- B. Train Owner's designated personnel (minimum two hours) on the cable-management software, label scheme, and procedure for ordering matching components for adds, moves, and changes.

**END OF SECTION 27 15 00**

## SECTION 27 21 00

### DATA COMMUNICATIONS NETWORK EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. All provisions of Division 00 and Division 01 apply to all work in Division 27 and Division 28.

##### 1.02 SCOPE OF WORK

- A. All Bidders shall have an established SPIN number from the federal government in order to participate in any E-Rate funding opportunities for the project. This can be obtained through USAC at <http://www.usac.org/sl/service-providers/>.
- B. Provide a main rack-mounted file server including OS software. Mount server in server cabinet provided under Section 27 11 00. Coordinate server and cabinet.
- C. The building core / aggregation switch is existing or Owner-furnished and is NOT provided under this Section. Provide edge / access switches in the MER to activate all wired data jacks served directly from the MER, and provide, install, label, and test all fiber and copper uplink jumpers between the switches furnished under this Section and the Owner-furnished core switch. Coordinate the available uplink port type, speed, and quantity on the Owner-furnished core switch with the Owner prior to submittal. Copper station ports shall provide 1000BASE-T as the standard port speed, with all ports serving wireless access points furnished as multi-gigabit (HPE Smart Rate / IEEE 802.3bz NBASE-T) ports supporting 2.5GBASE-T and 5GBASE-T auto-negotiation; additional multi-gigabit ports shall be provided as indicated on Drawings for high-bandwidth endpoints. Drawings shall drive multi-gigabit port counts per closet. IEEE 802.3bt Type 3 (60W, PoE Class 6) PoE shall be provided on all PoE ports, auto-sensing to connected devices.
- D. Provide a stacked, full Layer 3-capable switch system in each wiring closet to activate each wired data jack terminated in each wiring closet (including the outlets served directly from the main wiring closet). Access tier switches shall provide both wire-speed Layer 2 switching and full Layer 3 routing services as specified herein, supporting routed-access designs, distributed default gateway, and Dynamic Segmentation role-based forwarding per Section 27 21 33 coordination. Provide fiber uplinks from each switch stack to the Owner-furnished core switch in the MER in the quantity and at the speed specified in Article 2.04.
- E. Provide PoE+ enabled ports in each wiring closet switch to activate wired data jacks terminated in wiring closet (including the outlets served directly from the main wiring closet).
- F. UTP patch cables to connect network electronics to station cable patch panels in each wiring closet are furnished under Section 27 15 00. This contract shall be responsible for installing and labeling all patch cables from patch panels to network electronics.

- G. This contract shall be responsible for providing, installing, and labeling all required fiber jumpers and copper patch cables to connect network electronics to the fiber backbones and to the Owner-furnished core switch.
- H. Online UPS units to support network electronics as described herein and as shown on the contract documents.
- I. Network management software with licenses for all equipment installed under this project.
- J. Programming of each switch to coordinate with the Owner's LAN and WLAN Network Operating System configuration and requirements including establishing parameters and operations associated with QoS, CoS, VLANs, WLAN, etc.
- K. The systems and equipment installed shall be of the latest revision and of the latest technology. The data systems shall serve the building, as well as satellite buildings located throughout the Owner for the foreseeable future, and shall be able to grow as the Owner grows.
- L. Provide and install all labor, tools, materials, and accessories for a complete Data Network LAN comprised of switch components as listed.
- M. The Contractor shall furnish and install switches:
  - 1. Install in appropriate rack.
  - 2. Connect to UPS.
  - 3. Patch to associated patch panel.
  - 4. Label (coordinate labeling with Owner/Architect).
- N. The Contractor shall demonstrate to the Owner and Engineer that the system is complete and complies with all operational requirements set forth in the plans and specs. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.
- O. The Contractor shall review all plans and specifications for any detail that may impact the installation of the system. Any discrepancies discovered shall be brought to the attention of the Engineer prior to installation.
- P. The data network and all its components shall be installed so that access is provided to all components for general maintenance and repair.
- Q. The new data network equipment shall connect to various wide-area connections and interface types. The Contractor shall make all necessary arrangements with the Local Service Provider(s) to provide all connections to the WAN well in advance of project close-out. WAN connections shall be routed through the MC.
- R. The Contractor shall provide and configure all the equipment required for connecting the data network to the wide-area network.
- S. The Contractor shall ensure the data network is compatible with any routers, gateways, and firewall provided by others/Owner.
- T. The data network electronics may be used to support voice traffic. Configure the system to meet all requirements of a voice system.

- U. The Contractor shall work with the Owner to develop a patching scheme for all devices attached to the data network.
- V. The Contractor shall be responsible for patching all devices from the patch panel(s) to the network equipment and any patching between the network electronics.
- W. Contractor shall coordinate with the Installation Company providing patch cables under 27 15 00 and the Owner on color schemes and lengths of patch cables.
- X. In these specifications the words "data network," "data system," "network electronics," and "electronics" shall be interchangeable and shall refer to the data network system and electronics and all its components.

### 1.03 SYSTEM DESCRIPTION

- A. Section Includes:
  - 1. Edge / Access Switches.
  - 2. KVM Switch.
  - 3. RADIUS Server.
- B. The "Contractor," as referred to in these specifications, shall be the bidder whose bid is eventually chosen as the winner.
- C. The "Engineer," as referred to in these specifications, shall be BCL and its representative on this project.
- D. The "Owner," as referred to in these specifications, shall be the project owner and its representative on this project.
- E. In the detailed specifications and on the contract drawings, the phrases "or equivalent," "approved equivalent," "approved equal," "or equal," and "engineer approved equivalent" shall be used interchangeably and shall mean the same thing.
- F. All equals, equivalents, or alternates shall be approved by the Engineer prior to ordering or installation. Without approval, deviation from the products listed in the specifications and on the drawings shall be presumed to be nonconforming and shall be removed and replaced at the direction of the Engineer and at the Contractor's expense.
- G. The network electronics shall provide full-duplex, auto-sensing 1000BASE-T UTP Ethernet ports for wired data jacks. The edge / access switches shall provide wire-speed Layer 2 switching and full hardware-based Layer 3 routing (static and dynamic IP routing, IPv4 and IPv6, ACLs, VRF where required), enabling routed-access topologies, distributed gateway, and policy-driven role-based forwarding.
- H. PoE-capable switches shall provide IEEE 802.3bt Type 3 (60W PSE, PoE Class 6) compliant PoE on all provided PoE ports simultaneously. Switches shall be backward-compatible with IEEE 802.3af (PoE) and IEEE 802.3at (PoE+) devices. Devices requiring more than 60W per port shall be served by a listed midspan power injector, or by IEEE 802.3bt Type 4 (90W, Class 8) capable ports where specifically indicated on Drawings.
- I. The network electronics shall provide software management capabilities such as Virtual LANs (VLANs), multilevel access security, and group management protocol. Software management shall be web-based and utilize a standard web browser.

VLAN trunks shall be capable of being created from any port on any switch using IEEE 802.1Q standards-based tagging. The edge / access switches shall provide full Layer 2 and full Layer 3 switching and routing.

- J. The network electronics shall provide features associated with Quality of Service (QoS) and Class of Service (CoS) as well as port-based prioritization. The QoS shall be based upon IEEE 802.1.

#### **1.04 QUALITY ASSURANCE**

- A. All equipment shall be UL listed.
- B. All equipment and installation practices shall comply with the latest ANSI/NFPA-70 National Electrical Code.
- C. All equipment installation practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises Standard (current revision ANSI/TIA-607-E, 2024).
- E. All equipment and installation practices shall comply with the latest BICSI Telecommunications Distribution Methods Manual (TDMM), current revision 15 (2024).
- F. All equipment shall comply with the latest ANSI/TIA-568 series (current E revisions, including ANSI/TIA-568.2-E), ANSI/TIA-569-E, ANSI/TIA-606-D, ANSI/TIA-607-E, and ANSI/TIA-862-C standards and all Technical Service Bulletins (TSB).
- G. All work applicable shall conform to the following standards:
  - 1. IEEE 802.3-2022 (current revision, with applicable amendments), Standard for Ethernet.
  - 2. NERC CIP (Critical Infrastructure Protection) Standards, CIP-002 through CIP-014, where applicable to the Owner's operating environment.
- H. The system shall comply with all FCC Rules and Regulations.
- I. All materials furnished under this contract shall be new, of highest quality, and shall be of a regularly manufactured line currently in production at the time of installation. All switch components shall be of a single manufacturer.

#### **1.05 CONTRACTOR QUALIFICATIONS**

- A. The network electronics system shall be furnished, installed, and programmed by a contractor who meets all the requirements listed herein. It shall not be acceptable for the contractor to utilize a sub-contractor for any portion of the work, unless the sub-contractor has been approved in writing by the Engineer based upon adherence to the qualifications listed herein.
- B. The Contractor shall maintain a fully equipped, factory-certified service organization capable of providing full maintenance and service of the installed system within 24 hours. This facility shall be available for inspection by the Engineer.
- C. The Contractor shall employ factory-trained service personnel for the service and maintenance of the system.



- D. The Contractor shall have a minimum of 1 year experience with the specified network electronics. This experience shall include having completed a minimum of 2 installations in the past 12 months of similar size and scope. The Contractor shall provide references and contact information for the project sites in which the qualifying installations occurred.

#### 1.06 SHOP DRAWINGS AND SUBMITTALS

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Drawings shall be prepared and submitted electronically in PDF format and, if hard copies are requested, on 30" × 42" bond paper. Equipment lists, data sheets, etc. shall be 8-1/2" × 11" size properly bound into a single or multiple volumes.
- B. Submit to the following for approval:
1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.
  2. Manufacturer's data sheets on all equipment items.
  3. System block diagram(s).
  4. Equipment rack layouts showing all rack-mounted equipment items.
  5. **PoE Power Budget Calculation:** For each switch and switch stack, showing total connected PoE load at worst case (all PoE ports drawing maximum rated power per device class), installed PSU capacity, and headroom margin. Installed PSU capacity shall exceed worst-case connected load by a minimum of 20%. Include this calculation for both normal operation and with one PSU failed (N+1 redundancy scenario).
  6. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.
- C. **Final Documentation:** All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Within 45 days after completion of the work, deliver to the Owner four (4) sets of the following:
1. A complete as-installed equipment list, listed by room, with manufacturer's names, model numbers, serial numbers, and quantities of each item.
  2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers, layouts, and other designations and codings.
  3. Complete equipment rack layouts showing all rack-mounted equipment items.
  4. Operations instructions for each major item of equipment furnished.
  5. Manufacturer's warranty for each major item of equipment furnished.
  6. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their

relationship to system function. This manual shall be bound separately and labeled appropriately.

## **1.07 COORDINATION**

- A. Coordinate the location of the data network electronics and racks with the Electrical Contractor for placement of electrical connections.
- B. Coordinate the configuration of the data network electronics for compatibility with WAN connections, addressing, and routing.
- C. Coordinate UPS and Power Strip locations with other trades for placement of electrical connections.
- D. Coordinate all UPS and Power Strip input connectors with electrical contractor.
- E. Coordinate with the Network Integrators such that the UPS units are communicating with the network utilizing their SNMP cards or IP-based web monitoring.

## **1.08 STORAGE OF MATERIALS**

- A. All materials shall be secured when not in use by the Contractor.
- B. It shall be the Contractor's responsibility to secure all equipment including all material to be installed as part of the contract. No changes shall be made to the contract due to loss or theft of equipment and materials not officially accepted by the Owner.

## **1.09 SYSTEM WARRANTY**

- A. The Local Area Network Electronics software shall be warranted by the Contractor for a period of three (3) years from date of Substantial Completion.
- B. Provide advanced replacement for all Network Electronics for the three (3) year period.

## **1.10 RELATED WORK BY OTHERS**

- A. All conduit with pull strings, all electrical pull boxes, and all outlet boxes shall be furnished and installed under the electrical section of Division 26. Coordinate as necessary for proper installation. All conduit systems shall be insulated from the equipment racks using non-metallic bushings or raceways.
- B. All power conductors and conduits associated with power circuits to all equipment locations shall be furnished and installed under the electrical section of Division 26. The power to the equipment racks shall be terminated inside the racks to Contractor-supplied isolated ground plugstrips or quad convenience outlets. All conduit systems shall be insulated from the equipment racks using non-metallic bushings or raceways.
- C. An insulated #6 AWG stranded copper ground wire from each equipment rack to the building main service ground.

## **PART 2 - PRODUCTS**

### **2.01 PRODUCT EQUIVALENCY**

- A. Where products are listed with multiple manufacturers, these manufacturers will be approved as equals if all specified features are provided. Any equipment not

specifically approved in writing prior to the bid date will not be considered regardless of qualifications. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate equipment at the Contractor's expense.

- B. Different manufacturers may require various options, accessories, converters, patch cables, etc. to perform the specified features and functions. Therefore, all material and/or equipment necessary for proper operation of the system shall be deemed part of these specifications.

## **2.02 SYSTEM REQUIREMENTS**

- A. The Contractor shall be required to fully review the existing infrastructure prior to cutover to the new system.
- B. The Contractor shall verify that space is available in existing racks/cabinets for all new network electronics equipment.
- C. All network equipment shall mount in standard 19" relay racks or cabinets.
- D. The overall intent of the data network is to provide a high-speed Ethernet-based system for connecting all the users to their applications, files, and the Internet while providing management of all aspects of the user connectivity via a network management system (NMS).
- E. All electronics provided for the system shall be from the same manufacturer and shall be fully supported by the management system provided by the Contractor.
- F. In each communications room, the equipment shall be directly connected to a ground bar ground in the building. Follow manufacturer's recommendations for grounding.

## **2.03 MANUFACTURERS — DATA NETWORK**

- A. Approved Vendors for Data Network Equipment:
  - 1. HPE Aruba Networking (basis of design — see Article 2.04).
  - 2. Cisco.
  - 3. Extreme.
- B. Basis of Design: HPE Aruba Networking CX 6300M Series switches running AOS-CX, as further specified in Article 2.04 Edge / Access Switch. Products of the other manufacturers listed above will be considered as equals only where they demonstrate feature-for-feature equivalency with the basis of design and the requirements of Article 2.04, and are approved in writing by the Engineer prior to ordering.

## **2.04 EDGE / ACCESS SWITCH — MER AND TR**

- A. Basis of Design: HPE Aruba Networking CX 6300M Series (AOS-CX), in the port counts, PoE classes, and uplink configurations indicated on Drawings. Specific model and SKU selection shall be made by the Contractor to satisfy the requirements of this Article and shall be documented in submittals; model numbers shall be verified against the manufacturer's current ordering guide at time of bid. Equivalent products by the other manufacturers listed in Article 2.03 will be considered only as provided in Article 2.03. The basis of design assumes the following characteristics, all of which are requirements of this Section:

1. Fixed-configuration, 1U, stackable Layer 3 switches; 24-port and 48-port models as indicated on Drawings.
  2. HPE Smart Rate multi-gigabit copper ports (1 GbE / 2.5 GbE / 5 GbE, IEEE 802.3bz) with auto-negotiation on all ports serving wireless access points and on additional ports serving high-bandwidth endpoints as indicated on Drawings.
  3. PoE Class 6 (IEEE 802.3bt Type 3, 60W per port) available simultaneously on all PoE ports, with the installed PoE budget verified by the PoE power budget calculation required under Article 1.06.
  4. Integrated SFP56 fiber uplink ports supporting 1 / 10 / 25 / 50 Gbps optics.
  5. Redundant, hot-swappable power supplies (N+1) and hot-swappable fan trays.
  6. Virtual Switching Framework (VSF) stacking supporting a minimum of eight (8) stack members, ring topology, and In-Service Software Upgrade (ISSU).
  7. Manufacturer limited lifetime hardware warranty, in addition to the Contractor warranty required under Article 1.09.
- B. All switch ports shall be 1000BASE-T minimum. Ports serving wireless access points, and additional ports indicated on Drawings, shall be multi-gigabit (1 GbE / 2.5 GbE / 5 GbE Smart Rate per IEEE 802.3bz) with auto-negotiation. 10GBASE-T copper station ports are not required under this Section.
- C. Each switch stack shall provide sufficient fiber uplink ports for full-duplex connections to the Owner-furnished core switch in the MER over the installed fiber optic cable backbone and backbone patch cables as indicated on Drawings and as specified herein. Uplink optics shall be matched to the port type available on the Owner-furnished core switch and to the installed fiber type (multimode or singlemode); verify both with the Owner prior to submittal.
- D. Uplink configuration: Provide a minimum of two (2) fiber uplinks per switch stack, aggregated via IEEE 802.3ad / LACP and, where the Owner-furnished core switch supports it, terminated on separate core line cards or stack members for resiliency. Uplink speed shall be 25 Gbps per link where supported by the Owner-furnished core switch; 10 Gbps per link is the minimum acceptable where 25 Gbps is not available. Provide provisions for a future increase to four (4) uplinks per stack as an Owner-directed option. Coordinate uplink quantity, speed, and optic type with the Owner prior to submittal.
- E. PoE-capable edge switches shall provide IEEE 802.3bt Type 3 (60W PSE, PoE Class 6) compliant PoE on all provided PoE ports simultaneously, and shall be backward-compatible with IEEE 802.3af and IEEE 802.3at devices. Devices requiring more than 60W per port shall be served by a listed midspan power injector, or by IEEE 802.3bt Type 4 (90W, Class 8) capable ports where specifically indicated on Drawings. Drawings shall drive multi-gigabit and high-power port counts per switch stack.
- F. Layer 3 Capabilities: Edge / access switches shall provide full hardware-based Layer 3 routing in addition to wire-speed Layer 2 switching. Required Layer 3 features:
1. **IPv4 and IPv6 unicast routing:** Static routing on all units; dynamic routing via OSPFv2 (IPv4) and OSPFv3 (IPv6) at minimum; BGP support shall be available

either out of the box or via standard licensed feature set, where required by Owner topology.

2. **Multicast routing:** PIM-SM and PIM-SSM, IGMPv2/v3 snooping and querier, MLDv1/v2 for IPv6 multicast, in support of streaming, AV, and IoT applications.
  3. **VLAN and SVI capacity:** Minimum 4,000 active VLANs supported; minimum 256 Switch Virtual Interfaces (SVIs / routed VLAN interfaces) per stack to support per-role and per-segment routing; jumbo frames (9216 bytes minimum) supported.
  4. **First-hop redundancy and resilience:** VRRP (RFC 5798) for redundant default gateway services; gateway stickiness shall be configurable to align with active forwarding members of the stack.
  5. **Access control and segmentation:** IPv4 and IPv6 access control lists (ACLs) at line rate; downloadable user/role ACLs supplied by RADIUS or NAC platform per Article 2.06 Unified Policy Enforcement; VRF-Lite or full VRF support for tenant/segment isolation where Owner topology requires.
  6. **DHCP and address services:** DHCP relay (DHCPv4 and DHCPv6), DHCP snooping, IP Source Guard, Router Advertisement Guard for IPv6, and ND inspection.
  7. **Quality of Service:** Layer 2 (802.1p) and Layer 3 (DSCP) classification, marking, queuing, and shaping; minimum 8 hardware queues per port; trust boundary configuration consistent across access tier; coordinate marking scheme with Owner UC platform per Section 27 21 33.
  8. **Topology:** Design shall be Owner-selected: traditional Layer 2 access with default gateway at distribution/core (acceptable for smaller deployments) OR routed-access design with default gateway at the access switch and dynamic routing to the core (preferred for resilience and Dynamic Segmentation). Where Owner selects routed-access, all access switches in scope shall participate in the chosen routing protocol with appropriate authentication.
- G. Redundant, hot-swappable power supplies (N+1 minimum), sized to maintain the full connected PoE load with any single power supply failed.
- H. Single switching fabric across the stack. Switching fabric shall be minimum full wire speed for all connected switches in the stack.
- I. The switch operating system shall provide full Layer 2 and full Layer 3 switching and routing services. Layer 2 features including VLAN trunks, rapid spanning tree, 802.1Q link aggregation, IGMP multicast, and QoS/CoS. Layer 3 features including static IP routing, IP multicast, IGMP, IP routing protocols, IPv6. Hardware-based IPv6.
- J. Port-based QoS encompassing classification, scheduling, and marking (QoS, ToS): including per-port configuration and strict priority queuing.
- K. Multicast management including hardware-based PIM and IGMP server.
- L. Flash memory to enable future software and hardware upgrades without taking the switch offline.

- M. Remote management via web-based graphical user interface (HTTPS), SSH, and SNMPv3. Telnet and unencrypted SNMP (v1/v2c) shall be disabled.
- N. SSH, Ethernet-based SNMPv3, and HTTPS web-based GUI remote management interface.
- O. Stacking interconnect shall provide a minimum of 100 Gbps of stacking bandwidth per stack member in a ring topology, such that failure of any single stack link or stack member does not disrupt traffic between the remaining members.
- P. All switchports must support 802.1X and MAC Authentication Bypass (MAB).

## 2.05 NETWORK MANAGEMENT MODULE

- A. Provide network management software module and all required support software/servers to provide Owner-wide, network-enabled, secure remote management of all switches, routers, etc. provided under this contract. License shall allow for a minimum of 2 concurrent seats.

## 2.06 UNIFIED POLICY ENFORCEMENT, DYNAMIC SEGMENTATION, AND LINK-LAYER ENCRYPTION

- A. Switches shall support consistent identity-based policy enforcement across wired and wireless access, coordinated with Section 27 21 33 Data Communications Wireless Access Points. Feature names below use HPE Aruba Networking terminology; approved equivalents from Cisco (Catalyst + ISE with TrustSec / SGT), Juniper (EX + Mist), or other approved manufacturers shall provide equivalent functionality.
- B. **Dynamic Segmentation / Role-Based Access Control:** Switches shall support dynamic assignment of network access roles based on client authentication (MAC-Auth, 802.1X with EAP-TLS preferred, or device-profile-based), with role-to-VLAN or role-to-policy mapping administered centrally. Where Aruba AOS-CX switches are furnished, Dynamic Segmentation shall be enabled using either VLAN-based enforcement (downloadable role VLANs) or User-Based Tunneling (UBT) to an Aruba Gateway cluster per Owner selection. For equivalent manufacturers, comparable wired policy enforcement (e.g., Cisco TrustSec with Security Group Tags and ISE policy matrix) shall be provided.
- C. **NAC Integration:** Access switches shall integrate with the Owner's Network Access Control (NAC) platform where provided by Owner (e.g., HPE Aruba Networking ClearPass Policy Manager, Cisco ISE, Forescout, or Owner-approved equivalent) for authentication, authorization, device profiling, posture assessment where supported, and dynamic role/VLAN assignment via RADIUS. Where Owner does not provide a NAC platform, switches shall be pre-configured with RADIUS profiles suitable for later NAC integration. RadSec (RADIUS over TLS, RFC 6614) shall be used in preference to plain RADIUS where supported by both switch and authentication backend.
- D. **MACsec (IEEE 802.1AE) Link-Layer Encryption:** Access switches shall support MACsec on downlink ports serving access points where the AP supports MACsec (e.g., HPE Aruba Networking 730 Series APs) and on switch-to-switch uplinks where Owner policy requires link-layer encryption on backbone/inter-closet links. MACsec shall use GCM-AES-256 where supported by both endpoints; GCM-AES-128 is acceptable as a fallback. MKA (MACsec Key Agreement) pre-shared keys or

certificate-based MKA shall be used; static session keys shall not be used.  
Coordinate MACsec endpoint selection with Section 27 21 33 to ensure AP-to-switch compatibility.

- E. **Client Visibility and Profiling:** Where the manufacturer provides an AI/ML-based client identification service as part of the management platform (e.g., HPE Aruba Networking Central Client Insights, Cisco AI Endpoint Analytics, Juniper Mist Marvis), that service shall be enabled and integrated with the Dynamic Segmentation policy engine to drive automatic role assignment based on classified device type.
- F. **Zero-Touch Provisioning (ZTP):** Access switches shall support ZTP through the Owner-selected management platform (e.g., Aruba Central, Cisco Catalyst Center / Meraki Dashboard, Juniper Mist) to enable automated configuration download without manual console setup at each device.

## 2.07 FILE SERVER

- A. **Processor:** Two (2) 2.4 GHz / 10-core / 25MB / 90W Processors.
- B. Adequate space for all line cords and future port capacity as indicated on the Drawings.
- C. **Cache Memory:** 25MB L3 Cache.
- D. **I/O Slots:** 1 PCIe, 1 Storage.
- E. **Memory:** Minimum 64GB DDR5 RDIMM (4800 MT/s or current generation), expandable.
- F. **Network Controller:** Quad-port 1 GbE Network Interface Card, current-generation from server OEM (e.g., Broadcom BCM5719 or equivalent).
- G. **Additional Network Controller:** Dual-port 10 Gbps SFP+ Converged Network Adapter, current-generation from server OEM.
- H. **Storage Controller:** Current-generation hardware RAID controller with battery-backed or flash-backed cache (e.g., Dell PERC H755 / HPE MR416i / equivalent), configured for RAID 6.
- I. **Internal Storage:** 8TB RAID Level 6 of internal storage (SAS) hot-swappable.
- J. **Network Interface:** Provide dual 10 Gbps fiber connections with failover and load balancing.
- K. **Power Supply:** Dual, hot-plug, redundant power supply (1+1), 1100W.
- L. **Fans:** Hot-plug, redundant fans (individually removable).
- M. **Video:** Provide embedded video card.
- N. Integrated Lights-Out Management:
  - 1. Dedicated 10/100/1000 Base-TX LAN port for LAN console and embedded web console access.
  - 2. One RS-232 serial port for local console.
  - 3. Password-protected console ports.
  - 4. Console mirroring between all local, modem, LAN, and web consoles.

5. Remote power up and power down control.
  6. Configurable remote access control.
  7. Event notification to system console — provides connectivity, information, and support for UX tools (such as STM and EMS) to notify by email, pager, and/or response centers.
  8. Interface to system monitoring and diagnostic hardware via an internal I<sup>2</sup>C bus.
  9. Secure Sockets Layer security on web console.
  10. Current-generation out-of-band management (e.g., HPE iLO6, Dell iDRAC 9 or later, or equivalent) with advanced licensing providing LDAP/Active Directory directory services, Virtual Media (ISO image and USB redirection), and Integrated Remote Console (Virtual Keyboard, Video, and Mouse).
  11. The integrated chip provides basic graphic capabilities. One VGA port is supported, with optional connection from front or rear of the system.
- O. **Form Factor:** 2U Rack.
- P. **Mounting:** Provide 4-post mounting hardware with sliding rails and cable management.
- Q. Rack-mount server in server cabinet provided under this section.
- R. Install current supported release of VMware vSphere / ESXi (minimum version supported by the manufacturer at time of installation; VMware 6.5 reached end of general support in November 2021 and shall not be used). License and software to be provided by the Owner. Owner may, at their discretion, substitute an equivalent Owner-approved hypervisor (e.g., Microsoft Hyper-V, Proxmox VE, Nutanix AHV); Contractor shall coordinate accordingly.
- S. Server to be VMware Certified.
- T. Server to be loaded with Aruba ClearPass Policy Manager and appropriate licensing or equivalent:
1. Full support for 802.1X authentication.
  2. Server shall support unlimited clients, VoIP equipment, and WLAN equipment.
  3. Server shall support SQL, LDAP, and proxy operation.
  4. Server shall utilize web-based admin and reporting.
- U. 22" LCD Wide Display Monitor.
- V. **Warranty:** Server warranty includes 3-year Parts, 3-year Labor, 3-year Onsite support with next-business-day response.
- W. VMware/ESXi should be installed on an embedded flash media.
- X. **Approved Manufacturers:** HPE, Dell, IBM.

## 2.08 RACK MOUNT LCD WITH 8-PORT KVM SWITCH

- A. **Server Cabinets:** Provide a 1×8 multi-port KVM switch with secure IP remote connectivity to connect servers and other equipment to monitor/keyboard/mouse. Connect to the following:



1. New file server.
2. VoD servers.
- B. **CCTV/CATV Cabinets:** Provide a 1×8 multi-port KVM switch with secure IP remote connectivity to connect servers and other equipment to monitor/keyboard/mouse. Connect to the following:
  1. CCTV NVR.
  2. Digital Enterprise Management System.
- C. Provide all required Serial, PS/2, USB, VGA, and HDMI cabling as required to fully connect each computer/server/NVR on each port. Provide full cabling/connector bundles for each unused port and turn over to Owner.
- D. 1U rack-mount design.
- E. Shall allow attached servers or devices to continue network functions in the event the KVM switch loses power or functionality.
- F. **Manufacturers:** Avocent, Rose, Raritan, Minicom, or approved equal.

## 2.09 MONITOR/MOUSE/KEYBOARD

- A. Provide a combination 15" color display with native resolution of 1024×768, 103-key keyboard, built-in trackball or touchpad (support for AT/XT, PS/2, USB, and UNIX) in a rack-mounted pull-out drawer. Unit shall be rack-mountable in a single rack space.
- B. Mount in each server cabinet and connect to KVM.
- C. **Manufacturers:** Rose, APC, or Raritan or approved equal.

## 2.10 PATCH CABLES

- A. The Contractor shall be responsible for providing and installing all required fiber and copper patch cables at each switch uplink port and at the Owner-furnished core switch uplink ports to make a complete and fully functioning network. The following patch cable requirements are considered part of these specifications:
  1. Fiber Jumper: Provide fiber jumper cables at each edge switch requiring fiber uplink and duplex fiber jumpers at each corresponding fiber uplink port on the Owner-furnished core switch to fully connect the network. Coordinate jumper type and color with equipment and jumper length to provide a neat, orderly, and workmanlike appearance after system patching is complete.
  2. Copper Patch Cable: Provide patch cables at each edge switch requiring copper uplink ports and copper patch cables at each corresponding copper 1000BASE-T port on the Owner-furnished core switch to fully connect the network. Patch cables to match the EIA/TIA channel configuration of the cabling system. Coordinate patch cable length and color to provide a neat, orderly, and workmanlike appearance after system patching is complete.
- B. The Contractor shall be responsible for coordinating with the 27 15 00 Contractor regarding patch cables being supplied by the 27 15 00 Contractor for patch-panel-to-switch patching. Final quantities and lengths of patch cables shall be arranged to provide the cleanest best-managed patching solution. This Contractor is responsible

for taking delivery of the patch cables, installing the patch cables, and labeling each end for patch panel port and switch port identification.

- C. Ensure adequate strain relief for any fiber or copper patch cable supplied.
- D. The Contractor shall work with the Owner to develop a patching scheme for all devices attached to the data network. The Contractor shall be responsible for patching all devices from the patch panel(s) to the network equipment and any patching between the network electronics. Copper patch cords for patch-panel-to-switch patching are FURNISHED under Section 27 15 00 — Communications Horizontal Cabling (100 percent port population plus 10 percent spares); this Contractor shall take delivery, install, and label them per paragraph B above and shall not separately furnish duplicate copper patch cords. This Contractor shall provide a fiber patch cord for every fiber port provided under this contract.

## 2.11 UPS — MANUFACTURERS

- A. **Approved Manufacturers for Communications Rack Online UPS with lithium iron phosphate (LiFePO<sub>4</sub> / LFP) battery:** Standard of quality is Eaton 9PX Lithium-Ion or Vertiv Liebert GXT5 Lithium-Ion. UPS shall be ordered with the manufacturer's network management card supporting SNMPv3, HTTPS, and integration with the manufacturer's monitoring platform (Eaton Brightlayer / IPM, Vertiv Power Insight, or equivalent). Acceptable manufacturers must demonstrate product equivalency.
  - 1. Tripp Lite.
  - 2. Liebert.
  - 3. APC.
- B. **Approved Manufacturers for Power Strips:** Standard of quality is Tripp Lite. Acceptable manufacturers must demonstrate product equivalency.
  - 1. Tripp Lite.
  - 2. Geist.
  - 3. Wiremold.

## 2.12 UPS — GENERAL REQUIREMENTS

- A. Provide true online battery back-up, power-conditioning UPS, rack-mounted in each TR to serve network electronics as indicated on the Drawings. Unit shall utilize combination of battery and microprocessor regulation to provide protection from brownouts and overvoltage. UPS to have the following features at a minimum:
  - 1. 5000 / 3000 / 2200 / 2000 / 1500 VA capacity as indicated on Drawings.
  - 2. **Topology:** True online double-conversion with pure sine wave output, near-zero transfer time, and continuous power conditioning. Line-interactive UPS shall not be used for closet-class network electronics on this project.
  - 3. **Battery Chemistry:** Lithium iron phosphate (LiFePO<sub>4</sub> / LFP). Other lithium-ion chemistries (NMC, LCO, LMO) are not permitted. Sealed lead-acid (VRLA) and gel-cell batteries are not permitted on new installations under this section.
  - 4. **Battery and Energy Storage Safety Listings:** Battery cells and module shall be UL 1973 listed (Stationary Auxiliary Power) and the integrated UPS-battery

assembly shall demonstrate compliance with UL 9540A thermal runaway propagation testing per the manufacturer's published certification. Battery management system (BMS) shall provide cell-level voltage and temperature monitoring with telemetry available via SNMP and the management platform.

5. **Battery Service Life and Warranty:** Minimum 8-year design service life at 25°C ambient with manufacturer warranty covering both UPS electronics and the LFP battery for 5 years minimum. Battery shall support a minimum of 2,000 charge / discharge cycles to 80% retained capacity.
6. **Operating Environment:** UPS and batteries shall be rated for continuous operation at 0°C to 40°C without runtime or service-life derating; some derating between 40°C and 50°C is acceptable. Coordinate telecom-room HVAC capacity and setpoints with mechanical engineer; LFP chemistry tolerates higher ambient than VRLA but optimal cell life is at 25°C.
7. **Code Coordination:** Verify with Authority Having Jurisdiction (AHJ) and project Fire Protection Engineer that aggregate stationary energy storage in any one telecom room remains below the threshold requiring NFPA 855 / IFC Chapter 12 compliance (currently 20 kWh aggregate per room is the typical small-system threshold; verify with current code edition adopted locally). Where aggregate storage exceeds the threshold, coordinate detection, suppression, and ventilation requirements with the design team. Recycled / second-life batteries are not permitted.
8. **Disposal and End-of-Life:** Contractor shall remove and properly recycle existing lead-acid UPS batteries (where applicable) per EPA universal waste rules and any state requirements. New LFP batteries shall be returned to the manufacturer at end of life via the manufacturer's take-back program; documentation shall be provided to Owner.
9. **Output Operating Range:** 208V (5000 VA) / 120V (< 3000 VA) nominal.
10. **Communications:** Unit shall provide an Ethernet-based SNMP management interface, through the LAN, to provide remote diagnostics and alarm conditions. Provide vendor management software with all applicable licenses.
11. **Expandability:** UPS shall accept lithium iron phosphate Extended Battery Modules (EBMs) from the same manufacturer (e.g., Eaton 9PXEbm72RT-L, Vertiv Liebert GXT5 Lithium-Ion EBM) to extend total runtime. Mixing of LFP and VRLA EBMs is not permitted. Maximum number of EBMs shall be sized to meet the runtime targets specified for each room and the systems they serve (see other Division 27 / 28 sections referencing run-time requirements).
12. **Complete Battery Independence:** Battery-independent restart ensures automatic UPS power-up without user interaction after lengthy power outages, even when batteries are completely drained/discharged.
13. All UPS will be equipped with network management over IP or SNMP capable.

## 2.13 1500 VA ONLINE UPS

- A. 1500 VA online double-conversion UPS shall include the following: Standard of quality is Eaton 9PX Lithium-ion 9PX1500RT-L (1500 VA / 1350 W, 2U rack/tower, LiFePO<sub>4</sub> battery, online double-conversion topology) or Vertiv Liebert GXT5 Lithium-

Ion GXT5LI-1500LVRT2UXL (1500 VA / 1350 W, 2U rack/tower). Acceptable manufacturers must demonstrate product equivalency.

1. Output Power Capacity: 1350 W / 1500 VA.
2. Nominal Output Voltage: 120V.
3. Output Connections: (6) NEMA 5-15R.
4. Nominal Input Voltage: 120V.
5. Input Connections: NEMA 5-15P.
6. Cord Length: 12'.
7. Rack Mounted: Max. 1U rack space.
8. Transfer Time: 2–4 ms.
9. **Battery Type:** Lithium iron phosphate ( $\text{LiFePO}_4$  / LFP), maintenance-free, hot-swappable battery module(s) where supported by the model. Battery cells, module, and battery management system shall be UL 1973 listed. UPS chassis with installed batteries shall demonstrate compliance with UL 9540A thermal runaway propagation testing per the manufacturer's published certification. Battery service life shall be a minimum of 8 years at 25°C ambient.
10. **Communications/Interface Ports:** Unit shall communicate through the LAN to provide remote diagnostics and alarm conditions.
11. **LED Status:** On Battery / Replace Battery / Overload indicators.
12. Audible Alarms.
13. Filtering: Full-time multi-pole noise filtering.

## 2.14 2200 VA ONLINE UPS

- A. 2200 VA online double-conversion UPS shall include the following: Standard of quality is Eaton 9PX Lithium-ion 9PX2200RT-L (2200 VA / 1980 W, 2U rack/tower,  $\text{LiFePO}_4$ ) or Vertiv Liebert GXT5 Lithium-Ion GXT5LI-2000LVRT2UXL (2000 VA / 1800 W, 2U) — UPS sized to meet or exceed the connected load. Acceptable manufacturers must demonstrate product equivalency.
1. Output Power Capacity: 1800 W / 2200 VA.
  2. Nominal Output Voltage: 120V.
  3. Output Connections: (6) NEMA 5-15/20R and (2) NEMA L5-20R.
  4. Nominal Input Voltage: 120V.
  5. Input Connections: NEMA 5-20P.
  6. Cord Length: 10'.
  7. Rack Mounted: Max. 2U rack space.
  8. Transfer Time: 2–4 ms.
  9. **Battery Type:** Lithium iron phosphate ( $\text{LiFePO}_4$  / LFP), maintenance-free, hot-swappable battery module(s) where supported by the model. Battery cells, module, and battery management system shall be UL 1973 listed; UPS shall

demonstrate UL 9540A thermal runaway propagation compliance per manufacturer certification. Battery service life shall be a minimum of 8 years at 25°C ambient.

10. Backup Time: 28 minutes at half load (925 W); 8 minutes at full load (1850 W).
11. Extended Run Capable options.
12. **Communications/Interface Ports:** Unit shall communicate through the LAN (SNMP) to provide remote diagnostics and alarm conditions.
13. **LED Status:** On Battery / Replace Battery / Overload indicators.
14. Audible Alarms.
15. Surge Energy Rating: 570 joules.
16. Filtering: Full-time multi-pole noise filtering.

## 2.15 3000 VA ONLINE UPS

- A. 3000 VA online double-conversion UPS shall include the following: Standard of quality is Eaton 9PX Lithium-ion 9PX3000RT-L (3000 VA / 2700 W, 2U rack/tower, LiFePO<sub>4</sub>) or Vertiv Liebert GXT5 Lithium-Ion GXT5LI-3000LVRT2UXL (3000 VA / 2700 W, 2U rack/tower). Acceptable manufacturers must demonstrate product equivalency.
  1. Output Power Capacity: 2700 W / 3000 VA.
  2. Nominal Output Voltage: 120V.
  3. Output Connections: (9) NEMA 5-15R and (2) NEMA 5-20R.
  4. Nominal Input Voltage: 120V.
  5. Input Connections: NEMA L5-30P.
  6. Cord Length: 10'.
  7. Rack Mounted: Max. 2U rack space.
  8. Transfer Time: 2–4 ms.
  9. **Battery Type:** Lithium iron phosphate (LiFePO<sub>4</sub> / LFP), maintenance-free, hot-swappable battery module(s) where supported by the model. Battery cells, module, and battery management system shall be UL 1973 listed; UPS shall demonstrate UL 9540A thermal runaway propagation compliance per manufacturer certification. Battery service life shall be a minimum of 8 years at 25°C ambient.
  10. Backup Time: 11 minutes at half load (1350 W); 4 minutes at full load (2700 W).
  11. Extended Run Capable options.
  12. **Communications/Interface Ports:** Unit shall communicate through the LAN (SNMP) to provide remote diagnostics and alarm conditions.
  13. **LED Status:** On Battery / Replace Battery / Overload indicators.
  14. Audible Alarms.
  15. Surge Energy Rating: 570 joules.

16. Filtering: Full-time multi-pole noise filtering.

## **2.16 5000 VA ONLINE UPS**

- A. 5000 VA online double-conversion UPS shall include the following: Standard of quality is Eaton 9PX Lithium-ion 9PX5KTF5-L (5000 VA / 4500 W, 3U rack/tower, LiFePO<sub>4</sub>) or Vertiv Liebert GXT5 Lithium-Ion 5 kVA model with LFP battery (3U or 4U rack/tower configuration per Owner-selected runtime). Acceptable manufacturers must demonstrate product equivalency.
1. Output Power Capacity: 4000 W / 5000 VA.
  2. Max Configurable Power: 4000 W / 5000 VA.
  3. Nominal Output Voltage: 120V, 208V.
  4. Efficiency at Full Load: 90.0%.
  5. Output Voltage Distortion: Less than 2%.
  6. Output Frequency: (sync to mains) 50/60 Hz  $\pm$  3 Hz user adjustable  $\pm$  0.1.
  7. Other Output Voltages: 240.
  8. Crest Factor: 3 : 1.
  9. Topology: Double-Conversion Online.
  10. Waveform Type: Sine wave.
  11. Output Connections: (8) NEMA 5-15/20R; (2) NEMA L6-30R; (2) NEMA L6-20R.
  12. Bypass: Internal Bypass (Automatic and Manual).
  13. Nominal Input Voltage: 208V.
  14. Input Frequency: 50/60 Hz  $\pm$  5 Hz (auto-sensing).
  15. Input Connections: NEMA L14-30P.
  16. Cord Length: 10'.
  17. Input voltage range for main operations: 100–140 VAC (L1-N : L2-N).
  18. Input voltage adjustable range for mains operation: 85–136V.
  19. Other Input Voltages: 240.
  20. Interface Port(s): RJ-45 10/100 Base-T.
  21. Control panel LED status display with load and battery bar graphs and On Line / On Battery / Replace Battery / Overload and Bypass indicators.
  22. Alarm when on battery; distinctive low-battery alarm; overload continuous-tone alarm.
  23. Emergency Power Off (EPO).
  24. Surge Energy Rating: 365 joules.
  25. Filtering: Full-time multi-pole noise filtering; 0.3% IEEE surge let-through; zero clamping response time; meets UL 1449.

- B. All UPS units shall be rack-mountable with proper mounting hardware and support. Tower UPS systems are not permitted unless otherwise noted.

## **2.17 UPS EXTENDED BATTERY MODULES (EBMs)**

- A. LiFePO<sub>4</sub> chemistry, matched to the parent UPS manufacturer and model (e.g., Eaton 9PXEBM72RT-L for Eaton 9PX 2200 / 3000 VA Lithium-ion units; Vertiv Liebert GXT5 Lithium-Ion EBM for Vertiv UPS units) — quantity per UPS as required to meet runtime targets specified by other systems (e.g., phone system, voice gateway, key surveillance / access control loads).

## **2.18 POWER STRIPS**

- A. Standard of quality is Tripp Lite part number PDU1220. Acceptable manufacturers must demonstrate product equivalency.
- B. Raceway and all components shall be UL listed. The base and cover shall be ivory in color, and shall be attached to the cable ladder of the rack system or wall field as per the Drawings.
- C. Electrical outlet strip shall have (13) NEMA 5-15/20 outlets.
- D. Provide all attachment hardware required to securely attach the outlet strip to the back of the vertical cable ladder or wallfield. Refer to the detailed Drawings for required locations.
- E. All power strips shall be equipped with surge protection.
- F. All power strips shall come with adjustable mounting brackets for 2- or 4-post installation.
- G. Strips shall be 20A-120V with NEMA 5-20P on a 15-foot line cord.
- H. Install and test all outlets prior to project completion.
- I. Provide outlet strip with attached cord and 3-prong plug.
- J. All power strips shall be equipped with a cord long enough to reach the UPS units located at the bottom of the racks.
- K. All power strips will plug into UPS units unless otherwise specified. Custom-length cords may be required.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION**

- A. Install systems in accordance with UL, NEC, and all other applicable codes. Install system to comply with Drawings and final shop drawings in compliance with manufacturer instructions. Provide all required hardware and labor for rack mounting of system components.
- B. Some network electronics such as Layer 3-capable access switches, UPS units, etc., will be required to be mounted in relay racks and server cabinets provided under Section 27 11 00. Careful coordination with 27 11 00 will be required. This coordination shall include providing all required dimensional, weight, thermal, and mounting data to the 27 11 00 Contractor to ensure a fully coordinated installation.

- C. It is the Contractor's responsibility to program the devices in this section according to the Owner's Network requirements. The Contractor shall meet with the Owner and/or Engineer and reach agreement on the programming.
- D. Provide any miscellaneous equipment such as identification tags, cable tie, wiring harnesses, patch cables (both copper and fiber), stacking cables, etc. necessary for a complete TURNKEY system.
- E. Provide all required jumper and patch cables and coordination with the Owner to connect to the Owner's File Server(s).
- F. Install and set up all UPS equipment. Review power-down procedure with the Owner.

### **3.02 EXAMINATION**

- A. The Contractor shall be knowledgeable of the requirements and limitations at the site prior to submission of the Bid Response.

### **3.03 PREPARATION**

- A. Each location where equipment of the data network will be placed shall be identified and reviewed prior to installation of the components.
- B. All work shall be done by trained professionals with a history of work on the equipment being installed.
- C. The Contractor shall provide all hardware, software, cable, connecting blocks, electronics, configuration, and labor required for a complete and operating system.

### **3.04 SYSTEM CONFIGURATION**

- A. The Contractor shall configure and install the data network as per the detailed specifications and the configuration meetings with the Owner.
- B. Meetings shall be scheduled with the Owner to discuss the configurations of all electronics and the capabilities of the system. The system shall be configured for all Ethernet IP systems installed such as: Video on Demand, VoIP, wireless network, IP cameras and Video Surveillance Control, Access Control, etc. Contractor shall configure VLANs as well as OS setup with priority being given to voice and video.
- C. The Owner shall be made aware of all the capabilities of the data network electronics and all possible configurations and shall be able to decide all aspects of the programming and configuration.
- D. The Contractor shall generate a report on the requirements of the Owner and shall program and configure all the data electronics to meet the Owner's needs. All costs associated with the meetings and programming are to be included in the bid.
- E. From the meetings the Owner and Contractor shall generate a plan for all configuration issues of the data network including but not limited to:
  - 1. IP Numbering Scheme.
  - 2. VLAN Settings — possible VLANs for: Administration, HVAC, Management, Personnel, Video, Voice, Wireless, etc.
  - 3. Quality of Service (QoS) Settings.



4. Network Prioritization.
  5. New Data Connections.
  6. Wireless Connectivity for Patrons and Administrators.
  7. Wireless Security.
  8. Video Surveillance and Access Control.
- F. The Owner shall be able to be involved in all aspects of the configuration.
- G. The network electronics shall be configured with complex authentication credentials (passwords).
- H. The network electronics shall NOT be configured with default usernames, default passwords, or default SNMP community strings.
- I. Configured SNMP community strings shall be protected via an access control list such that only the NMS and Owner-selected IP addresses can perform SNMP queries.
- J. The network electronics shall be configured to synchronize internal clocks to a designated internal NTP server.

### **3.05 CYBERSECURITY**

- A. The Contractor shall configure the network electronics in accordance with current industry cybersecurity practices, including as applicable the NIST Cybersecurity Framework (CSF 2.0), CIS Critical Security Controls (v8 or later), and any Owner-specific security policies provided at the configuration meetings.
- B. Management Plane Hardening:
1. Telnet, HTTP, SNMPv1, and SNMPv2c shall be disabled. Device management shall use SSH (v2 or later), HTTPS (TLS 1.2 minimum, TLS 1.3 preferred), and SNMPv3 with authentication and privacy (authPriv).
  2. Administrative access shall use centralized authentication (TACACS+ or RADIUS, integrated with Owner's directory service) with role-based access control (RBAC) if a centralized authentication backend is provided by Owner. Where Owner does not provide a centralized authentication backend, local accounts shall be used with complex passwords of 14 characters or more, unique per device, and managed via the Owner's password management process. In either case, local fallback accounts shall be limited to emergency use, use complex passwords of 14 characters or more, and be documented in the closeout package.
  3. Multi-factor authentication (MFA) shall be required for all administrative access where an MFA-capable authentication backend is provided by Owner and supported by the device.
  4. Management access shall be restricted to a dedicated out-of-band management VLAN and/or management network, with ACLs limiting source IP addresses to approved management workstations, jump hosts, and NMS.
  5. Idle session timeout shall be configured to 10 minutes or less. Failed login attempts shall trigger account lockout and generate a log event.

C. Network Access Control (NAC):

1. All edge ports shall be configured for 802.1X port-based authentication with MAC Authentication Bypass (MAB) fallback for non-802.1X-capable devices. Where a NAC platform is provided by Owner (Aruba ClearPass Policy Manager or Owner-approved equivalent, including the ClearPass instance furnished under this section), switches shall be integrated with it. Where Owner does not provide a NAC platform, switches shall be pre-configured for 802.1X/MAB with configuration parameters suitable for later NAC integration.
2. Where a NAC platform is provided by Owner, it shall perform device profiling (fingerprinting) to identify endpoint type, and apply dynamic VLAN assignment, downloadable ACLs, or role-based policy enforcement based on device type, user identity, and posture.
3. Unauthenticated devices shall be placed in a quarantine or guest VLAN with restricted network access, per Owner policy.
4. Unused switch ports shall be administratively shut down and assigned to an unused VLAN, or configured for authentication with automatic port shutdown on failed authentication.

D. Network Segmentation and Switch Security Features:

1. Dynamic segmentation (user/device-based role assignment, downloadable ACLs, or micro-segmentation) shall be configured per Owner policy where the capability is provided by Owner, to restrict lateral traffic between endpoint classes.
2. Switches shall be configured with DHCP snooping, Dynamic ARP Inspection (DAI), IP Source Guard, BPDU Guard, Root Guard, and storm control on all edge ports to mitigate common Layer 2 attacks.
3. Control Plane Policing (CoPP) shall be enabled to protect switch CPUs from denial-of-service conditions.

E. Logging, Monitoring, and SIEM Integration:

1. Where a centralized logging platform or SIEM is provided by Owner, all network devices shall be configured to forward syslog events to it. Where Owner does not provide a central logging destination, devices shall be configured with local syslog buffering sized per manufacturer recommendation, and shall be pre-configured with a placeholder syslog destination for later redirection. Minimum log categories shall include authentication events (success and failure), configuration changes, interface state changes, and security violations.
2. Syslog transport shall be TCP with TLS where supported by the device, falling back to UDP only where TLS is unavailable.
3. Time synchronization: all devices shall use the Owner's authoritative NTP server(s); where supported, NTP authentication shall be enabled.
4. Flow telemetry (NetFlow, sFlow, or IPFIX) shall be enabled and forwarded to the Owner's flow collector if provided by Owner.

F. Firmware, Patch Management, and Supply Chain:

1. All devices shall be delivered with firmware that is a currently supported release from the manufacturer and that contains no known critical or high-severity CVEs at time of installation. Contractor shall document firmware versions in the closeout package.
2. Devices shall support cryptographically signed firmware images and secure boot; these features shall be enabled.
3. Equipment shall be sourced from authorized manufacturer channels to prevent counterfeit or tampered hardware. Contractor shall provide chain-of-custody documentation on request.
4. Equipment shall not originate from manufacturers restricted by applicable federal procurement regulations (e.g., Section 889 of the FY2019 NDAA) where Owner is subject to those regulations.

G. Wireless and Wired Guest Access:

1. Guest networks (wired and wireless) shall be isolated from internal VLANs at Layer 3 and shall not be permitted to initiate connections to Owner internal networks except as explicitly allowed by Owner policy.
2. Wireless SSIDs shall use WPA3-Enterprise for employee networks where the AP and client ecosystem support it, with WPA2-Enterprise as fallback. Open (unencrypted) SSIDs are not permitted except as captive-portal guest networks with OWE (Opportunistic Wireless Encryption) where supported.

H. Documentation and Handoff:

1. Contractor shall deliver a security configuration summary at project closeout documenting: enabled management protocols, authentication backend and fallback accounts, SNMPv3 users, syslog destinations, NAC integration details, firmware versions, enabled Layer 2 security features, and any deviations from this section with justification.
2. Credentials, keys, and certificates used during configuration shall be rotated before handoff to the Owner; the credentials-at-handoff set shall be delivered to the Owner through a secure channel (not email).

### 3.06 USER CONNECTIVITY

- A. The Contractor shall meet with the Owner as soon as the project has begun to discuss connectivity of the new data electronics to, but not limited to: Local/Remote users, WAN, WLAN, VLAN, LAN, printers, etc.
- B. The Contractor shall provide a minimum of the detailed quantity of 10/100/1000 Ethernet ports shown on the Drawings.
- C. The Owner may provide additional locations where additional 10/100/1000 Ethernet connections shall be made, and the Contractor shall locate those cables and make plans to connect them to the new data electronics.
- D. When the new electronics are installed, the Contractor shall provide all new patch cables for all data connectivity in the rack/cabinet and to the user's device.
- E. Patch cables shall be of same category as horizontal cables, fiber cables, etc., and shall be factory-made and matched to the length required between the user patch panel and the data electronics.

- F. When installing the new electronics, the Contractor shall ensure that all patch cables and ports are connected to a user PC or printer.

### **3.07 ELECTRONICS PLACEMENT**

- A. The Contractor shall be responsible for the placement of the data electronics and all its components in the assigned Communications Rooms.
- B. Contractor shall consult with the Owner about electronics placement prior to cutover.
- C. All equipment shall be secured in communication racks using the maximum number of screws as there are holes provided by vendor equipment.

### **3.08 TESTING**

- A. The Contractor shall be responsible for energizing and testing each port. This test shall include "Rack-to-Jack" and from main switch and from main switch to switch "stacks." The Contractor shall be responsible for ensuring that the network is in proper working condition.
- B. The Contractor shall be responsible for testing and verifying that all software and management-level functions of the system as required by the Owner's network system are programmed and operating properly. This includes but is not limited to:
1. Setup and segregation of VLANs as required by the Owner on a per-port and per-switch basis.
  2. Switch clustering and addressing through a single IP address.
  3. Operation of remote monitoring events such as alarm, history, statistics, events, etc.
  4. Setup of multilevel security including MAC-address-based and terminal access control to prevent unauthorized users from altering the configurations.
  5. Setup and administration of prioritization, quality of service, IP clustering, video multicasting, VoIP, etc.

### **3.09 LABELING**

- A. All labeling and recording shall be approved by the Owner and the Engineer prior to application.
- B. Provide a printed, computer-generated record of each connected port in each switch. Label shall indicate data jack label, port and switch label, and closet label.
- C. All supplied devices shall have a label affixed in a visible location on the front and rear of the equipment.
- D. The label shall identify the switch name and IP address.
- E. All labels shall be machine printed.
- F. All copper and fiber patch cables interconnecting switches shall have a self-laminating label affixed on each end of the patch cable. The label shall identify the switch and port at the opposite end of the cable.
- G. All copper and fiber patch cables interconnecting switches to servers shall have a self-laminating label affixed on each end of the patch cable. The label shall identify

the switch and port at the server end of the cable and the server name at the switch end of the patch cable.

- H. All copper and fiber patch cables interconnecting switches to routers, firewalls, and gateways shall have a self-laminating label affixed on each end of the patch cable. The label shall identify the switch and port at the router end of the cable and the router name at the switch end of the patch cable.

### **3.10 WORK AREA**

- A. The Contractor shall provide a clean and orderly area to work in during system installation.
- B. The work areas shall be cleaned daily. All packing trash and other assorted junk items shall be removed at the end of each workday.
- C. Dust shall be kept to a minimum during the installation. All dust shall be removed prior to the cutover, and then again just prior to project closeout.
- D. The Owner and Engineer shall have access to the work area at any time during normal working hours.
- E. The Owner and Engineer have the right to stop work and seek answers to questions and concerns that may come up during the installation of the new data network.

### **3.11 UPS INSTALLATION**

- A. Contractor is to be familiar with other specification sections where system run time is specified in the event of a power outage. It is the Contractor's responsibility to configure and provide the required extended battery packs to the UPS units to meet all specified system run times.
- B. Location of the UPS units and Power Strips shall be finalized in the communications room or space shown on the Drawings prior to installation.
- C. Locate all equipment to be installed, and make certain that space is available for maintenance and service during the life of the system.
- D. If any changes from the Drawings are required, the Contractor shall submit a proposed layout of the communications room/racks to the Engineer for approval prior to installation.
- E. Placement of UPS units shall be in the Main Equipment Room and Telecommunications Closets.
- F. All UPS units shall be rack-mounted unless otherwise noted.
- G. Mount UPS units on the bottom of the communications racks or cabinets.
- H. Mount UPS units using all manufacturer-recommended and required hardware.
- I. Provide support between the floor and the UPS unit. Wood or plastic blocks cut to the width of the space between the UPS and the floor shall be installed.
- J. Provide all programming for SNMP setup of all UPS units to Owner's LAN. Provide all cards and cords for connection to the LAN.
- K. Power strips shall be installed so that they do not interfere with the cable routing or the installation of components into the rack.

- L. Modular plug for the outlet strip shall be installed at the bottom of the outlet strip.
- M. All power strips shall plug into UPS units. UPS units shall be plugged into 1 of 2 duplex receptacles installed at the bottom of the rack. Refer to the detailed Drawings for receptacle locations.
- N. Coil any extra cord from the outlet strip and tie-wrap it to the bottom of the vertical cable ladder.
- O. Securely attach the outlet strips to the back edge of the vertical cable ladder or wallfield as per detailed Drawings.
- P. Electrical outlets are installed by others. Communications Contractor shall be responsible for connecting the power strips to the UPS unit(s) and the UPS unit(s) to the power receptacles.

### **3.12 TRAINING**

- A. Provide the Owner with a minimum of 40 hours of training designed to make all users familiar with the operation of the system. Appropriate hands-on training as well as manuals and detailed troubleshooting guides should be given to Owner personnel.
- B. Provide all training and utilize specified manuals and record documentation. All training shall be provided at the project site and coordinated with the Owner.
- C. Training shall include multiple four-hour sessions encompassing all instructions required for system operation. Provide operators manuals and user guides with training. Provide follow-up training after initial training.
- D. Training shall utilize the equipment provided at the project site. Coordinate use, time, and availability of equipment with the Owner.
- E. Demonstrate adjustment, operation, and maintenance of the system including each component and control.

### **3.13 AS-BUILT DOCUMENTATION**

- A. The Contractor shall furnish the Owner complete as-built manuals and drawings as indexed PDF files, delivered via USB flash drive, the Owner's document management system, or other electronic means acceptable to the Owner. Drawings shall be a minimum of 11" × 17" engineering format. These manuals shall contain:
  - 1. System Operating Instructions.
  - 2. System Functional Block Diagram(s).
  - 3. System Schematic Diagram(s).
  - 4. System Wiring Diagrams.
  - 5. As-Built Drawings of Entire System including Equipment Rack Elevations.
  - 6. Component Technical Operation Manuals.
  - 7. Component Service Manuals.
  - 8. Software Operating Manuals.
  - 9. Port and Switch Labeling.
  - 10. Final Endurance Test Report.

- B. **Maintenance Manual:** The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- C. The Contractor shall provide a new Owner network map indicating all new buildings included in this scope of work. Network map shall include equipment information, IP addresses, VLAN information, etc. Network map shall be prepared utilizing a computer drafting program such as AutoCAD or Visio, and shall be presented in electronic format.

### 3.14 WARRANTY

- A. If any defects are found within the three (3) year full warranty period, the defective system component shall be replaced at no extra cost to the Owner for part or labor. Provide a statement of this warranty with the O&M Manuals.
- B. During the warranted operation, the Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. Resolve any previous outstanding problems.
- C. Make available a service contract offering continuing factory-authorized service of this system after the initial warranty period.
- D. The Contractor shall be responsible to provide service during normal working hours on a normal business day within four (4) hours after notification by the Owner for normal service or within two (2) hours for emergency service. Emergency service is defined as the loss of 25% or more of system components operation, or the loss of the main switch or other dead-end equipment which renders the entire system beyond 50% inactive or unusable. Provide an on-site authorized factory technician within 24 hours if required.
- E. If equipment cannot be repaired within 24 hours of service visit, Contractor shall supply "loaner" equipment to the Owner at no charge.

### 3.15 CERTIFICATION

- A. Upon completion of the testing, the manufacturer or representative shall issue to the Owner a letter of certification attesting to the fact that he has tested and adjusted the system, that all components are properly installed and free of defects, and that the system is in compliance with this specification.

**END OF SECTION 27 21 00**

## SECTION 27 21 33

### DATA COMMUNICATIONS WIRELESS ACCESS POINTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. All provisions of Division 00 and Division 01 apply to all work in Division 27.

##### 1.02 SCOPE OF WORK

- A. This specification section is intended to provide a complete Wireless Local Area Network (WLAN) electronics system as indicated herein and as shown on the contract documents.
- B. Provide a Wi-Fi Alliance certified Wi-Fi 7 (IEEE 802.11be) tri-band (2.4 GHz / 5 GHz / 6 GHz) wireless system, with Wi-Fi 6E (802.11ax in 6 GHz) acceptable as a minimum for projects where Wi-Fi 7 is cost-prohibitive or not supported by the Owner's client ecosystem; Owner to select standard at submittal. System shall include wireless access points (AP) with integrated antennas, external antennas where required, plenum-rated AP enclosures, cabling, RF management platforms (on-premises controller or cloud-managed), RF site survey, mobile device management (MDM) integration where provided by Owner, application management, programming, and testing as required to provide a complete and comprehensive WLAN within the specified areas.
- C. The WLAN shall provide capacity for the expected concurrent client population plus growth, with adequate per-client throughput and aggregate system throughput. Design assumptions:
1. 25 Mbps per concurrent user minimum for general office / education environments, 50 Mbps per concurrent user minimum for high-bandwidth use cases (video conferencing, cloud desktops, streaming), with the ability to apply per-user, per-SSID, and per-role throughput policies. Owner to specify target profile per building / zone; higher targets (100+ Mbps) required where AR/VR, 4K/8K video, or large-file collaboration is anticipated.
  2. Provide minimum -65 dBm primary AP signal level at all intended-use locations (measured at 1.2 m / 4 ft above finished floor, device oriented toward AP) for 5 GHz and 6 GHz coverage. Provide minimum -72 dBm secondary AP signal level at all locations to support band steering, 802.11k/v/r fast roaming, and Wi-Fi 7 Multi-Link Operation. Minimum 25 dB SNR required at intended-use locations for data applications, 28 dB SNR for VoWiFi / real-time voice and video. Note: signal strength is properly expressed in dBm (power relative to 1 mW), not dB.
  3. Design AP density based on concurrent associated clients per AP (aggregate across all radios) and per-client throughput targets, not a fixed per-radio client count. Design targets: 40–60 concurrent clients per AP for general office / classroom environments; 25–40 concurrent clients per AP for high-density lecture halls, auditoriums, and conference centers (capacity-driven, not coverage-driven); 15–25 concurrent clients per AP for voice/real-time



applications. Predictive and validation surveys shall confirm these targets are met at the design signal and SNR levels specified herein.

4. Design assumes a minimum of 3 concurrent Wi-Fi devices per person (laptop + phone + tablet/wearable/IoT) for occupancy planning in employee/student areas, and 2 devices per person in guest/visitor areas, plus building-system IoT (sensors, cameras, access control, AV) on separate SSID(s). Owner to provide occupancy counts per room/zone; Contractor to apply the device-per-person multiplier to size APs accordingly.
- D. Programming of each AP to coordinate with the Owner's LAN Network Operating System and mobile wireless client device configuration and requirements, including establishing parameters and operations associated with security, QoS, CoS, VLANs, etc.
- E. Provide and install all labor, tools, material, and accessories for a complete Data Network WAN comprised of components as listed in Part 2.
- F. This Contractor is responsible for supplying the proper configuration to Owner with quantities and model numbers for a complete working system.
- G. Perform three (3) distinct wireless surveys using industry-standard professional survey software (Ekahau Pro, iBwave Wi-Fi, Hamina, or Owner-approved equivalent):
  1. **Predictive (RF modeling) survey:** Based on architectural drawings and construction materials, performed before bid or early in design to drive AP quantity and placement.
  2. **On-site validation (AP-on-a-stick) survey:** Before cabling installation to confirm predictive assumptions against as-built conditions.
  3. **Post-installation verification survey:** Performed with the final installed APs powered and configured.
  4. Contractor shall provide a written report and the native survey project file (.esx, .ibwc, or equivalent) for each survey to the Owner and Engineer for review and approval. See Part 3 Execution for detailed survey methodology and pass/fail criteria.
- H. Owner may opt to have third party site survey verification of the wireless coverage provided by Contractor.
- I. The Contractor shall demonstrate to the Owner and Engineer that the system is complete and complies with all operational requirements set forth in the plans and specifications. The Contractor shall provide all miscellaneous items and accessories required to make the system operational whether or not such items are specifically mentioned in the plans and specifications.
- J. The Contractor shall review all plans and specifications for any detail that may impact the installation of the system. Any discrepancies discovered shall be brought to the attention of the Engineer prior to installation.

### 1.03 SYSTEM DESCRIPTION

- A. The WLAN system shall be 802.11ax / 802.11be standard and Wi-Fi standard compliant and shall conform to the following minimum requirements:

1. WPA3-Enterprise (mandatory for Wi-Fi 7 and for 802.11ax data rates and MLO) with Protected Management Frames (PMF); WPA3-Personal and Enhanced Open (OWE) also supported. WPA3-Enterprise 192-bit mode (CNMA suite) where required by Owner. WPA2-Enterprise supported only as a transitional fallback for legacy clients that cannot support WPA3.
  2. Fully Wi-Fi 7, Wi-Fi 6E, Wi-Fi 6, and Wi-Fi 5 compliant, including full MU-MIMO, downlink and uplink OFDMA, 4K-QAM, preamble puncturing, Multiple Resource Unit (MRU), and Multi-Link Operation (MLO) with at least eMLSR mode support (STR strongly preferred).
  3. BLE 5.
  4. Advanced cellular coexistence.
  5. VoWiFi compliant.
  6. Comply with all appropriate FCC regulations. This shall be deemed to include the equipment as well as the installation.
  7. Provide ubiquitous coverage throughout the facility regardless of frequency band.
- B. Access points shall be powered over Ethernet per IEEE 802.3bt Type 3 (60W) minimum, with 802.3bt Type 4 (90W) required for Wi-Fi 7 tri-band APs and any AP operating all radios at full power with MLO active. IEEE 802.3at (PoE+) is acceptable only for APs whose manufacturer documents full operation at that power class; reduced-functionality operation on 802.3at is not acceptable.
- C. Provide a system of RF management with features such as Intrusion Detection, seamless Layer 3 roaming, load balancing, self-healing, etc. The WLAN system shall provide real-time awareness and location of all authorized access points and shall provide means and methods to isolate and remove rogue access points automatically.
- D. The WLAN system shall provide intelligent management with such features as support for VLANs and 802.11e QoS features to ensure highest priority to the most sensitive data (such as VoIP and video conferencing).
- E. Patch cables to connect the WLAN AP to the LAN electronics are furnished under Section 27 15 00 — Communications Horizontal Cabling and installed under Section 27 21 00. This contract shall be responsible for connection of cable to AP and coordination of exact AP locations with the Section 27 15 00 contractor.
- F. The wireless network and all its components shall be installed so that access is provided to all components for general maintenance and repair.
- G. The wireless network equipment shall connect to various types of new or existing equipment.
- H. The Contractor shall provide and configure all the equipment required for connecting the wireless network to the local area network.
- I. The Contractor shall ensure the wireless network is compatible with any routers, gateways, firewalls, etc. provided by others.
- J. The Contractor shall be responsible for working with the Owner, Owner's representative, or other contractors for the final layout and configuration of the wireless network. This shall include but not be limited to all aspects of security,

VLANs, traffic shaping, IP addressing, integration with servers, DHCP address assignments, traffic prioritization, routing, and all other aspects of the configuration of the data electronics.

#### 1.04 QUALITY ASSURANCE

- A. The Contractor shall maintain a fully equipped factory-certified service organization which under normal business operations will provide full maintenance and service of the installed system within 24 hours.
- B. The equipment supplier shall have been an authorized distributor of the equipment provided for a minimum of 1 year. The equipment supplier shall provide factory-trained technicians for programming, installation support, and training of Owner personnel.
- C. All components of the system shall be newly manufactured products. Remanufactured, refurbished, or show floor equipment is not permissible.
- D. The system shall be installed with the latest revision of all hardware, firmware, and software supported by the manufacturer as of the date of the solution implementation.
- E. All equipment shall be UL listed.
- F. All equipment and installation practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- G. All equipment installation practices shall comply with the local electric code.
- H. All equipment shall comply with the latest ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises Standard (current revision ANSI/TIA-607-E, 2024).
- I. All equipment and installation practices shall comply with the latest BICSI Telecommunications Distribution Methods Manual (TDMM) (current revision 15th edition, 2024).
- J. All equipment shall comply with the latest ANSI/TIA-568 series (current E revisions, including ANSI/TIA-568.2-E, 2024), ANSI/TIA-569-E, ANSI/TIA-606-D, ANSI/TIA-607-E, and ANSI/TIA-862-C standards.
- K. All equipment shall provide protection and containment of unwanted wireless signals and prevent access to unwanted networks and content, in accordance with CIPA requirements.
- L. Regulatory and Certification Compliance:
  - 1. FCC / Industry of Canada.
  - 2. CE Marked.
  - 3. Radio Equipment Directive (RED) 2014/53/EU (supersedes the retired R&TTE Directive 1999/5/EC).
  - 4. Low Voltage Directive 2014/35/EU (supersedes 72/23/EEC and 2006/95/EC).
  - 5. EN 300 328.
  - 6. EN 301 489.

7. EN 301 893.
8. UL/IEC/EN 62368-1 (Audio/Video and ICT Equipment Safety; supersedes the withdrawn 60950 series).
9. CB Scheme Safety, cTUVus.
10. UL 2043 plenum rating.
11. Wi-Fi Alliance certified 802.11a/b/g/n/ac/ax/be.

#### **1.05 CONTRACTOR QUALIFICATIONS**

- A. The Network Electronics system shall be furnished, installed, and programmed by a contractor who meets all the requirements listed herein. It shall not be acceptable for the Contractor to utilize a subcontractor for any portion of the work, unless the subcontractor has been approved in writing by the Engineer based upon adherence to the qualifications listed herein.
- B. The Contractor shall maintain a fully equipped, factory-certified service organization capable of providing full maintenance and service of the installed system within 24 hours. This facility shall be available for inspection by the Engineer.
- C. The Contractor shall employ factory-trained service personnel for the service and maintenance of the system.
- D. The Contractor shall have a minimum of 3 years' experience with the specified manufacturer's wireless network electronics, including at least 2 years' experience with Wi-Fi 6E or Wi-Fi 7 deployments. Experience shall include having completed a minimum of 3 installations of similar size and scope in the past 24 months, at least one of which shall be Wi-Fi 6E or Wi-Fi 7. Contractor shall provide references and contact information for the project sites in which the qualifying installations occurred. Contractor shall employ at least one currently certified engineer from the selected manufacturer (e.g., HPE Aruba ACMX/ACSA, Cisco CCNP Wireless / CCIE Wireless, Ruckus WISE, or equivalent current credential).

#### **1.06 SHOP DRAWINGS AND SUBMITTALS**

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Drawings shall be prepared and submitted electronically in PDF format and, if hard copies are requested, on 30" x 42" bond paper. Equipment lists, data sheets, etc. shall be 8-1/2" x 11" size properly bound into a single or multiple volumes.
- B. Submit the following for approval:
  1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.
  2. Manufacturer's data sheets on all equipment items.
  3. System block diagram(s).
  4. Equipment rack layouts showing all rack-mounted equipment items.
  5. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.

- C. **Final Documentation:** All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Within 45 days after completion of the work, deliver to the Owner four (4) sets of the following:
1. A complete as-installed equipment list, listed by room, with manufacturer's names, model numbers, serial numbers, and quantities of each item.
  2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers, layouts, and other designations and codings.
  3. Complete equipment rack layouts showing all rack-mounted equipment items.
  4. Operations instructions for each major item of equipment furnished.
  5. Manufacturer's warranty for each major item of equipment furnished.
  6. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.

#### **1.07 COORDINATION**

- A. Coordinate the location of the data network electronics and racks with the Electrical Contractor for placement of electrical connections.
- B. Coordinate the configuration of the data network electronics for compatibility with WAN connections, addressing, and routing.
- C. Coordinate UPS and power strip locations with other trades for placement of electrical connections.
- D. Coordinate all UPS and power strip input connectors with the electrical contractor.
- E. Coordinate with the Network Integrators such that the UPS units are communicating with the network utilizing their SNMP cards or IP-based web monitoring.

#### **1.08 STORAGE OF MATERIALS**

- A. All materials shall be secured when not in use by the Contractor.
- B. It shall be the Contractor's responsibility to secure all equipment including all material to be installed as part of the contract. No changes shall be made to the contract due to loss or theft of equipment and materials not officially accepted by the Owner.

#### **1.09 SYSTEM WARRANTY**

- A. The Wireless Area Network Electronics software shall be warranted by the Contractor for a period of three (3) years from date of substantial completion.
- B. Provide advanced replacement for all Network Electronics for the three (3) year period.
- C. Provide proof of warranty from manufacturer.

#### **1.10 RELATED WORK BY OTHERS**

- A. All conduit with pull strings, all electrical pull boxes, and all outlet boxes shall be furnished and installed under the electrical section of Division 26. Coordinate as necessary for proper installation. All conduit systems shall be insulated from the equipment racks using non-metallic bushings or raceways.
- B. All power conductors and conduits associated with power circuits to all equipment locations shall be furnished and installed under the electrical section of Division 26. The power to the equipment racks shall be terminated inside the racks to Contractor-supplied isolated ground plug strips or quad convenience outlets. All conduit systems shall be insulated from the equipment racks using non-metallic bushings or raceways.
- C. An insulated #6 AWG stranded copper ground wire from each equipment rack to the building main service ground.

## **PART 2 - PRODUCTS**

### **2.01 PRODUCT EQUIVALENCY**

- A. Where products are listed with multiple manufacturers, these manufacturers will be approved as equals if all specified features are provided. Any equipment not specifically approved in writing prior to the bid date will not be considered regardless of qualifications. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate equipment at the Contractor's expense.
- B. Different manufacturers may require various options, accessories, converters, patch cables, etc. to perform the specified features and functions. Therefore, all material and/or equipment necessary for proper operation of the system shall be deemed part of these specifications.

### **2.02 MANUFACTURERS**

- A. Approved Vendors for Wireless Network Equipment:
  - 1. Aruba.
  - 2. Ruckus.
  - 3. Extreme.

### **2.03 WIRELESS NETWORK — GENERAL**

- A. Provide all necessary licenses required for a fully operational system.
- B. Provide centrally powered (PoE per IEEE 802.3bt) tri-band Wi-Fi 7 (802.11be) access points, with Wi-Fi 6E (802.11ax in 6 GHz) acceptable as a minimum per Owner selection. APs shall have a multi-gigabit uplink of 5GBASE-T minimum, with 10GBASE-T preferred for Wi-Fi 7 tri-band APs since combined tri-radio throughput with MLO exceeds 5 Gbps. APs shall be managed by an on-premises wireless controller, cloud-based controller/cloud management, or distributed controller-less architecture per Owner preference, to support wireless devices, phones, and IoT endpoints throughout the building and associated campus.
- C. Shall have the ability to manage the AP directly.
- D. Tri-band radios shall support, at minimum: 2.4 GHz (802.11b/g/n/ax), 5 GHz (802.11a/n/ac/ax/be), and 6 GHz (802.11ax/be). Aggregate maximum PHY rate shall

- be a minimum of 10 Gbps for a Wi-Fi 7 AP (e.g., 2.4 GHz ≈688 Mbps, 5 GHz ≈5.76 Gbps at 160 MHz, 6 GHz ≈11.5 Gbps at 320 MHz for a 4x4:4 AP). Final rates per manufacturer datasheet; Owner to approve at submittal.
- E. Coordinate 802.1X, VLAN, and security settings/requirements with the Owner.
  - F. Provide capacity-driven wireless coverage for the entire building and associated perimeter. Base design on a minimum of 3 concurrent Wi-Fi devices per person in employee/student areas and 2 per person in guest areas, plus separate IoT / building-system endpoints on dedicated SSIDs. Design shall be capacity-driven, not coverage-driven, in high-density spaces such as auditoriums, conference rooms, lecture halls, cafeterias, and gathering areas.
  - G. Provide minimum of:
    - 1. Minimum 3 concurrent devices per person (laptop + phone + tablet/wearable/IoT) in employee and student areas, 2 per person in guest areas.
    - 2. Minimum -65 dBm primary and -72 dBm secondary signal throughout building, minimum 25 dB SNR (28 dB for voice), at 1.2 m / 4 ft AFF for 5 GHz and 6 GHz coverage.
    - 3. 25 Mbps per concurrent user minimum (50 Mbps for high-bandwidth use cases; higher for AR/VR/4K) with the ability to apply per-user, per-SSID, and per-role throughput policies.
    - 4. Concurrent clients per AP (aggregate across all radios): 40–60 general office/classroom, 25–40 high-density auditorium/lecture hall, 15–25 voice/real-time. Design capacity-driven where occupancy exceeds coverage-driven AP count.
  - H. Supply sufficient access points to provide for expected throughput and load sharing.
  - I. Clients shall “see” at least 3 APs at or above -72 dBm to provide for load sharing, band steering, fast roaming (802.11k/v/r), and Wi-Fi 7 Multi-Link Operation. At least one primary AP at or above -65 dBm and at least one secondary AP at or above -72 dBm shall be available at every intended-use location.

## 2.04 WIRELESS SURVEY

- A. Contractor shall perform a staged survey program consisting of a Predictive Survey, an On-Site Validation Survey, and a Post-Installation Verification Survey (the latter described in Part 3 Execution / Testing). All surveys shall use industry-standard professional survey software (Ekahau Pro, iBwave Wi-Fi, Hamina, or Owner-approved equivalent). Native project files (.esx, .ibwc, or equivalent) shall be delivered to the Owner along with written reports for each phase.
- B. **Predictive Survey:** Contractor shall perform a predictive (RF modeling) survey using architectural drawings and Owner-provided construction material information before bid or at the earliest stage of design. The model shall include: building footprint, floor-to-floor dimensions, wall/floor construction attenuation values, floor-to-floor RF leakage, and expected occupancy and device density per room/zone. The predictive survey shall produce an AP placement plan showing AP quantity, model, mounting location, antenna orientation, channel plan, and transmit power for 2.4 GHz, 5 GHz, and 6 GHz bands. The predictive plan shall demonstrate compliance with the signal strength, SNR, and client capacity targets specified herein before cabling is installed.

- C. **On-Site Validation (AP-on-a-Stick) Survey:** Prior to installation of cabling for access points, and after general construction has progressed to the point that final interior wall construction is in place (including any movable partitions), the Contractor shall perform an on-site validation survey. This survey shall use at least one AP of the specified model mounted on a portable stand or pole ("AP on a stick") at candidate locations to measure actual received signal strength (dBm), SNR (dB), noise floor, interference from non-802.11 sources, and co-channel/adjacent-channel interference from neighboring wireless networks. Survey walk pattern shall provide sample density of no more than 2 m between measurement points in intended-use areas, with the survey device held at 1.2 m / 4 ft AFF oriented as a typical end-user device would be held. The Contractor shall reconcile validation results against the predictive model, fine-tune AP placement, and adjust quantities and locations before cabling is run. A revised AP placement plan and survey report shall be provided to the Owner and Engineer for review and approval.
- D. **Post-Installation Verification Survey:** After complete installation and configuration of all APs, and with the building as close to final occupancy conditions as practical (furniture in place, construction debris removed, movable partitions set), the Contractor shall perform a final verification survey with all APs powered, configured, and operating on their production channel plan. The survey shall document, for every intended-use area: primary AP signal level (dBm), secondary AP signal level (dBm), SNR (dB), noise floor (dBm), data rate, channel utilization, and retry rate per band (2.4 GHz, 5 GHz, 6 GHz).
1. **Pass/Fail Criteria:** Primary -65 dBm or better, secondary -72 dBm or better, SNR 25 dB minimum (28 dB in voice/real-time zones), at 1.2 m AFF with the client device oriented as a typical end-user device.
  2. Contractor shall also perform active performance testing at minimum 5 representative locations (including any Media Center, Cafeteria, Auditorium, and high-density gathering spaces) using iPerf3 or equivalent to measure upstream and downstream TCP throughput, UDP jitter, and packet loss against the per-client throughput targets specified in Scope of Work.
  3. Any area failing criteria shall trigger AP relocation, added AP, or channel/power adjustment at no additional cost; verification shall be re-performed after remediation. Deliver final written report and native survey project file to Owner and Engineer.
- E. Coordinate with local law enforcement and safety forces regarding their requirements for remote and wireless access into building security and energy management systems.
- F. Law enforcement and safety forces shall be responsible for providing their own remote access equipment.

## **2.05 WIRELESS MANAGEMENT ARCHITECTURE (CONTROLLER, CLOUD-MANAGED, OR DISTRIBUTED)**

- A. The wireless management system shall be furnished as one of the following architectures, selected by Owner at submittal based on operational preference:
1. On-premises wireless controller (dedicated hardware or virtual appliance) with licensed AP count per manufacturer, noting that Aruba Wi-Fi 7 APs (700 Series)



require AOS-10 and Aruba Central and are not supported on Aruba Instant or legacy on-premises Mobility Conductor.

2. Cloud-managed platform with Contractor-furnished subscription licenses for the required term (e.g., HPE Aruba Networking Central with AOS-10, Cisco Meraki Dashboard, Cisco Catalyst Wireless Cloud, Ruckus Cloud, Juniper Mist).
  3. Distributed / controller-less / branch architecture using AP-resident management with cloud dashboard (e.g., Aruba Instant on Wi-Fi 6/6E APs only, Ruckus Unleashed).
- B. For Aruba deployments with Wi-Fi 7 APs, option (2) with Aruba Central + AOS-10 is required. Contractor shall furnish all required licenses, subscriptions, and activation for the Owner-selected term, minimum three (3) years from date of substantial completion, with renewal terms clearly documented in the closeout package. Subscription licensing true-up and renewal responsibility shall pass to Owner at the end of the Contractor-furnished term; Contractor shall provide advance written notice of expiration dates. All APs shall support Zero-Touch Provisioning (ZTP) through the Owner-selected management platform.
- C. Scalability and performance:
1. 1,024 access points.
  2. 24,000 clients.
  3. 4,096 VLANs.
- D. RF Management:
1. Proactively identifies and mitigates signal interference for better performance.
  2. Provides both real-time and historical information about RF interference affecting network performance across controllers, through system-wide integration.
  3. Multimode with indoor, outdoor mesh access points.
  4. Controller with support for centralized, distributed, and mesh deployments to be used at different places in the network.
  5. Centralized control, management, and client troubleshooting.
  6. Seamless client access in the event of a WAN link failure (local data switching).
  7. Access point upgrade optimizes the WAN link utilization for downloading access point images.
  8. Technology that supports corporate wireless service for mobile and remote workers with secure wired tunnels to indoor access points.
- E. Security:
1. Client data shall be securely encrypted and tunneled from APs to controller.
  2. Management frame protection detects malicious users and alerts network administrators.
  3. Rogue access point detection and detection of denial-of-service attacks.
- F. Voice Support:

1. Supports Unified Communications for improved collaboration through messaging, presence, and conferencing.
  2. Supports all Unified IP phones for cost-effective, real-time voice services.
- G. Fault tolerance and high availability:
1. Sub-second access point and client failover for uninterrupted application availability.
  2. Multi-1 Gigabit or NBASE-T Ethernet connectivity.
  3. Solid-state device-based storage — no moving parts.
  4. Hot-swappable redundant AC or DC power supply and solid-state storage with no incremental system downtime.
- H. Service Provider Wi-Fi:
1. Wi-Fi Alliance Passpoint (Hotspot 2.0) certified, facilitating hotspot operation for mobile data offload.
  2. Network-based mobility management.
- I. Enterprise Wireless Mesh:
1. Ideal for locations where extending a wired connection may prove difficult or aesthetically unappealing: parking lots, playgrounds, stadiums, campus environments.
  2. Mobility, security, and management for IPv6 and dual-stack clients.
  3. Highly secure, reliable wireless connectivity and consistent end-user experience.
  4. Increased network availability through proactive blocking of known threats.
- J. Licensing:
1. For on-premises controller deployments: provide per-AP licensing for the total installed AP count plus 20% growth capacity. For cloud-managed or subscription-licensed deployments: provide the appropriate tier (e.g., Aruba Central Foundation/Advanced, Meraki Enterprise/Advanced, Mist Wi-Fi Assurance) for the Owner-selected term (minimum 3 years) covering all installed APs. License keys, subscription account information, and renewal details shall be documented in the closeout package.
  2. Additional access point capacity licenses can be added over time.
  3. Licensing model shall match Owner-selected architecture: perpetual per-AP licenses for on-premises controller, or subscription licenses for cloud-managed platforms, with all license keys and subscription details documented at closeout.
- K. Wireless: IEEE 802.11a, 802.11b, 802.11g, 802.11d, WMM/802.11e, 802.11h, 802.11n, 802.11k, 802.11r, 802.11u, 802.11w, 802.11ax Wave 1 and Wave 2, 802.11ax, 802.11be.
- L. Data Request for Comments (RFC) — supported:
1. RFC 768 UDP; RFC 791 IP; RFC 2460 IPv6; RFC 792 ICMP; RFC 793 TCP; RFC 826 ARP.

2. RFC 1122 Requirements for Internet Hosts; RFC 1519 CIDR; RFC 1542 BOOTP; RFC 2131 DHCP.

M. Security Standards:

1. Wi-Fi Protected Access 2 and 3 (WPA2, WPA3).
2. IEEE 802.11i (WPA2, RSN).
3. RFC 6234 SHA-2 family (SHA-256 / SHA-384 / SHA-512). MD5 (RFC 1321) is cryptographically broken and shall not be used.
4. RFC 3602 AES-CBC Cipher Algorithm for ESP, and RFC 4106 GCM for ESP. 3DES (RFC 1851) is deprecated and shall not be used.
5. RFC 2104 HMAC: Keyed Hashing for Message Authentication.
6. RFC 5246 TLS Protocol Version 1.2 (minimum) and RFC 8446 TLS Protocol Version 1.3 (preferred). TLS 1.0 (RFC 2246) and TLS 1.1 (RFC 4346) are deprecated (RFC 8996) and shall not be used.
7. RFC 2401 Security Architecture for the Internet Protocol.
8. RFC 4868 HMAC-SHA-256/384/512 within ESP and AH. HMAC-MD5 (RFC 2403) and HMAC-SHA-1 (RFC 2404) shall not be used.
9. RFC 4106 AES-GCM for ESP (preferred) or RFC 3602 AES-CBC for ESP. DES-CBC (RFC 2405) is deprecated and shall not be used.
10. RFC 2407 Interpretation for ISAKMP; RFC 2408 ISAKMP; RFC 2409 IKE; RFC 2451 ESP CBC-Mode Cipher Algorithms.
11. RFC 3280 Internet X.509 PKI Certificate and CRL Profile.
12. RFC 4347 Datagram Transport Layer Security.

N. Encryption:

1. WEP, TKIP, and RC4 are cryptographically broken and shall not be supported or enabled. AES-based encryption is required.
2. Advanced Encryption Standard (AES): Cipher Block Chaining (CBC), Counter with CBC-MAC (CCM), Counter with Cipher Block Chaining Message Authentication Code Protocol (CCMP).
3. DES and 3DES are deprecated and shall not be supported or enabled. Use AES-128 (minimum) or AES-256 as specified elsewhere.
4. Transport Layer Security (TLS) 1.2 minimum, TLS 1.3 preferred, with modern cipher suites (ECDHE key exchange, AES-GCM or ChaCha20-Poly1305, SHA-256 or better). RSA 2048-bit minimum for legacy compatibility; ECDSA P-256 or P-384 preferred. All SSL versions (SSLv2, SSLv3), TLS 1.0, TLS 1.1, RC4, and RSA 1024-bit shall be disabled.
5. DTLS: AES-CBC.
6. IPsec: AES-GCM (preferred) or AES-CBC with SHA-256 or better integrity. DES, 3DES, MD5, and SHA-1 shall not be supported.
7. 802.1AE MACsec encryption.

O. Authentication, Authorization, and Accounting (AAA):

1. IEEE 802.1X.
  2. RFC 2548 Microsoft Vendor-Specific RADIUS Attributes; RFC 2716 PPP EAP-TLS; RFC 2865 RADIUS Authentication; RFC 2866 RADIUS Accounting; RFC 2867 RADIUS Tunnel Accounting; RFC 3576 Dynamic Authorization Extensions to RADIUS; RFC 3579 RADIUS Support for EAP; RFC 3580 IEEE 802.1X RADIUS Guidelines; RFC 3748 Extensible Authentication Protocol (EAP).
  3. Web-based authentication.
  4. TACACS support for management users.
- P. Management:
1. SNMPv3 with authentication and privacy (authPriv, SHA-256 or better / AES-128 or better). SNMPv1 and SNMPv2c shall be disabled.
  2. RFC 4251 SSH Protocol Architecture (SSHv2). Telnet (RFC 854) shall be disabled.
  3. RFC 1155 Management Information for TCP/IP-Based Internets; RFC 1156 MIB; RFC 1157 SNMP; RFC 1213 SNMP MIB II; RFC 1350 TFTP; RFC 1643 Ethernet MIB; RFC 2030 SNMP; RFC 2616 HTTP; RFC 2665 Ethernet-Like Interface Types MIB; RFC 2674 Bridges with Traffic Classes; RFC 2819 RMON MIB; RFC 2863 Interfaces Group MIB; RFC 3164 Syslog; RFC 3414 USM for SNMPv3; RFC 3418 MIB for SNMP; RFC 3636 IEEE 802.3 MAUs.
- Q. Management Interfaces:
1. Web-based: HTTP/HTTPS.
  2. Command-line interface: Secure Shell (SSH v2) and local serial port. Telnet shall be disabled.
  3. Cloud-based or on-premises network management software support.
- R. Interfaces and Indicators:
1. 50 Gbps of uplink capacity minimum (2 x 25 Gbps SFP28 or greater), with 100 Gbps (QSFP28) as an Owner option for campus-scale controllers aggregating large Wi-Fi 7 AP fleets. 2 x 10 Gbps SFP+ is acceptable as absolute minimum only where 25 Gbps is not feasible; coordinate with Owner.
  2. 1 x console port: serial port (RJ-45 or USB).
  3. LED indicators: Network Link, Diagnostics.
- S. Regulatory Compliance:
1. CE Markings per current EU directives: EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU.
  2. Safety: UL 62368-1; CAN/CSA-C22.2 No. 62368-1; EN/IEC 62368-1; AS/NZS 62368.1 (supersede the withdrawn 60950-1 series).
  3. EMC Emissions: 47CFR Part 15 (CFR 47) Class A; AS/NZS CISPR22 Class A; EN 55022 Class A; ICES003 Class A; VCCI Class A; EN 61000-3-2; EN 61000-3-3; KN22 Class A; CNS 13438 Class A.
  4. EMC Immunity: EN 55024; CISPR 24; EN 300386; KN24.

T. Warranty: three (3) year license with maintenance.

## 2.06 WIRELESS ACCESS POINTS

- A. **Basis of Design:** HPE Aruba Networking AP-735 (tri-band Wi-Fi 7 flagship campus AP, 4x4:4 in 5 GHz and 6 GHz, Ultra Tri-Band filtering, dual 5 Gbps Ethernet ports, dual integrated IoT radios with Bluetooth 6 and 802.15.4/Zigbee, dual USB ports, built-in GNSS receiver and barometric sensor for sub-1-meter location). Alternative Aruba models: AP-725 (compact Wi-Fi 7 2x2, 2.5 Gbps port, lower density) or AP-755 (high-capacity Wi-Fi 7 4x4) may be selected per drawings. Approved equals from other manufacturers: Cisco Catalyst 9178I / Meraki CW9178 or Ruckus R770. Wi-Fi 6E alternates (Aruba AP-655, Cisco Catalyst 9166, Ruckus R760) acceptable where Owner selects Wi-Fi 6E as project baseline. Final selection to be approved at submittal; substitutions shall meet or exceed all specified features.
- B. The Owner requires a new wireless data network that will attach to the wired data network in the communications room. The system shall consist of wireless access points (AP) and management software.
- C. The APs shall be 802.11ax / 802.11be standard, Wi-Fi compliant utilizing multi-band transceivers and shall conform to the following minimum specifications:
1. Indoor tri-band Wi-Fi 7 (802.11be) access point, minimum 4x4:4 in 5 GHz and 6 GHz, with 5GBASE-T uplink minimum (10GBASE-T preferred). Wi-Fi 6E (802.11ax, 4x4:4 tri-band) acceptable as Owner-selected alternate.
- D. Maximum PHY Rate:
1. 2.4 GHz: 688 Mbps minimum (802.11ax / 802.11be).
  2. 5 GHz: 5.76 Gbps minimum at 160 MHz (802.11ax / 802.11be, 4K-QAM).
  3. 6 GHz: 11.5 Gbps minimum at 320 MHz (802.11be, 4K-QAM, 4x4:4); for Wi-Fi 6E alternate, 4.8 Gbps minimum at 160 MHz (802.11ax).
- E. Wi-Fi Technology — Radio Chains:Streams:
1. 2.4 GHz: 2x2:2.
  2. 5 GHz: 4x4:4.
- F. Antenna Gain (max): up to 7.5 dBi.
- G. USB: integrated USB port for sensor or IoT dongles.
- H. Ethernet Ports:
1. 1x 1/2.5/5/10 Gbps multi-gigabit port (NBASE-T / IEEE 802.3bz compliant, 10GBASE-T per IEEE 802.3an), RJ-45, with IEEE 802.3bt PoE Type 3 minimum (Type 4 where required).
  2. 1x 100/1000/2500 Mbps secondary port, RJ-45, for link aggregation, console, or mesh backhaul.
- I. Integrated Bluetooth 5.3 (or later) with BLE support; integrated IEEE 802.15.4 radio (Zigbee / Thread / Matter) for IoT; integrated USB port for sensor or IoT dongles.
- J. Changes to the APs shall be able to be made globally from one interface.

- K. The AP shall be able to be deployed across any Layer 2 or Layer 3 network and bridge traffic onto the local network or tunnel to a central location.
- L. AP shall be able to be deployed as a stand-alone AP or as part of a centrally managed wireless LAN.
- M. Each AP shall have at least two (2) Gigabit Ethernet ports for aggregated bandwidth.
- N. The wireless network access points shall be equipped with 802.11 a/b/g/n/ac/ax/be radios for multiple connectivity. Each access point shall meet the following specifications:
  - 1. **Wi-Fi Standards:** IEEE 802.11a/b/g/n/ac/ax/be.
  - 2. Supported Rates:
    - a. 802.11ax: 4 to 4800 Mbps.
    - b. 802.11ac: 6.5 to 3467 Mbps.
    - c. 802.11n: 6.5 to 600 Mbps.
    - d. 802.11a/g: 6 to 54 Mbps.
    - e. 802.11b: 1 to 11 Mbps.
  - 3. Supported Channels:
    - a. 2.4 GHz: 1–13.
    - b. 5 GHz: 36–64, 100–144, 149–165.
    - c. 6 GHz: U-NII-5 through U-NII-8 channels per Article 2.09 of this Section and applicable FCC rules (20/40/80/160/320 MHz widths).
  - 4. **MIMO:** 4x4 MU-MIMO; 4x4 SU-MIMO.
  - 5. **Spatial Streams:** 4 MU-MIMO; 4 SU-MIMO.
  - 6. **OFDMA:** Uplink and downlink.
  - 7. **Channelization:** 20, 40, 80, 160 MHz.
  - 8. **Security:** WPA3-Enterprise (primary, mandatory for Wi-Fi 7 / MLO), WPA3-Personal (SAE), Enhanced Open (OWE), WPA2-Enterprise (transitional fallback only), 802.11i, Protected Management Frames (PMF) required per Wi-Fi 7. WEP, TKIP, and WPA-PSK (original WPA) shall not be supported or enabled.
  - 9. WIPS/WIDS.
  - 10. **Other Wi-Fi Features:** WMM, Power Save, TxBF, LDPC, STBC, 802.11r/k/v.
- O. Networking:
  - 1. Mesh — self-healing mesh.
  - 2. IP — IPv4, IPv6.
  - 3. VLAN 802.1Q (16 BSSIDs / radio).
  - 4. VLAN Pooling — Port-based, Dynamic, per user based on RADIUS.
  - 5. 802.1X — Wired & wireless Authenticator & Supplicant.
- P. Policy Management Tools:

1. Application Visibility and Control.
2. Access Control Lists.
3. Device Fingerprinting.

Q. RF:

1. Antenna Type (2.4 GHz Antenna): Omni: 2 antennas; Adaptive: 2 antennas.
2. Antenna Type (5 GHz and 6 GHz Antennas): Omni: 4 antennas per band.
3. Antenna Gain (Max): up to 7.5 dBi maximum across bands, per paragraph F of this Article.
4. Frequency Bands:
  - a. 2.4–2.484 GHz.
  - b. 5.17–5.33 GHz.
  - c. 5.49–5.71 GHz.
  - d. 5.735–5.835 GHz.
  - e. 5.925–7.125 GHz (6 GHz, U-NII-5 through U-NII-8).
- R. The APs shall provide for rapid traffic forwarding and capabilities that will enable effective real-time and air traffic management through load balancing.
- S. Traffic management shall be used to ensure maximum network uptime. Clients shall be routed around a failed access point to the closest available alternative on a real-time basis without manual intervention.
- T. Each AP shall be able to support VoIP wireless phones and dynamically throttle back non-VoIP traffic.
- U. Each AP shall operate tri-band (2.4 GHz, 5 GHz, and 6 GHz) and conform to IEEE 802.11ax and IEEE 802.11be.
- V. Integrated antennas.

## 2.07 ANTENNAS

- A. Provide each access point with the integral antennas based upon system configuration and site survey results. Utilize wall-mounted antennas for exterior applications.
- B. **Exterior:** Shall be rated for outdoor environment and shall be provided with lightning protection on the cabling. Provide drip loop on cabling entering the building. Both AP and antennas must be external and outdoor rated.

## 2.08 NEMA RATED ENCLOSURES

- A. Used for rugged areas, areas exposed to moisture, and outdoor areas.
- B. **Basis of Design:** Oberon 1021 or equal.
- C. **Design:** Rugged polycarbonate AP enclosure designed for surface mounting AP indoors or outdoors, including wall mounting or light pole mounting. Conceal and protect AP, antennas, and cabling.

- D. **Performance:** Designed to NEMA 1, 2, 4, 4X, 12, and 13, and IEC 529-IP66 specifications for indoor/outdoor wet, dirty, or corrosive environments. UV-stabilized for exposure to direct sunlight. Transparent to wireless signals. Paintable.
- E. Oberon Skybar™-shaped screw-on cover with gasket; cover screws must be torqued to 8 in-lbs.; cover screws are recessed into cover.
- F. Includes internal universal T-bar bracket and universal mounting panel.
- G. Large enough for external antenna and AP.
- H. AP max operating temperature should be de-rated by 5°C inside the enclosure, when solar loading is not present (see Oberon application note in resources section).
- I. For outdoor installation, the 1021 is white to reduce solar loading. Painting the 1021 a darker color will increase solar loading. Avoid mounting the 1021 where it is directly exposed to the sun. Temperature rating: -40 to 120°C.
- J. **Construction:** White UL 94 V-0 polycarbonate enclosure, gray UL 94-HB ABS plastic universal mounting panel, gray UL 94-HB ABS plastic wall mount brackets, 18 ga. white powder-coated steel T-bar bracket.

## 2.09 WIRELESS MANAGEMENT SOFTWARE

- A. RF Management:
  - 1. In-band per spectrum analysis.
  - 2. Dynamic channel configuration.
  - 3. Dynamic cell size configuration.
  - 4. Monitor radio for threat assessment and mitigation.
  - 5. Wired and wireless packet captures (including all 802.11 headers).
  - 6. Radio Assurance for radio self-test and healing.
  - 7. RF monitor.
  - 8. High availability supports Hot Stand-by for mission-critical areas.
  - 9. Supports ability to turn off radios based on schedule configuration or automatically when not in use.
- B. Wireless Protocols: IEEE 802.11, 802.11a, 802.11b, 802.11d, 802.11e, 802.11g, 802.11h, 802.11i, 802.11n, 802.11ac, 802.11ax, 802.11be.
- C. Wired Protocol:
  - 1. IEEE 802.1p — Layer 2 Traffic Prioritization.
  - 2. IEEE 802.1q — VLAN Tagging.
- D. RFC Support: RFC 768 UDP; RFC 791 IP; RFC 2460 IPv6 (bridging only); RFC 792 ICMP; RFC 793 TCP; RFC 1122 Requirements for Internet Hosts; RFC 1542 BOOTP; RFC 2131 DHCP.
- E. Security:
  - 1. IEEE 802.11i WPA2, RSN.



2. RFC 6234 SHA-2 family (SHA-256 / SHA-384 / SHA-512). MD5 (RFC 1321) is cryptographically broken and shall not be used.
  3. RFC 5246 TLS Protocol Version 1.2 (minimum) and RFC 8446 TLS Protocol Version 1.3 (preferred). TLS 1.0 / TLS 1.1 are deprecated (RFC 8996) and shall not be used.
  4. RFC 3280 Internet X.509 PKI Certificate and CRL Profile.
  5. RFC 4347 Datagram Transport Layer Security.
  6. WPA3-Enterprise (required); WPA-Personal; WPA-Enterprise; WPA2-Personal; WPA2-Enterprise.
- F. EAP Type(s): EAP-TLS, EAP-TTLS/MSCHAPv2, PEAPv0/EAP-MSCHAPv2, PEAPv1/EAP-GTC.
- G. Encryption Type:
1. Open.
  2. AES-GCMP-256 (required for WPA3-Enterprise 192-bit mode / CNSA).
  3. GCMP-128 / CCMP-128 (AES).
  4. CCMP/AES.
  5. TLS 1.2 minimum, TLS 1.3 preferred (RSA 2048-bit minimum or ECDSA P-256/P-384; AES-GCM or ChaCha20-Poly1305 cipher suites). SSL (all versions), TLS 1.0, TLS 1.1, RC4, and RSA 1024-bit shall be disabled.
  6. IKEv2 / IPsec VPN (RFC 7296) for site-to-site or remote-access VPN. PPTP and L2TP without IPsec shall not be used; both are cryptographically obsolete.
- H. Authentication:
1. IEEE 802.1X.
  2. RFC 2548 Microsoft Vendor-Specific RADIUS Attributes; RFC 2716 PPP EAP-TLS; RFC 2865 RADIUS Authentication; RFC 2866 RADIUS Accounting; RFC 2867 Tunnel Accounting; RFC 2869 RADIUS Extensions; RFC 3576 Dynamic Authorizations Extensions to RADIUS; RFC 3579 RADIUS Support for EAP; RFC 3748 Extensible Authentication Protocol.
  3. Web Page Authentication; WPR Landing Page Redirect — support for internal and external WPR, landing page, and authentication.
- I. Channel Support — 2.4 GHz: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.
- J. Channel Support — 5 GHz:
1. UNII-1 Non-DFS Channels: 36, 40, 44, 48.
  2. UNII-1 DFS Channels: 52, 56, 60, 64.
  3. UNII-2 DFS Channels: 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.
  4. UNII-3 Non-DFS Channels: 149, 153, 157, 161, 165.
- K. Channel Support — 6 GHz (Wi-Fi 6E and Wi-Fi 7):
1. U-NII-5 (5.925–6.425 GHz): channels 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93.

2. U-NII-6 (6.425–6.525 GHz): channels 97, 101, 105, 109, 113.
  3. U-NII-7 (6.525–6.875 GHz): channels 117, 121, 125, 129, 133, 137, 141, 145, 149, 153, 157, 161, 165, 169, 173, 177, 181, 185.
  4. U-NII-8 (6.875–7.125 GHz): channels 189, 193, 197, 201, 205, 209, 213, 217, 221, 225, 229, 233.
  5. Support 20, 40, 80, 160, and 320 MHz channel widths in 6 GHz. Support Low Power Indoor (LPI), Standard Power with Automated Frequency Coordination (AFC) where Wi-Fi 7 APs and regulatory environment allow, and Very Low Power (VLP) modes as applicable to deployment.
- L. Management Interfaces:
1. Command Line Interface via serial console and SSHv2. Telnet shall be disabled.
  2. Web interface (HTTP / HTTPS).
- M. Management:
1. SNMPv3 with authPriv only. SNMPv1 and SNMPv2c shall be disabled.
  2. RFC 4251 SSHv2. Telnet (RFC 854) shall be disabled.
  3. RFC 1155 Management Information for TCP/IP Based Internets; RFC 1156 MIB; RFC 1157 SNMP; RFC 1213 SNMP MIB II; RFC 1350 TFTP; RFC 1643 Ethernet MIB; RFC 2030 SNTP; RFC 2616 HTTP 1.1; RFC 3636 IEEE 802.3 Managed Objects; RFC 2674 Bridges with Traffic Classes; RFC 2819 Remote Network Monitoring MIB; RFC 2863 Interface Group MIB; RFC 3164 BSD Syslog Protocol; RFC 3414 USM for SNMPv3; RFC 3418 MIB for SNMP.

## **2.10 RADIO OPTIMIZATION MANAGEMENT**

- A. Shall individually control band selection (2.4 GHz or 5 GHz), transmit power, and channel allocation.
- B. Shall have option of controlling band selection either automatically or manually.
- C. Shall support Auto Channel, which provides an automatic means of allocating Wi-Fi channels between radios in a deployment.
- D. Shall provide Auto Channel. System scans the RF environment on a radio-by-radio basis, coordinated among all APs in the network, to determine the best channel of operation per radio.
- E. Auto Channel function shall be scheduled periodically to tune the design in response to potential environmental changes.
- F. Shall support Auto Cell — an automatic, self-tuning mechanism that balances cell size between APs. Shall ensure sufficient coverage while limiting the RF energy that would extend beyond the organizational boundary between APs.

## **2.11 RESOURCE MANAGEMENT**

- A. Shall continuously monitor wireless client behavior for potential issues.
- B. If a client is detected encountering connectivity or performance issues, a notification is logged.

- C. Elements to be monitored:
  - 1. Authentication failures.
  - 2. Packet error rates.
  - 3. Packet retry rates.
  - 4. Data rates.
  - 5. Signal strength.
  - 6. Signal-to-noise ratio.
- D. Shall execute local testing of radio resources and self-healing to ensure wireless service availability.
- E. Automatic interference mitigation, optimized for high-density environments.
- F. AP shall be able to perform WIDS and spectrum analysis as well as serve clients simultaneously.
- G. Wireless network controller shall actively monitor the status of key wireless network elements, including RADIUS servers, NTP servers, SNMP trap hosts, and DNS servers. If any of these elements are unreachable, a notification is logged.
- H. The system shall be optionally configured to disassociate users proactively if network resources are not available so that clients do not remain connected wirelessly with no network service.

## **2.12 DEVICE OPTIMIZATION MANAGEMENT**

- A. Wi-Fi devices shall be identified by type upon connecting to the network (e.g., laptop, tablet, smartphone, gaming device, etc.).
- B. This information is then used to map the device to specific resources as desired. Dedicated radios and wireless networks (SSIDs) can be assigned to devices that need high bandwidth or are operating in a specific mode.
- C. Shall provide station load balancing.

## **2.13 SECURE WIRELESS NETWORK**

- A. Shall perform packet encryption and decryption. All encryption processes are performed at line rate in hardware.
- B. Wireless encryption supported shall include the standard three encryption options:
  - 1. Wi-Fi Protected Access with AES.
  - 2. Wi-Fi Protected Access (WPA2, WPA3) including WPA2 and WPA3 Enterprise.
  - 3. WEP is cryptographically broken and shall NOT be used under any circumstances, including for legacy devices. Legacy devices that cannot support WPA2-Enterprise or better shall be placed on an isolated, segmented network with no access to sensitive Owner resources, or shall be replaced.
- C. WPA3 and Enhanced Open support without hardware upgrade.
- D. AES-only (CCMP / GCMP) shall be enforced on all SSIDs. Mixed TKIP/AES mode shall not be used. WPA3 and WPA2 transition mode may be used temporarily to support legacy clients; migrate to WPA3-only per Owner schedule.

- E. Shall include PCI and FIPS 140-2 audit modes of operation to monitor for compliance.
- F. Shall monitor, detect, mitigate, and report on active or potential wireless threats to the network. These include:
  - 1. Continuous 24x7 monitoring of the wireless RF environment.
  - 2. Detection of potential rogue or malicious APs, ad hoc, and stations.
  - 3. Rogue device classification.
  - 4. Automatic alerts, alarms, and logging of rogue devices.
  - 5. Key rogue device information such as first seen, last seen, manufacturer, SSID, channel.
  - 6. Ensures compliance with wireless security policies and regulations through automated reporting.
- G. Continuously monitor all 802.11 channels for throughput, signal, noise, errors, and interference levels continually per channel.
- H. Administrators centrally collect data from their desk and monitor the entire network at one time.
- I. Monitor all 802.11 channels, not just the ones that are currently being used for data traffic.
- J. **Device Locating:** Provides device locating via analysis of Received Signal Strength Indication (RSSI) data collected by radios. This capability is available via the CLI, web interface, or network management application, and interfaces/applications at different levels of functionality.
- K. Aggregate data from multiple APs to determine device positioning. Multi-AP design provides for even greater accuracy than single-AP methods.
- L. Locating in normal conditions shall provide, at minimum, 3-meter accuracy using RSSI-based trilateration, with sub-1-meter accuracy required where 802.11az Fine Timing Measurement (FTM) capable APs and clients are deployed. Where APs include built-in GNSS receivers and barometric sensors (e.g., Aruba 730 Series), altitude locationing for multi-story buildings shall be supported. Open Locate support (an emerging standard for APs to share location over-the-air and via cloud APIs) shall be enabled where supported by the AP.
- M. User access control protocols and features designed to classify, assign, and monitor associated and unassociated clients. These include:
  - 1. RADIUS 802.1X.
  - 2. Fully support 802.1X authentication servers.
  - 3. MAC Access Control Lists (ACLs) supports 512 ACL entries.
  - 4. Web Page Redirect (Captive Portal) capabilities.
  - 5. Web-based authentication against internal or external RADIUS server.
  - 6. Local host or remotely hosted captive portal or web page redirect (log-in/splash screen).

7. Failover capability by allowing the specification of primary and secondary RADIUS servers and timeout values.
8. Each SSID can specify a unique RADIUS server set enabling each SSID independent authentication control.
9. Identify devices by operating systems, such as iOS®, Microsoft®, BlackBerry®, or Android™.
10. Identify devices by type, such as tablet, laptop, or smartphone.
11. The device ID, along with the user ID, can be used together to map the device to a policy to control a user's reach and behavior.

## 2.14 LOCATION SERVICES

- A. Provide Wi-Fi client location services across the entire wireless network using a management system. Each AP provides a signal reading for each client, and the direction of the antenna provides information about the direction of the client relative to the AP.
- B. **Mapping:** Based on RF settings and properties of the environment, the management software shall generate heat maps showing RF coverage patterns across the environment.
- C. **Asset Tracking:** Shall support tracking of Wi-Fi, BLE, and 802.15.4 (Zigbee/Thread) tagged assets. Accuracy targets: 3 meters for RSSI-based Wi-Fi tracking (typical); sub-1 meter for 802.11az FTM-capable clients; 1–2 meters for BLE Angle-of-Arrival (AoA) with BLE 5.1+ direction finding. Integration with Owner's real-time location system (RTLS) and IoT platforms shall be supported where provided by Owner.

## 2.15 CYBERSECURITY

- A. The Contractor shall configure the wireless infrastructure in accordance with current industry cybersecurity practices, including as applicable the NIST Cybersecurity Framework (CSF 2.0), CIS Critical Security Controls (v8 or later), and any Owner-specific security policies provided at the configuration meetings. This section supplements and does not replace the wireless-specific security controls in Secure Wireless Network above.
- B. Management Plane Hardening (APs and Wireless Controller):
  1. Telnet, HTTP, SNMPv1, and SNMPv2c shall be disabled. Device and controller management shall use SSH (v2 or later), HTTPS (TLS 1.2 minimum, TLS 1.3 preferred, with modern cipher suites), and SNMPv3 authPriv.
  2. Administrative access shall use centralized authentication (TACACS+ or RADIUS, integrated with Owner's directory service) with role-based access control (RBAC) if a centralized authentication backend is provided by Owner. Where Owner does not provide one, local accounts with complex passwords of 14 characters or more, unique per device, shall be used and managed via the Owner's password management process. Local fallback accounts shall be limited to emergency use and documented in the closeout package.
  3. Multi-factor authentication (MFA) shall be required for all administrative access where an MFA-capable authentication backend is provided by Owner and supported by the device.

4. Management access to APs and controller shall be restricted to a dedicated management VLAN / network with ACLs limiting source IP addresses to approved management workstations, jump hosts, and NMS.
  5. Idle session timeout shall be configured to 10 minutes or less. Failed login attempts shall trigger account lockout and generate a log event.
- C. Client Network Access Control (NAC) Integration:
1. Employee and BYOD SSIDs shall use WPA3-Enterprise (802.1X) with EAP-TLS preferred. Where a NAC platform is provided by Owner (Aruba ClearPass Policy Manager or Owner-approved equivalent, including any ClearPass instance furnished under Section 27 21 00), the wireless system shall be integrated with it for authentication, device profiling, posture assessment where supported, and dynamic VLAN / role assignment. Where Owner does not provide a NAC platform, the wireless system shall be pre-configured with RADIUS profiles suitable for later NAC integration.
  2. RADIUS and RadSec (RADIUS over TLS, RFC 6614) shall be used in preference to plain RADIUS where supported by the device and backend.
- D. Logging, Monitoring, and SIEM Integration:
1. Where a centralized logging platform or SIEM is provided by Owner, APs and controller shall forward syslog events to it. Where Owner does not provide one, devices shall use local syslog buffering per manufacturer recommendation and shall be pre-configured with a placeholder syslog destination for later redirection. Minimum log categories: authentication events (success and failure, wired and wireless), configuration changes, radio state changes, WIDS/WIPS events, and rogue AP detections.
  2. Syslog transport shall be TCP with TLS where supported, falling back to UDP only where TLS is unavailable.
  3. All APs and controller shall use the Owner's authoritative NTP server(s); NTP authentication shall be enabled where supported.
- E. Firmware, Patch Management, and Supply Chain:
1. All APs and controller shall be delivered with firmware that is a currently supported release from the manufacturer and that contains no known critical or high-severity CVEs at time of installation. Contractor shall document firmware versions in the closeout package.
  2. Devices shall support cryptographically signed firmware images and secure boot; these features shall be enabled.
  3. Equipment shall be sourced from authorized manufacturer channels. Contractor shall provide chain-of-custody documentation on request. Equipment shall not originate from manufacturers restricted by applicable federal procurement regulations (e.g., Section 889 of the FY2019 NDAA) where Owner is subject to those regulations.
- F. Documentation and Handoff:
1. Contractor shall deliver a security configuration summary at project closeout documenting: enabled management protocols, authentication backend and

fallback accounts, SNMPv3 users, syslog destinations, NAC integration details, firmware versions, enabled SSIDs with their security profiles (WPA3-Enterprise / WPA3-Personal / OWE / transition), WIDS/WIPS configuration, and any deviations from this section with justification.

2. Credentials, PSKs, certificates, and keys used during configuration shall be rotated before handoff to the Owner; the credentials-at-handoff set shall be delivered to the Owner through a secure channel (not email).

## 2.16 INTELLIGENT WIRELESS OPERATIONS AND EDGE SERVICES

- A. The wireless system shall provide AI-powered and automated operational features. Feature names below use HPE Aruba Networking (AOS-10 / Aruba Central) terminology; approved equivalents from Cisco Meraki, Cisco Catalyst, Ruckus, or Juniper Mist shall provide equivalent functionality.
- B. **Automated RF Optimization (AirMatch or equivalent):** The system shall provide machine-learning-based RF management that automatically and continuously optimizes channel assignments, channel bandwidth, and EIRP (transmit power) across all APs in a deployment. Optimization shall consider co-channel interference, adjacent-channel interference, client load, and roaming patterns, and shall support scheduled runs plus event-driven re-optimization.
- C. **AI Client Steering (ClientMatch or equivalent):** The system shall provide AI-driven client optimization to eliminate sticky-client issues, steer clients from 2.4 GHz to 5 GHz or 6 GHz based on client capability and RF conditions, and dynamically load-balance across APs. Steering shall use 802.11v BSS Transition Management frames preferentially, with deauthentication fallback only where 802.11v is not supported by the client. An unsteerable-client list shall be maintained for clients that do not cooperate with steering.
- D. **Cloud-Assisted Fast Roaming:** The system shall support 802.11r Fast Transition (FT) and Opportunistic Key Caching (OKC) orchestrated from the management platform to enable seamless roaming with minimal or no disruption for voice, video, and real-time application traffic. Roaming key material shall be propagated to neighboring APs in advance of client movement.
- E. **AI-Based Client and Device Profiling (Client Insights or equivalent):** The system shall provide agentless machine-learning-based client identification and classification using infrastructure telemetry (DHCP fingerprints, DNS, mDNS, HTTP user agents, radio behavior). Minimum classification coverage: 95% of known client categories including laptops, smartphones, tablets, VoIP phones, printers, IoT devices, medical devices, AV endpoints, and cameras. Classification results shall drive policy assignment automatically.
- F. **Dynamic Segmentation / Role-Based Access:** The system shall provide identity-based, role-driven policy enforcement consistent across wired and wireless access, with downloadable ACLs or user-based tunneling (UBT) to a central policy enforcement point. Coordinate wired-side Dynamic Segmentation configuration with Section 27 21 00 Data Communications Network Equipment. Where deployed on Aruba infrastructure, this feature shall be enabled end-to-end (wired + wireless).
- G. **IoT Platform Operations (IoT Operations or equivalent):** Where APs include integrated Bluetooth and 802.15.4 (Zigbee/Thread) radios, the APs shall function as

IoT connectors and local processing elements, eliminating the need for vendor-specific IoT overlay networks. Owner-specified IoT partner integrations (e.g., building automation, asset tracking, environmental sensing) shall be supported through the management platform's IoT dashboard.

- H. **Link-Level Encryption (MACsec):** Where supported by the AP and connected switch (e.g., Aruba 730 Series APs paired with AOS-CX switches), MACsec shall be enabled on the AP-to-switch uplink to extend link-layer encryption from the wired network to the access point. Coordinate with Section 27 21 00 for compatible switch selection.
- I. **Intelligent Power Management (IPM):** Where APs are powered by PoE, the system shall support intelligent power management that allows APs to operate in reduced-feature modes (e.g., reduced radio chains, disabled USB ports) when the power source supplies less than the AP's full operational requirement, with features restored automatically when full power becomes available. Feature restriction order and thresholds shall be configurable.
- J. **Multicast DNS / Zeroconf Optimization (AirGroup or equivalent):** The system shall support intelligent handling of mDNS / Bonjour / SSDP service discovery across VLANs and subnets for services such as AirPlay, AirPrint, Chromecast, and similar, with policy-based discovery scoping to prevent service announcement flooding and to enforce access control on who can discover and use services.
- K. **Unified Communications Visibility and Prioritization:** The system shall detect, classify, and prioritize voice, video, and collaboration traffic from major UC platforms (Microsoft Teams, Zoom, Webex, Google Meet, and SIP-based VoIP) with per-session visibility, QoS marking, and bandwidth allocation.
- L. **Hotspot Roaming and Passpoint (Air Pass or equivalent, optional):** Where Owner operates multiple sites or participates in a carrier roaming partnership, the system shall support Wi-Fi Alliance Passpoint (Hotspot 2.0 Release 2 or later) for automatic, credential-based roaming between Owner sites and optionally with cellular operator partners for Wi-Fi Calling offload.

## 2.17 GUEST SERVICES

- A. Guest access shall support multiple modern onboarding workflows, configurable per Owner policy:
  - 1. Click-through captive portal with terms-of-use acceptance.
  - 2. Self-registration with SMS or email verification and short-term credentials (configurable validity, typically 1–24 hours).
  - 3. Sponsor-approved access where a registered employee approves the guest via email or mobile app.
  - 4. Pre-generated vouchers or QR codes for events.
- B. Captive portal pages shall be mobile-responsive, support HTTPS only (no HTTP), support branding with Owner logo and colors, and be hosted either on the wireless controller / cloud management platform or on an Owner-approved external portal server.
- C. **Network Isolation:** Guest SSID(s) shall be isolated from internal Owner networks at Layer 3. Guest traffic shall not be permitted to reach internal VLANs, internal DNS,



- internal DHCP, or internal services except as explicitly allowed by Owner policy (typically limited to Internet-bound traffic only). Station-to-station isolation within the guest SSID shall be enabled.
- D. **Encryption:** Guest SSIDs shall use Enhanced Open (OWE / Opportunistic Wireless Encryption) where supported to provide encrypted over-the-air transport without pre-shared keys. Unencrypted open SSIDs are not permitted.
  - E. **Directory Integration:** Guest onboarding shall optionally integrate with the Owner's identity provider (SAML 2.0 or OpenID Connect) and/or directory service (LDAP / Active Directory) for sponsor lookup, audit logging, and access approval workflows, where provided by Owner.
  - F. **IoT / BYOD Access:** For IoT devices and personal devices that cannot use WPA3-Enterprise, the system shall support Dynamic Pre-Shared Key (DPSK / iPSK / MP SK) with per-device unique pre-shared keys, device-specific policy, and individual revocation without impacting other devices.
  - G. **Data Privacy:** Guest registration data shall be stored and retained in accordance with applicable privacy regulations (e.g., GDPR where applicable, state-level data protection laws). Owner shall specify retention period; default shall not exceed 90 days unless required by law or Owner policy.
  - H. **Policy Management:** Bandwidth limits can be configured to ensure guest users do not overrun employee traffic usage. Restrictions can be placed on time of day access and day of the week access. Policies can be set to enforce use policies for different device types. Policies can be set and enforced on a user, role, device, and time basis.

## 2.18 VOICE AND MULTIMEDIA SUPPORT (QoS)

- A. Optimize application support so all standard QoS (802.11e) and Wireless Multi-Media (WMM) features including multiple traffic queues (4) and packet level identification of voice traffic. Wired to wireless QoS mapping (802.11p/q) support. Separate protocol support for the leading providers of 802.11 handsets.
- B. Enable end-to-end QoS support and tag 802.1p packets.
- C. Shall have multicast-to-unicast conversion and IGMP snooping to optimize the performance of multicast in a Wi-Fi environment. IGMP (Internet Group Management Protocol) is used to establish and manage the membership of multicast groups. The following configuration options are available:
  - 1. Send multicasts unmodified.
  - 2. Convert to unicast and send unicast packets to all stations.
  - 3. Convert to unicast, snoop IGMP, and only send to stations subscribed (send as multicast if no subscription).
  - 4. Convert to unicast, snoop IGMP, and only send to stations subscribed (don't send packet if no subscription).
- D. Each SSID can define separate traffic controls based on business requirements, including QoS (VoIP) and QoS tags can also be updated based on policy rules via the integrated firewall.

## 2.19 MOBILE DEVICE MANAGEMENT

- A. Provide a high level of flexibility in allocating Wi-Fi users and devices among system resources to optimize overall performance.
- B. Wi-Fi devices shall be identified by type upon connecting to the network (e.g., laptop, tablet, smartphone, gaming device).
- C. Dedicated radios and wireless networks (SSIDs) can be assigned to devices that need high bandwidth or are operating in a specific mode. Coordinate with Owner.
- D. Based on device type, specific policies can be applied such as bandwidth restrictions, application types, and time restrictions. Coordinate with Owner.
- E. Resources can also be allocated based on device performance ensuring the performance of faster device types (e.g., 802.11ax) are not negatively impacted by slower device types (e.g., 802.11b). Coordinate with Owner.
- F. Users can be assigned to specific resources based on not just login information, but also client type and class. Identify the devices' operating systems such as iOS®, Microsoft® Windows®, BlackBerry®, or Android™ and can then classify the device type such as tablet, laptop, or smartphone. Once the device has been identified, a policy can be applied to control a user's reach and behavior. The device ID, along with the user ID, can be used together to map that instance to a specific user group.
- G. Allow different user groups to be created with each group being mapped to specific VLANs, access control list, and QoS parameters.

## 2.20 APPLICATION CONTROL

- A. Through software application and Deep Packet Inspection, monitor and control access to applications, prioritize critical applications, restrict usage of bandwidth-heavy applications, and block restricted applications from the network.
- B. Application control shall be tied to the policy engine.

## 2.21 SYSTEM REQUIREMENTS

- A. Wireless software management system requirements:
  - 1. Modular APs Managed: 1,000.
  - 2. Max Stations Managed: 5,000.
- B. **Self-Healing:** The system shall detect and automatically re-route traffic due to loss of communications with an access point.
- C. **Load Balancing:** The system shall monitor AP usage in real time and shift traffic between adjacent or overlapping APs to ensure the most efficient use of wireless bandwidth. The system shall also be able to dynamically allocate signal power between APs to compensate for changing network traffic and system configuration.
- D. The Contractor shall be required to fully review the existing infrastructure and conditions.
- E. The Contractor shall verify that space is available in existing racks/cabinets for all new wireless equipment.
- F. All wireless controller equipment shall mount in standard 19" relay racks or cabinets.

- G. All patch cables required for the entire connectivity of the wireless network shall be provided and installed by the Contractor.
- H. The overall intent of the wireless network is to provide complete coverage of the specified area(s) as shown on the detailed drawings.
- I. All electronics provided for the system shall be from the same manufacturer and shall be fully supported by the management system provided by the Contractor.
- J. In each communications room the equipment shall be directly connected to a ground bar that is connected to the electrical ground in the building.

## **2.22 SPARE AP**

- A. The Contractor shall include with the bid 10% but no less than ten (10) additional APs that will be applied as needed during the site survey to correct for RF coverage issues. The Contractor shall include 250' of data cable along with termination and testing with each AP for a fully installed and operational AP. In the event that the additional APs are not required, they shall be turned over to the Owner as "attic stock."

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. The Contractor shall make the construction manager aware of any site issues prior to submission of the Bid Response.

### **3.02 GENERAL INSTALLATION**

- A. Install systems in accordance with UL, NEC, and all other applicable codes. Install system to comply with drawings and final shop drawings in compliance with manufacturer instructions. Provide all required hardware and labor for rack mounting of system components.
- B. Prior to installation of cabling for access points, the Contractor shall perform an on-site validation survey. This survey shall be utilized to obtain actual site conditions including RF environment and RF properties of the construction. The validation survey shall be used by the Contractor to fine-tune the AP design/layout and set the final quantities and locations of access points. The site validation survey shall be conducted to meet the following minimum requirements:
  - 1. Utilize the appropriate RF sensing equipment to locate, identify, and document any sources of RF activity within the area that could degrade or interfere with the WLAN.
  - 2. Evaluate construction and possible obstacles to RF operation to determine final location of all APs and proper selection of antenna types.
  - 3. Evaluate potential for RF signal leakage outside the building and adjust AP locations, power settings, and antenna types to minimize leakage. The exception is specific areas of the site specifically requested to have WLAN coverage.
- C. It is the Contractor's responsibility to program the devices in this section according to the Owner's network requirements. The Contractor shall meet with the Owner and/or Engineer and reach agreement on the programming.

- D. Provide any miscellaneous equipment such as identification tags, cable ties, wiring harnesses, patch cables (both copper and fiber), stacking cables, etc. necessary for a complete turnkey system.
- E. Provide all required jumper and patch cables and coordination with the Owner to connect the wired LAN.
- F. Install and set up all UPS equipment. Review power-down procedures with the Owner.
- G. Review and modify document design to achieve minimum -65 dBm coverage throughout the building and to support true 1-to-1 client support. Provide detailed report to Engineer indicating any proposed changes to the quantity/locations of APs shown on the bid documents.
- H. After the system is installed, the Contractor shall perform a Network Validation Survey. This survey shall test the actual RF environment with the access points operating and the WLAN system functioning, including all applications designed to operate via the WLAN. The network validation will test, document, and provide certification that the various operating parameters of the WLAN are being met to a degree required by the various applications running over the WLAN. The network validation survey shall be conducted to meet the following minimum requirements:
  - 1. Finalize channel and power settings of each AP based upon location, proximity to adjacent APs, desired data throughput, desired exterior WLAN coverage, and possible sources of RF interference.
  - 2. Review antenna selection and make adjustments to individual APs as required.
  - 3. Verify that the system can meet or exceed the minimum recommendation of 20–25 dB SIR for VoWiFi applications.

### **3.03 WIRELESS ELECTRONICS PLACEMENT**

- A. The Contractor shall be responsible for the placement of the wireless electronics and all of its components in the assigned Communications Rooms.
- B. Per the Drawings, wireless AP cabling drops have been shown based on standard cabling design for APs.
- C. The actual AP placement on the drawings is for reference only and a means of showing quantities to provide.
- D. Once the RF survey has been completed the Contractor shall mount the APs based on the actual field data gathered from the surveys. This may require the Contractor to run patch cords from the existing AP cable drop locations to final mounting locations.
- E. All equipment shall be secured in communication racks using the maximum number of screws as there are holes provided by vendor equipment.

### **3.04 INSTALLATION AND CONFIGURATION**

- A. Contractor shall provide and install a wireless system and all associated cabling, PoE devices, central controllers/switches, and console.
- B. It is the Contractor's responsibility to program the system in this section according to the Owner's wishes. The Contractor shall meet with the Owner and/or Engineer and

- reach agreement on the programming. The programming agreement shall then be written out in detail and forwarded to the Engineer for approval. After approval is granted, proceed with final programming.
- C. WLAN electronics shall provide seamless communications between Windows and Apple machines running TCP/IP protocol. Access points shall be able to accept, route, and process Ethernet traffic from either platform provided they are using Wi-Fi compliant client adapters.
  - D. Develop a minimum of three levels of wireless access:
    - 1. Guest.
    - 2. Staff.
    - 3. People.
  - E. Coordinate access privileges, VLAN, sub-net assignments, resource allocation, etc. for each group.
  - F. Contractor shall configure the wireless network to support seamless roaming and fast roaming among all access points.
  - G. Enforce user load balancing to continually monitor user load and automatically redirect new users to alternative APs.
  - H. Configure Dynamic RF Management to calculate optimal 802.11 channel assignments and radio power transmission levels for all associated APs and adapt to user load, interference, RF obstacles, and jamming attacks.
  - I. User RF Optimization shall assimilate client RF data and usage patterns along with basic RF data from access points for improved RF tuning and user performance.
  - J. The switch shall be configured to be VPN and firewall compatible. It shall be configured to provide local control of access points and not require any reconfiguration of WAN routers, VPN gateways, or firewalls.
  - K. Configure the network to use current security standards. Required: WPA3-Enterprise (primary, mandatory for Wi-Fi 7 / MLO) with Protected Management Frames (PMF), 802.11i (RSN), 802.1X, CCMP (AES), GCMP (AES), Enhanced Open (OWE) for any open SSIDs, EAP-TLS (preferred), EAP-TTLS, PEAP, PEAP-TLS. WPA3-Personal (SAE) where pre-shared keys are used. WPA2-Enterprise acceptable as a transitional fallback only. WEP, Dynamic WEP, TKIP, and original WPA shall NOT be configured or enabled.
  - L. Rogue Access Point Protection shall be configured to identify, classify, and locate rogue APs.
  - M. Configure the system to allow patrons simple and immediate access to the internet if so directed by the Owner.
  - N. The system shall allow administrators to get to local and wide area applications.
  - O. Contractor shall be onsite and shall complete a wireless site survey to coordinate placement of the data cables for the wireless access points. Complete a site survey to ensure that the APs are placed so that they will cover the entire building for both wireless voice and data and video connectivity.

- P. Provide the results of the site survey to the Owner and Engineer prior to installation of the access points.
- Q. Balance wireless access points to ensure complete coverage with minimal services degradation.
- R. Set up wireless security and provide for CIPA compliance.
- S. The Contractor shall be responsible for establishing the graphical floor plans of each building, along with the information required for complete RF management on a building-by-building basis. The floor plans shall be updated with final AP layouts.
- T. The Contractor shall be responsible for developing and programming RF characteristics of major building components (walls, floors, windows, doors) of each floor plan to ensure more accurate RF design tool predictions.
- U. The Contractor shall take information from the Owner with regards to wireless assets (laptops, PDA, wireless phones, etc.) and popular asset database to accomplish asset tracking.
- V. Provide complete policy creation and enforcement as required by Owner IT staff. Coordinate with network administrators to create virtual LAN (VLAN), RF, quality of service (QoS), and security policies. Provide multiple unique service set identifiers (SSIDs) with individual security parameters per building. For example, a "guest" SSID may use captive-portal web authentication with Enhanced Open (OWE) encryption; a "voice" SSID may use WPA3-Enterprise with WMM and 802.11r/k/v for fast roaming; and employee data SSIDs shall use WPA3-Enterprise.
- W. Provide additional programming related to the RADIUS server in each building to establish additional policy, authentication, and user-based privileges.

### **3.05 IDENTIFICATION / LABELING**

- A. Contractor shall identify all major items of equipment and tag all cables with permanent markers to denote equipment served. Cables shall be tagged at both ends and at each point where the cable is administered.
- B. All labeling and recording shall be approved by the Owner and the Engineer prior to application.
- C. Provide a printed, computer-generated record of each connected port in each switch. Label shall indicate AP served, port and switch label, and closet label.
- D. Supply a label for each AP that is installed above the ceiling with the Owner-designated coding.

### **3.06 GROUNDING**

- A. The installing Contractor shall be responsible for ensuring the grounding integrity of all installed equipment to eliminate the potential for equipment or personnel hazards due to improperly or inadequately grounded systems.
- B. All grounding and bonding shall be in conformance with NEC Article 250 and as recommended by EIA/TIA-607.
- C. The Division 26 contractor has provided 120V branch circuitry for use by the Contractor. The branch circuitry is run with a dedicated equipment grounding

conductor which shall be utilized by the system equipment. In no case shall the installation compromise the integrity of the building electrical grounding system.

### 3.07 TESTING

- A. The Contractor shall be responsible for energizing and testing APs. The Contractor shall be responsible for ensuring that the WLAN is in proper working condition.
- B. The Contractor shall perform a minimum series of on-site RF survey with network verification and include the results in the O&M manuals.
- C. **Visual Inspection:** Note condition of interior spaces along with potential barriers/obstacles to RF transmission that may not be shown on the architectural floor plans.
- D. **RF Spectrum Test:** The Contractor shall walk the site and record the general RF environment that currently exists throughout the building. Special attention shall be paid to RF signals in the 802.11 band.
- E. **Ping Test:** The Contractor shall walk the site recording a continuous network ping test to validate that there are no significant quantities or response timeout events. Areas which result in a high number of timeout requests (more than 5%) or consistently long ping times (more than 5 ms) shall be flagged for further evaluation in the RF survey and AP configuration.
- F. **Packet Analyzer:** The final AP configuration showing channel utilization, SSIDs, device MAC addresses, and associated compiled signal strength measurements of a site walk.
- G. **Active Test:** Perform active network tests in a minimum of 5 rooms throughout the building. The Media Center and the Cafeteria utilizing a variety of typical network applications such as email, web browsing, file downloads, and streaming video. Test shall be witnessed by the Owner/Engineer.
- H. After the system is installed, the Contractor shall perform a Network Validation Survey while the building is fully occupied. This survey shall test the actual RF environment with the APs operating and the WLAN system functioning including all applications designed to operate via the WLAN. The network validation will test, document, and provide certification that the various operating parameters of the WLAN are being met to a degree required by the various applications running over the WLAN. The network validation survey shall be conducted to meet the following minimum requirements:
  - 1. Finalize channel and power settings of each AP based upon location, proximity to adjacent APs, desired data throughput, desired exterior WLAN coverage, and possible sources of RF interference.
  - 2. Review antenna selection and make adjustments to individual APs as required.
  - 3. Verify that the system can meet or exceed the minimum recommendation of 20–25 dB SIR for VoWiFi applications.
- I. The Contractor shall be responsible for testing and verifying that all software and management-level functions of the system as required by the Owner's network system are programmed and operating properly. This includes but is not limited to:

1. Set-up and segregation of user groups, VLANs, security, and authentication as required by Owner.
2. Set-up of multi-level security including authentication and encryption.
3. Set-up and administration of prioritization, quality of service, VoIP, etc.

### **3.08 TRAINING**

- A. Provide a minimum of sixty (60) hours of training to the Owner's personnel and/or designated representative. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:
  1. System equipment connectivity.
  2. Device configurations.
  3. Operation, maintenance, and upgrade procedures.
- B. Trainer must be certified by the manufacturer.
- C. Training shall be coordinated with the Owner. Coordinate time, use, and availability of equipment with the Owner.
- D. Demonstrate adjustment, operation, and maintenance of the system including each component and control.
- E. Provide a copy of a sign-off sheet (signed by Owner staff) for the completed training with the close-out documents.
- F. Record all training sessions electronically (MP4 H.264 or H.265, minimum 1080p) and deliver to the Owner via USB flash drive, the Owner's document management system, or other electronic means acceptable to the Owner.

### **3.09 AS-BUILT DOCUMENTATION**

- A. The Contractor shall furnish the Owner complete as-built manuals in an indexed PDF format. They shall contain:
  1. System operating instructions.
  2. System functional block diagrams.
  3. System schematic diagrams.
  4. System wiring diagrams.
  5. As-built drawings of entire system including equipment rack elevations.
  6. Component service manual.
  7. Software operating manuals.
  8. Final endurance test report.
- B. **Maintenance Manual:** The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

### **3.10 WARRANTY**



- A. If any defects are found within the three (3) year full warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warranty with the O&M manuals.
- B. During the warranted operation, the Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. Resolve any previous outstanding problems.
- C. Make available a service contract offering continuing factory-authorized service of this system after the initial warranty period.
- D. The Contractor shall be responsible to provide service during normal working hours on a normal business day within four (4) hours after notification by the Owner for normal service or within two (2) hours for emergency service. Emergency service is defined as the loss of 25% or more of system components operation, or the loss of the main switch or other head-end equipment which renders the entire system beyond 50% inactive or unusable. Provide an on-site authorized factory technician within 24 hours if required.
- E. If equipment cannot be repaired within 24 hours of service visit, the Contractor shall provide "loaner" equipment to the Owner at no charge.
- F. APs shall have a "Limited Lifetime" warranty minimum.

### **3.11 CERTIFICATION**

- A. Upon completion of the testing, the manufacturer or representative shall issue to the Owner a letter of certification attesting to the fact that they have tested and adjusted the system, that all components are properly installed and free of defects, and that the system is in compliance with this specification.

**END OF SECTION 27 21 33**

## SECTION 27 41 19

### AUDIO-VISUAL SYSTEMS AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
  - 1. Section 26 05 00 — Common Work Results for Electrical.
  - 2. Section 26 27 26 — Wiring Devices.
  - 3. Section 27 05 28 — Pathways for Communications Systems.
  - 4. Section 27 11 00 — Communications Equipment Room Fittings.
  - 5. Section 27 15 00 — Communications Horizontal Cabling.
  - 6. Section 27 51 16 — Public Address and Mass Notification Systems.

##### 1.02 SCOPE OF WORK

- A. All equipment furnished under this Section shall be fully cross-platform compatible with Windows, macOS, ChromeOS, iPadOS, Android, and Linux operating systems. BYOD (bring-your-own-device) interoperability via USB-C, HDMI, and standards-based wireless casting (Miracast, AirPlay 2, Google Cast) is required.
- B. The Work described in this Section includes furnishing all components, materials, equipment, software, licenses, installation, programming, commissioning, training, and technical labor — and the performance of all operations — necessary for complete installation of audio-visual (AV) systems in fully operational condition as indicated on the Drawings and specified herein.
- C. Conduit, cable tray, junction boxes, electrical power circuits, receptacles, and terminal cabinets required for a complete operating system shall be furnished and installed by the Electrical Contractor under Division 26. The entire responsibility for the AV system — its design coordination, installation, programming, operation, performance, and function — shall be that of the AV Systems Contractor (hereinafter "Contractor").
- D. The Contractor shall coordinate network connectivity, VLAN configuration, PoE budget, cybersecurity posture, and identity/access management with the Owner's IT department and the Structured Cabling Contractor (Section 27 15 00).

##### 1.03 SECTION INCLUDES

- A. Work consists of new AV equipment including:
  - 1. Flat-panel video displays with wall and mobile mounting hardware and connection to the local AV system, as detailed on the Drawings and specified herein.

2. Interactive flat panel (IFP) displays, Owner-furnished/Contractor-installed, with associated mounting, power, data, and HDMI/USB-C connectivity.
  3. Laser projector systems, where indicated on the Drawings, with wall/ceiling mounting hardware, electric projection screens, and connection to the local AV system.
  4. Networked AV distribution systems — complete with sources, inputs, AV-over-IP encoders/decoders, displays, DSP, controls, and connection to the Owner's network — as detailed on the Drawings and specified herein.
  5. Digital signal processing (DSP), microphones, loudspeakers, amplifiers, and assistive listening systems per ADA and Section 11 61 33 requirements where indicated.
  6. Control systems, touch panels, and centralized room management/monitoring software.
  7. All-in-one video conference bars (UC appliances) with touch controllers, mounting hardware, platform licensing, and connection to the Owner's network, where indicated on the Drawings.
  8. Uninterruptible power supplies (UPS), rack power conditioning, surge protection, and equipment racks and enclosures.
  9. All patch cables, adapters, plates, and accessories required for complete and operational systems.
- B. All material, equipment, software licenses, firmware, and subscriptions necessary for proper operation of the system(s), whether or not specifically described herein, shall be deemed included in this Section.

#### **1.04 REFERENCES AND STANDARDS**

- A. All equipment and installation practices shall comply with the latest published editions of the following standards, codes, and guidelines. Where standards conflict, the more stringent requirement shall govern.
- B. AVIXA / ANSI Standards (latest editions):
1. ANSI/AVIXA 2M-2010 (R2020) — Standard Guide for Audiovisual Systems Design and Coordination Processes.
  2. ANSI/AVIXA 10:2013 (R2020) — Audiovisual Systems Performance Verification.
  3. ANSI/AVIXA V201.01:2021 — Image System Contrast Ratio (ISCR).
  4. ANSI/AVIXA V202.01:2016 (R2021) — Display Image Size for 2D Content in Audiovisual Systems (DISCAS).
  5. ANSI/AVIXA F501.01:2015 — Cable Labeling for Audiovisual Systems.
  6. ANSI/AVIXA F502.01:2018 — Rack Building for Audiovisual Systems.
  7. ANSI/AVIXA F502.02:2020 — Rack Design for Audiovisual Systems.
  8. ANSI/AVIXA D401.01:2023 — Documentation Requirements for Audiovisual Systems.
  9. ANSI/AVIXA A102.01:2017 — Audio Coverage Uniformity in Listener Areas.

10. ANSI/AVIXA A103.01:2018 — Sound System Spectral Balance.
11. ANSI/AVIXA RP-38-17 — Security of Networked AV Systems; and AVIXA AV Network Security Recommended Practice.
12. ANSI/AVIXA 4:2012 — Audiovisual Systems Energy Management.
13. AVIXA AV Installation Handbook, current edition.
14. CEA/CEDIA/AVIXA J-STD-710 — Audio, Video, and Control Architectural Drawing Symbols.

C. Electrical and Life-Safety Codes:

1. ANSI/NFPA 70 — National Electrical Code (NEC), latest adopted Ohio edition, including Article 640 (Audio Signal Processing, Amplification, and Reproduction Equipment) and Article 645 (Information Technology Equipment).
2. ANSI/NFPA 72 — National Fire Alarm and Signaling Code (for mass-notification interfaces).
3. Ohio Building Code (OBC) and Ohio Mechanical Code, current adopted editions.
4. All applicable local authority having jurisdiction (AHJ) requirements.

D. Telecommunications and Structured Cabling Standards:

1. ANSI/BICSI-005 — Electronic Safety and Security (ESS) System Design and Implementation Best Practices.
2. ANSI/BICSI N1 — Installation Practices for Telecommunications and ICT Cabling.
3. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), current edition.
4. BICSI Telecommunications Distribution Methods Manual (TDMM), current edition.
5. ANSI/TIA-568.0-E, 568.1-E, 568.2-E, 568.3-E — Generic, Commercial, Balanced Twisted-Pair, and Optical Fiber Cabling standards.
6. ANSI/TIA-569-E — Telecommunications Pathways and Spaces.
7. ANSI/TIA-606-C — Administration Standard for Telecommunications Infrastructure.
8. ANSI/TIA-607-D — Generic Telecommunications Bonding and Grounding (Earthing).
9. ANSI/TIA-862-B — Structured Cabling Infrastructure Standard for Intelligent Building Systems.

E. Audio and Broadcast Standards:

1. AES48 — Interconnections: Grounding and EMC Practices, Shields of Connectors in Audio Equipment Containing Active Circuitry.
2. AES54-3 — Grounding and EMC Practices, Shields of Balanced Microphone-Level Outputs.
3. AES67 — High-Performance Streaming Audio-over-IP Interoperability.

4. SMPTE ST 2110 — Professional Media over Managed IP Networks (where applicable).
- F. Accessibility and Inclusion:
1. ADA Standards for Accessible Design (2010), including Section 706 — Assistive Listening Systems.
  2. ICC/ANSI A117.1 — Accessible and Usable Buildings and Facilities.
  3. WCAG 2.2 Level AA — Web Content Accessibility Guidelines (for control system GUIs and published user content).
  4. Section 508 of the Rehabilitation Act, as applicable.
- G. Product Safety and Certifications:
1. All equipment shall be UL-listed, ETL-listed, or otherwise NRTL-certified as appropriate to the equipment category.
  2. Plenum-rated cables shall bear UL CMP, CL2P, or CL3P marking per NEC Article 800.
  3. FCC Part 15 Class B compliance for all electronic devices.
  4. RoHS 3 (EU Directive 2015/863) compliance for all new equipment.

## 1.05 QUALITY ASSURANCE

- A. **Performance Verification:** All AV systems shall be commissioned in accordance with ANSI/AVIXA 10:2013 (R2020) Audiovisual Systems Performance Verification. All digital video systems shall be pre-tested to verify complete compatibility of all source, distribution, processing, and display components, and the integrity of the transmission media. Performance of each system shall be demonstrated — with all proposed components — in the presence of the Design Engineer and/or Owner prior to final acceptance. Any system failing to meet the specified performance requirements shall be rejected and reconfigured as required prior to re-testing.
- B. **Cybersecurity Posture:** All networked AV equipment shall be deployed in accordance with AVIXA AV Network Security Recommended Practice and the Owner's IT security policy. Default passwords shall be changed, unused services disabled, current firmware applied, and devices segmented onto dedicated AV VLAN(s) per the Owner's IT department.
- C. **Mock-Up:** A mock-up and review meeting shall be conducted for a typical teaching-wall installation where interactive flat panels and/or short-throw laser projectors occur. The wall shall be fully finished — including the projection/whiteboard surface, IFP or projector, teacher credenza or cart, AV connectivity plate(s), electrical receptacles, and all accessories. The Construction Manager, Architect, AV Contractor, Whiteboard/Wallcovering Installer, and Electrical Contractor shall be present. The purpose is to confirm interactive functionality, coordination among wall surface, mounting, and display, cable management, sight lines, and final mounting heights for each room type. Approved mock-up establishes the standard for balance of Work.
- D. All equipment described herein — or otherwise required to perform the specified system functions — shall be a regular product line currently in active production at the time of installation. Discontinued or end-of-life models shall not be acceptable.

Products with manufacturer end-of-service-life announcements less than three (3) years from substantial completion shall not be acceptable.

- E. All materials furnished under this Contract shall be new, of the highest quality, and of a regularly manufactured product line with current firmware and software support.

#### 1.06 CONTRACTOR QUALIFICATIONS

- A. The AV equipment package shall be furnished and installed by a contractor meeting all requirements listed herein. Subcontracting of any portion of the Work is not acceptable unless the Subcontractor has been approved in writing by the Engineer based on adherence to these qualifications.
- B. The Contractor shall be an authorized, factory-trained integrator for all major manufacturers specified herein and shall provide current, valid authorization letters with Shop Drawing submittals.
- C. The Contractor shall maintain a fully equipped, factory-certified service organization capable of providing full maintenance and service of the installed system within four (4) hours of notification. The service facility shall be located within seventy-five (75) miles of the Project site and shall be available for inspection by the Engineer.
- D. **Personnel Credentials.** Minimum required credentials:
1. **Project Manager / Design Engineer:** AVIXA CTS-D (Certified Technology Specialist — Design) certification.
  2. **Lead Installation Technician:** AVIXA CTS-I (Certified Technology Specialist — Installation) certification.
  3. All on-site technicians (non-apprentice): minimum AVIXA CTS certification.
  4. **Programmers for control systems (Crestron, QSC, AMX, Extron):** current manufacturer programmer-level certification (e.g., Crestron Certified Programmer, QSC Level 2).
  5. At least one staff member holding BICSI Registered Communications Distribution Designer (RCDD) or Technician (TECH) credential.
  6. **Cybersecurity:** At least one staff member with AVIXA Certified in Secure AV (CSAV) or equivalent IT security training (CompTIA Security+, etc.).
- E. The Contractor shall have completed at least three (3) K–12 or higher-education AV integration projects of comparable size and scope within the previous five (5) years. Provide references including Owner contact information.

#### 1.07 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall comply with ANSI/AVIXA D401.01:2023 Documentation Requirements for Audiovisual Systems.
- B. Completely detailed Shop Drawings shall be prepared prior to procurement of equipment or commencement of Work. Drawings shall be prepared electronically in AutoCAD, Revit, or Visio and submitted as indexed PDFs. Printed sets, where required, shall be 30" × 42". Cut sheets, data sheets, and O&M content shall be 8½" × 11" bound into indexed volumes.
- C. Submit to the Engineer the following for approval:

1. Complete equipment list with manufacturer, model number, firmware/software version, quantity, and location.
  2. Manufacturer data sheets for all proposed equipment.
  3. System block diagrams and signal-flow diagrams.
  4. Rack elevations showing all rack-mounted equipment, including rack-unit (RU) assignment, cable management, power distribution, and thermal (airflow) calculations per ANSI/AVIXA F502.02:2020.
  5. IP address plan, VLAN assignments, and multicast/AV-over-IP bandwidth calculations — coordinated with Owner's IT.
  6. Control system user-interface (UI) wireframes and page-flow diagrams.
  7. DISCAS-based display-size calculations per ANSI/AVIXA V202.01 for each viewing space.
  8. Acoustic coverage and STIPA/speech-intelligibility calculations where assembly/learning sound reinforcement is provided.
  9. Structural load calculations and mounting details for displays >55" and for ceiling-mounted projectors/speakers, sealed and signed by a licensed Structural Engineer registered in Ohio where required by the AHJ.
  10. Cybersecurity plan identifying device hardening, firmware management, credential management, and patch cadence.
  11. Commissioning plan and test procedures per ANSI/AVIXA 10:2013.
- D. **Final Documentation.** All final documentation shall be submitted and approved before Final Acceptance by the Owner will be granted. Within forty-five (45) days after completion of the Work, deliver to the Owner:
1. Two (2) printed sets, bound in 3-ring binders with tabbed sections.
  2. Two (2) digital sets on encrypted USB drives, in indexed PDF format; all drawings native in AutoCAD/Revit/Visio source files; and
  3. One (1) cloud-hosted copy delivered to an Owner-specified repository (e.g., SharePoint, Google Drive).
- E. Final Documentation shall include:
1. Complete as-installed equipment list, by room, with manufacturer, model, serial number, MAC address, IP address, firmware version, and quantity.
  2. As-built system schematics and wiring diagrams with cable numbers, terminal-block numbers, and port assignments.
  3. As-built rack elevations.
  4. Operation instructions for each major item of equipment.
  5. Manufacturer warranty documents for each major item of equipment.
  6. Custom-written Technical Systems Operations Manual providing step-by-step operating and preventive-maintenance procedures.

7. Control-system source code (compiled and uncompiled), exported configuration files for DSPs, switchers, encoders/decoders, and control processors, and all software licenses registered to the Owner.
8. Cybersecurity handoff document including inventory of default-password changes, enabled/disabled services, user accounts created, and firmware baseline.

#### **1.08 COORDINATION**

- A. Coordinate Work of this Section with the Owner, Owner's IT Department, Construction Manager, Architect, and the Structured Cabling Contractor.
- B. Participate in joint coordination meetings with the above parties to exchange information and agree on equipment arrangement and installation interfaces. Record agreements and distribute meeting minutes to all participants within five (5) business days.
- C. Confirm installation schedule, documentation delivery dates, network-provisioning lead times, and service-provider requirements.
- D. Coordinate with all other trades and provide connection interfaces as applicable, including Divisions 26, 27, and 28.
- E. Coordinate all power and load requirements with UPS sizing so that UPS equipment is properly sized in submittals. Include cooling-load information for transmittal to the Mechanical Contractor.
- F. Coordinate low-voltage, data, and AV pathways with the Electrical, Structured Cabling, and Mechanical Contractors to avoid cable-pathway conflicts.

#### **1.09 STORAGE OF MATERIALS**

- A. All materials shall be stored in a secure, dry, climate-controlled area (60–80°F, 30–70% RH) and shall remain in original manufacturer packaging until installation.
- B. The Contractor shall be responsible for security of all Contract-supplied equipment and material, including Owner-furnished items received by the Contractor. No changes to the Contract shall be granted due to loss or theft of equipment not officially accepted by the Owner.

#### **1.10 RELATED WORK BY OTHERS**

- A. All conduit (with pull strings), pull boxes, and outlet boxes shall be furnished and installed under Division 26. All conduit systems entering equipment racks shall be insulated from the rack using non-metallic bushings or raceways.
- B. All power conductors and conduits associated with AV equipment locations shall be furnished and installed under Division 26. Power to equipment racks shall be terminated inside the racks at Contractor-supplied, isolated-ground, rack-mounted power conditioners or UPS units.
- C. An insulated #6 AWG stranded copper telecommunications bonding conductor (TBC) from each equipment rack to the building telecommunications main grounding busbar (TMGB) shall be provided in compliance with ANSI/TIA-607-D.

#### **1.11 WARRANTY**



- A. The installed system shall be warranted by both the Contractor and the respective manufacturers for a period of three (3) years from the date of Substantial Completion, covering parts, labor, and programming. Provide written warranty documentation from each manufacturer.
- B. During the warranty period, the Contractor shall perform two (2) preventive-maintenance inspections at six-(6-)month intervals. Work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. Resolve any outstanding issues and update firmware as part of each visit.
- C. Response Times:
  - 1. **Normal service:** Contractor shall be on-site within four (4) hours of notification during normal working hours (7:30 AM – 4:30 PM, Monday through Friday, excluding Owner holidays).
  - 2. **Emergency service** (defined as loss of 25% or more of system functionality, or loss of the main switch/head-end rendering the system more than 50% inoperable): Contractor shall be on-site within two (2) hours.
  - 3. An authorized factory technician shall be provided on site within twenty-four (24) hours where specialized factory-level service is required.
- D. If equipment cannot be repaired within twenty-four (24) hours, the Contractor shall supply equivalent loaner equipment at no charge.
- E. Make available an extended service contract offering continuing factory-authorized service following the initial warranty period.

## PART 2 - PRODUCTS

### 2.01 PRODUCT EQUIVALENCY

- A. Where products are listed with multiple manufacturers, these manufacturers shall be considered approved equals provided all specified features are delivered. Substitutions not approved in writing prior to the bid date will not be considered. Failure to provide the “precise functional equivalent” shall result in removal of the alternate equipment at the Contractor's expense.
- B. Different manufacturers may require various options, accessories, adapters, and patch cables to provide specified features. All such material and equipment necessary for proper operation of the system shall be deemed included in this Section.
- C. All products shall be in active production with firmware/software support commitments of at least five (5) years from date of Substantial Completion.

### 2.02 INTERACTIVE FLAT PANEL (IFP) DISPLAYS – Owner Provided

- A. **Basis of Design:** 85” 4K UHD Interactive Flat Panel, Owner-Furnished / Contractor-Installed (OFICI). Sizes to be determined per room type and verified using ANSI/AVIXA V202.01 DISCAS calculations.
- B. **Acceptable Manufacturers (OFICI coordination):** ViewSonic ViewBoard IFP51/IFP52 Series; Promethean ActivPanel 10 or ActivPanel LE; SMART Board MX or RX Series; Newline Q Pro or Z Pro Series; BenQ Board Pro RP04 or RM04 Series.

C. Minimum Performance Requirements (where IFPs are Contractor-furnished):

1. **Display:** 4K UHD (3840 × 2160) native resolution, minimum 400 cd/m<sup>2</sup> brightness, minimum 1200:1 contrast.
2. **Touch Technology:** Infrared or optical, minimum 20-point multi-touch, with simultaneous palm rejection and object/pen differentiation.
3. **Operating Systems:** Google EDLA (Enterprise Devices Licensing Agreement) Android 14 or newer, providing licensed Google Mobile Services and Play Store access; plus OPS (Open Pluggable Specification) slot accepting Windows 11 Pro or ChromeOS Flex compute modules.
4. **Connectivity:** Minimum (3) HDMI 2.0 inputs with CEC; (1) HDMI output; (1) USB-C with DisplayPort Alt Mode and Power Delivery ≥ 65 W; (4) USB-A; (2) RJ-45 Gigabit Ethernet; Wi-Fi 6 (802.11ax) and Bluetooth 5.2.
5. **Wireless Casting:** Native support for Miracast, Apple AirPlay 2, and Google Cast; plus manufacturer application for managed-cast workflows.
6. **Audio:** Integrated 2.1-channel speaker array (minimum 2 × 20 W + 20 W subwoofer); microphone array for voice capture.
7. **Management:** Remote device management via manufacturer cloud console (ViewSonic Manager, Promethean Panel Management, SMART Remote Management, Newline Display Management Plus, etc.) with SSO integration.
8. **Certifications:** UL listed, ENERGY STAR 9.0 qualified, TCO Certified (where available).
9. **Warranty:** Minimum five (5) years manufacturer on-site parts and labor.

**2.03 INTERACTIVE FLAT PANEL WALL MOUNTS**

- A. Provide heavy-duty, VESA-compliant fixed wall mounts rated for the installed display with a minimum 4:1 safety factor and UL 2442 listing for flat-panel display mounts.
- B. **Acceptable Manufacturers:** Chief (by Legrand) LTM1U / LTMU; Peerless-AV DS-VWM, SmartMount XF; Premier Mounts CTM-MS3; Middle Atlantic Proximity Series.
- C. Mount shall be compatible with VESA 400 × 400 through 800 × 600 patterns and rated for displays up to 150 lb. Provide integral cable management channel and integrated small-device (OPS/streaming stick/signal-extender) mounting bracket — e.g., Middle Atlantic Proximity Series mounting plates — attached directly to the display mount, offering 9" × 12" of accessory mounting real estate with UMS pattern.
- D. Mounts shall be installed in strict accordance with the manufacturer's written instructions. Mounting location, configuration, backing/blocking, and exact installation detail shall be approved prior to installation.

**2.04 IFP PORTABLE HEIGHT-ADJUSTABLE TILT MOUNT**

- A. Acceptable Manufacturers:
  1. Conen Mounts SCETTA3535 (or current equivalent model).
  2. Chief Large Fusion LPAU Series with mobile base.
  3. Clear Touch / Heckler CTI-MOUNT-CONM.

4. Balt / MooreCo Hercules Mobile Flat Panel Cart.

B. Performance Requirements:

1. **Compatibility:** 42"–100" flat-panel displays; VESA 200 × 200 through 800 × 600.
2. **Height adjustment:** 700 mm (27.5") of smooth, powered or manual travel.
3. **Tilt:** 0° to 90° continuous.
4. **Column:** Height-adjustable and tiltable aluminum, RAL 9006 (white aluminum) finish.
5. **Base:** Mobile H-shape, RAL 9006 white aluminum, with locking casters.
6. **Load capacity:** Minimum 150 kg (330 lb).
7. Integrated cable-management sleeve and accessory shelf.

**2.05 DIGITAL DISPLAY MONITORS (NON-INTERACTIVE) – Owner provided**

A. **Basis of Design:** 85" commercial 4K UHD displays as indicated on the Drawings.

B. **Acceptable Manufacturers:** Samsung QBC / QMC Series; LG UR / UM Series commercial displays; Sony Bravia Professional BZ Series; NEC/Sharp ME or MultiSync Series.

C. Minimum Performance Requirements:

1. **Panel:** 4K UHD (3840 × 2160) LED/IPS, minimum 400 cd/m<sup>2</sup> brightness, minimum 4000:1 contrast, 16:9 aspect ratio, minimum 120 Hz refresh.
2. **Duty Cycle:** Rated for 16/7 or 24/7 commercial operation (do not accept consumer-TV duty cycles for permanently installed classroom use).
3. **HDR:** HDR10 support.
4. Interfaces:
  - a. HDMI 2.0 inputs (minimum 3) with HDCP 2.3.
  - b. DisplayPort 1.4 input (minimum 1).
  - c. USB-C with DisplayPort Alt Mode (minimum 1, where available).
  - d. USB-A (minimum 2) for media playback and firmware updates.
  - e. RJ-45 Gigabit Ethernet (minimum 1).
  - f. RS-232C or IP-based control port.
  - g. Optical S/PDIF and 3.5 mm audio output.
5. **Wireless:** Wi-Fi 6 and Bluetooth 5.2.
6. **Audio:** Integrated speakers, minimum 20 W total.
7. **Smart Platform:** Tizen, webOS, or Android-based commercial platform with remote device management (Samsung MagicINFO, LG SuperSign, etc.).
8. **Control:** IP-based API, Crestron Connected and/or QSC Q-SYS native driver.
9. **Accessibility:** Closed-captioning support, audio description, ADA-compliant OSD.

10. **Certifications:** UL, FCC Class B, ENERGY STAR 9.0, EPEAT Gold (where available).

11. **Warranty:** Minimum three (3) year commercial warranty.

## 2.06 FLAT-PANEL WALL MOUNTS (NON-INTERACTIVE DISPLAYS)

- A. Provide articulating-arm wall mounts with minimum 20° forward tilt and 180° side-to-side swivel. Mounts shall be commercial grade, UL 2442 listed, and rated for flat-panel displays up to 100" and 150 lb.
- B. **Acceptable Manufacturers:** Peerless-AV; Premier Mounts; Chief (Legrand AV).
- C. Middle Atlantic Proximity Series accessory mounting plates attach directly to the display mount for local signal-extender, streaming-stick, or OPS device mounting, featuring UMS pattern with 9" × 12" of mounting space; provide for each display location where active electronics are located behind the display.
- D. Mounts shall be installed in strict compliance with manufacturer's instructions. Configuration, method, and exact location shall be approved prior to installation. Wall backing and structural support shall be coordinated with the General Contractor.

## 2.07 LASER PROJECTORS AND PROJECTION SCREENS

- A. Where projectors are indicated on the Drawings, provide laser (solid-state) projectors; conventional lamp-based projectors are not acceptable.
- B. **Acceptable Manufacturers:** Epson BrightLink EB- / EB- PU Series; Sony VPL; Christie DWU; Panasonic PT-RZ; BenQ LU; NEC PA/NP.
- C. Minimum Performance Requirements:
  - 1. **Light source:** Laser/phosphor, minimum 20,000-hour rated life to 50% brightness.
  - 2. **Brightness:** 4,000 ANSI lumens minimum for classroom/conference use; 5,500+ ANSI lumens for larger assembly spaces.
  - 3. **Native resolution:** WUXGA (1920 × 1200) minimum; 4K UHD preferred for large assembly spaces.
  - 4. **Contrast:** Minimum 2,500,000:1 dynamic.
  - 5. **Inputs:** HDMI 2.0 (minimum 2, one with HDBaseT receiver integration or separate HDBaseT input), USB-C (where applicable), RJ-45 Gigabit Ethernet for IP control.
  - 6. **Control:** IP-based API, Crestron Connected, and/or PJLink Class 2.
  - 7. **Interactive models (where indicated):** Finger-touch or stylus-based interactivity supporting up to six (6) simultaneous touch points with automatic calibration.
- D. **Electric Projection Screens (where indicated):** Provide tab-tensioned, matte-white (gain 1.0–1.3) electric projection screens with 12 V trigger for automatic operation, integrated IR/RF remote, and low-voltage control input. Acceptable Manufacturers: Da-Lite (Legrand AV); Draper; Stewart Filmscreen.

## 2.08 NETWORKED AV DISTRIBUTION (AV-OVER-IP)

- A. Provide an AV-over-IP distribution system utilizing 1 GbE or 10 GbE encoders/decoders on a dedicated, Owner-coordinated AV VLAN.
- B. **Acceptable Manufacturers / Platforms:** QSC Q-SYS with NV Series; Crestron DM NVX Series (NVX 350/363/384); Extron NAV Series; Biamp Tesira / Impera (where applicable); AMX SVSI N-Series; Netgear AV-Line (M4250/M4350) managed switches with pre-loaded AV profiles (with AVIXA-aligned configuration).
- C. Performance Requirements:
  - 1. **Video:** 4K60 4:4:4 with HDR10 support; visually lossless or JPEG 2000 codec as appropriate to network bandwidth.
  - 2. **Latency:**  $\leq 1$  frame end-to-end for interactive use cases.
  - 3. **Audio:** Dante, AES67, or Q-LAN networked audio natively integrated with video transport.
  - 4. **Control:** Secure web interface with SSO, SNMPv3 monitoring, syslog export, and REST API.
  - 5. **Security:** AES-128 or AES-256 encryption of management plane; TLS 1.2 or higher; 802.1X supplicant.

## 2.09 DIGITAL SIGNAL PROCESSING (DSP) AND AUDIO SYSTEMS

- A. **DSP Platform:** Provide networked DSP with open architecture and audio-over-IP capability.
- B. **Acceptable Manufacturers:** QSC Q-SYS Core; Biamp Tesira; Symetrix Prism/Radius; BSS BLU Series.
- C. **Loudspeakers:** Provide commercial-grade ceiling, pendant, or surface loudspeakers sized and spaced to achieve the requirements of ANSI/AVIXA A102.01 (Audio Coverage Uniformity) and ANSI/AVIXA A103.01 (Spectral Balance). Acceptable Manufacturers: QSC AcousticDesign; JBL Control Contractor; Tannoy CMS; Atlas Sound IsoVox; Community I Series.
- D. **Microphones:** Provide ceiling beamforming or pendant microphone arrays for voice capture where indicated. Acceptable: Shure MXA Series (MXA902/920/710); Sennheiser TeamConnect Ceiling Medium/2; Biamp Parlé TCM.
- E. **Amplifiers:** Class D, networked (Dante, Q-LAN, or AES67), with integral DSP and fault monitoring. Provide minimum 30% headroom over calculated peak loudspeaker load. Acceptable: QSC CX-Q Series; Crown DCi-N Series; Lab.gruppen D Series; Biamp Impera.

## 2.10 CONTROL SYSTEMS

- A. Provide a networked control system with a touch-panel interface, scheduling integration, and centralized monitoring.
- B. **Acceptable Manufacturers:** Crestron (3-Series, 4-Series processor); QSC Q-SYS (Core with UCI); Extron Pro Series; AMX NetLinx NX.
- C. **Touch Panels:** 7" or 10" color capacitive, wall-mount or tabletop; PoE-powered where possible. Accessible/ADA-compliant UI design.

- D. **Scheduling:** Native integration with Microsoft Exchange / Google Calendar for room scheduling on door-mounted displays where indicated.
- E. **Monitoring:** Centralized management platform (Crestron XiO Cloud, QSC Q-SYS Reflect, Extron GlobalViewer, AMX Resource Management Suite) with alerting, usage analytics, and remote firmware update. Deploy in the Owner's cloud tenant per IT requirements.

## 2.11 EQUIPMENT RACKS, UPS, AND POWER PROTECTION

- A. **Equipment racks** shall comply with ANSI/AVIXA F502.01:2018 (Rack Building) and F502.02:2020 (Rack Design). Acceptable Manufacturers: Middle Atlantic (Legrand AV); Lowell; Chief; AtlasIED.
- B. Rack design shall include:
  - 1. Minimum 20% spare RU capacity at project closeout.
  - 2. **Thermal management:** Calculated airflow with blanking panels, vented doors/sides, and/or active cooling fans; rack-internal temperature monitored and reported via IP.
  - 3. Front and rear horizontal and vertical cable management; dedicated power and signal pathways maintained as separate vertical runs.
  - 4. Rack grounding bar per ANSI/TIA-607-D, bonded to the building TMGB with insulated #6 AWG stranded copper conductor.
- C. **Rack Power Distribution / UPS:** Provide rack-mounted, network-managed UPS and power distribution with isolated-ground output, sequencing, surge suppression, and remote monitoring.
  - 1. **Minimum specifications:** Pure sine-wave double-conversion (online) or line-interactive topology with AVR; minimum 15 minutes runtime at calculated load; IP-managed with SNMPv3 and environmental monitoring; isolated-ground receptacles.
  - 2. **Acceptable Manufacturers:** Middle Atlantic Premium Series with RackLink; Furman CN-Series with BlueBOLT; Eaton 9PX / 5PX G2; Panamax M-Series; APC Smart-UPS SMX/SRT.
- D. **Surge Suppression at Displays and Local AV Outlets:** Provide rack- or surface-mount surge suppressor for each unracked display/local AV device, UL 1449 5th Edition listed, with the following minimum performance:
  - 1. **Enclosure:** Magnetic-shielded steel, compact and mountable.
  - 2. **Input:** 120 V AC, 3-wire grounded cord, minimum 6 ft; 15 A load rating.
  - 3. **Protection:** Multi-stage filtering with series-mode surge reactor, pulse inverter, and cascaded auto-tracking voltage limiter; auto-resetting overvoltage shutdown.
  - 4. **Ratings:** Unlimited Applied Surge Current (8 × 20 μs waveform); withstand 1,000+ occurrences at 6,000 V.
  - 5. **Acceptable Manufacturers:** SurgeX (AMETEK ESP); Furman SMP Series; Middle Atlantic PD-Series.

## 2.12 CONNECTORS AND PLATES

A. Jack Plates:

1. Outlet faceplates shall be custom-fabricated aluminum or powder-coated steel modular frames with metal, screw-retained jack modules. Plastic voice/data snap-in modules are not acceptable for AV applications.
2. Each AV, CATV, USB, and control jack shall be labeled engraved and paint-filled (or with laminated, adhesive-backed engraved label) to indicate function (audio L/R, video, CATV, USB-C, etc.). P-touch labels and hand-marked labels are not acceptable. Labeling shall conform to ANSI/AVIXA F501.01:2015.
3. Data jacks integrated into custom AV jack plates shall be provided by the Structured Cabling Contractor; custom cutouts shall be coordinated for exact fit. Each data jack shall be labeled to corresponding patch panel and port per ANSI/TIA-606-C.

B. Floor-box and poke-through plates shall be compatible with the specified floor-box/poke-through housing; un-mounted or loose jacks are not acceptable.

C. Refer to the Drawings for the arrangement, quantities, and types of workstation jack plates. All AV jacks shown in each faceplate shall be deemed included in this Section unless specifically excluded.

D. **Acceptable Manufacturers:** Ace Backstage; Panel Crafters; ProCo; FSR; RCI Custom; Hubbell; Extron WallVault / Cable Cubby.

## 2.13 AV PATCH CABLES AND ACCESSORIES

A. Provide all associated AV patch cables for each equipment item to yield a fully operational system. All jack plates shall be provided with a patch cable for every used/unused AV jack. Lengths to be field-adjusted for a neat, professional installation.

B. Minimum Cable Requirements (unless noted otherwise):

1. **HDMI:** 18 Gbps / HDMI 2.0 certified; 48 Gbps / HDMI 2.1 where 4K120 or 8K signals are present; lengths ≤ 25 ft passive, > 25 ft use active optical (AOC) or HDBaseT extension.
2. **USB-C:** USB 3.2 Gen 2 (10 Gbps) minimum with 65 W Power Delivery; USB4 / Thunderbolt-rated for lengths > 6 ft; active optical for lengths > 10 ft.
3. **DisplayPort:** 1.4 certified.
4. **Analog Audio:** 1/8" (3.5 mm) TRS M/M, 3 ft standard; balanced XLR where active DSP connections are made.
5. **Category Cabling (AV-over-IP, HDBaseT, Control):** Category 6A minimum; shielded (F/UTP) where signal runs parallel to AC power or > 180 ft; plenum-rated where installed in air-handling spaces.

C. **Patch Cable Management at End Devices:** Provide abrasion-resistant expandable sleeving (e.g., Panduit SE50PSC-CR0 or equivalent) to protect and dress cable bundles at displays, projectors, and rack ingress. Lightweight, flexible, UL-recognized, and suitable for intended environment.

- D. **Miscellaneous:** Provide all additional equipment, connectors, terminations, adapters, and cabling necessary between items of equipment for a complete and operational system.

## 2.14 ASSISTIVE LISTENING

- A. In all assembly spaces and learning spaces where sound reinforcement is provided, furnish ADA-compliant assistive listening in quantities and type per 2010 ADA Standards Section 706. Hearing-loop (induction loop, IEC 60118-4) is the preferred technology; where a hearing loop is not feasible, provide FM or Wi-Fi-based (Listen EVERYWHERE / Williams AV WaveCAST) system with receivers and neck loops.
- B. **Acceptable Manufacturers:** Williams AV; Listen Technologies; Ampetronic; Contacta.

## 2.15 VIDEO CONFERENCE BARS (ALL-IN-ONE UC APPLIANCES)

- A. Basis of Design: All-in-one video conference bar integrating camera, microphone array, and loudspeakers in a single enclosure, for small and medium conference and huddle rooms as indicated on the Drawings. Video conference bars shall be provided in lieu of discrete camera, DSP, microphone, and loudspeaker components only where specifically indicated.
- B. Acceptable Manufacturers: Logitech Rally Bar / Rally Bar Mini; Poly Studio X52 / X70; Cisco Room Bar / Room Bar Pro; Neat Bar / Neat Bar Pro; Yealink MeetingBar A30 / A20.
- C. Minimum Performance Requirements:
1. Camera: 4K UHD sensor with minimum 120° diagonal field of view, 5× total zoom, and automatic framing, speaker tracking, and people-count reporting. Electronic pan/tilt/zoom with no mechanical noise during operation.
  2. Microphones: Integral beamforming array, minimum six (6) elements, with acoustic echo cancellation, noise suppression, and de-reverberation. Minimum voice pickup radius of 15 feet (4.5 m). Provide expansion microphone(s) where room dimensions exceed the manufacturer's published pickup coverage.
  3. Loudspeakers: Integral full-range loudspeaker(s) capable of achieving 70 dBA at the farthest listener position with a minimum frequency response of 90 Hz – 20 kHz.
  4. Operating Modes: Native (appliance) mode running Microsoft Teams Rooms on Android, Zoom Rooms, or Cisco Webex firmware, and USB peripheral mode for BYOD/laptop connection. Both modes shall be field-selectable without hardware change.
  5. Connectivity: Minimum one (1) RJ-45 10/100/1000 Ethernet port with IEEE 802.3at (PoE+) support where offered by the manufacturer; USB-C or USB-A host port for BYOD; HDMI input for content ingest; minimum two (2) HDMI outputs supporting dual-display 1080p60 (4K30 minimum on primary output).
  6. Wireless Content Sharing: Native support for AirPlay, Miracast, and the platform's proprietary wireless share (e.g., Teams Cast, Zoom Share) without additional hardware.
  7. Peripherals: Provide a PoE-powered touch controller (10" minimum) for in-room call control and scheduling, and a wall- or door-mounted scheduling panel where indicated.
  8. Sensors and Analytics: Occupancy/people counting and ambient reporting, with data available to the Owner's management platform via API.



9. Certifications: Certified for the room-platform ecosystem indicated (Microsoft Teams Rooms, Zoom Rooms, and/or Cisco Webex) and listed on the applicable manufacturer's certified-device roster at time of submittal.
- D. Mounting: Provide the manufacturer's display-mount, wall-mount, or table-stand kit as required by the installed condition. Where mounted with a flat panel, the bar shall be located directly below the display, centered on the display's horizontal axis, with the camera lens between 42" and 60" AFF and unobstructed by furniture, whiteboards, or the display bezel. Coordinate mount selection with Article 2.03 and 2.06 mounts so that the bar and display share a single structural backing.
- E. Power and Network: Where PoE+ is used, coordinate switch port budget and VLAN assignment with the Owner's IT Department in accordance with Article 1.08. Where a local power supply is required, coordinate the receptacle location behind the display with the Electrical Contractor per Article 1.10. All cabling shall be concealed within the wall or display mount.
- F. Software and Licensing: Furnish all firmware, device-management licenses, and platform room licenses required for a fully functional system for the duration of the warranty period, including enrollment in the manufacturer's management platform (Logitech Sync, Poly Lens, Cisco Control Hub, or Yealink Device Management Platform) and the Owner's tenant.
- G. Cybersecurity: Deploy in accordance with Article 3.05, including local-admin credential change, certificate-based network authentication where supported, and disabling of unused ports and services.

## **2.16 SOUND BARS**

- A. Basis of Design: Commercial-grade, self-powered sound bar mounted directly to the display carts, providing program audio reinforcement for classroom and small-group spaces where a distributed loudspeaker system (Article 2.09) or video conference bar (Article 2.15) is not indicated on the Drawings.
- B. Acceptable Manufacturers: ViewSonic VB-AUD-201 / VB-AUD-202; SMART Technologies SBA-100 / SBA-200; Promethean ActivSoundBar; Yamaha ESB-1090 Enterprise Sound Bar; Newline SoundBar; or approved equal in accordance with Article 2.01.
- C. Minimum Performance Requirements:
1. Amplification: Integral Class D amplifier, minimum 40 W RMS total (2 × 20 W), stereo, with electronic overload and thermal protection.
  2. Drivers: Minimum two (2) full-range drivers, 2" (50 mm) or larger, with passive radiators or tuned ports; frequency response 80 Hz – 20 kHz (±6 dB) minimum.
  3. Output: Minimum 90 dB SPL at 1 m; capable of achieving 70 dBA at the farthest listener position in the room served with ≤ 3% THD.
  4. Inputs: HDMI ARC/eARC and/or optical (Toslink) S/PDIF digital input; 3.5 mm analog stereo input; USB audio (UAC) input where mounted to an interactive flat panel. Bluetooth, where provided, shall be capable of being disabled.
  5. Control: Power and volume shall follow the display via HDMI-CEC/ARC or signal-sensing auto power-on/standby; IR remote; where connected to the control system specified in Article 2.10, provide RS-232 or IP volume and mute control, or route program audio through the DSP specified in Article 2.09.
  6. Mounting: Manufacturer's bracket attaching to the display's VESA pattern or to the display mount specified in Articles 2.03 and 2.06; bar shall not obstruct the display's IR receiver, touch sensors, ports, or the camera of any video conference bar.

7. Finish and Size: Black; length coordinated with display width (minimum 36" for 75" and larger displays).
  8. Power: 120 V AC with detachable cord, or powered from the display USB port where the manufacturer permits; coordinate receptacle location behind the display with the Electrical Contractor per Article 1.10.
  9. Certifications: UL or ETL listed, FCC Part 15 Class B, RoHS compliant.
  10. Warranty: Minimum three (3) years manufacturer warranty.
- D. Installation: Mount directly below the display (or above where indicated), centered on the display's horizontal axis, with all cabling concealed within the display mount. Configure the display's internal speakers off and the sound bar as the default audio output. Coordinate mounting height with Article 2.15 where a video conference bar is also present.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION — GENERAL**

- A. Installation shall comply with the latest AVIXA AV Installation Handbook, ANSI/BICSI-N1, BICSI ITSIMM, and all applicable AVIXA standards enumerated in Article 1.04.
- B. Mount all equipment using manufacturer-recommended hardware. Equipment shall be secured firmly with the correct hardware type. All equipment affixed to the building structure shall be self-supporting with a safety factor of not less than three (3) — six (6) for overhead or ceiling-suspended loudspeakers and projectors — unless otherwise specified.
- C. Connect all networked devices to the IP network for central control and monitoring, under the Owner IT-approved VLAN, subnet, and firewall profile.
- D. For projectors: adjust for proper geometry, focus, keystone, lens-shift, and display size. Where interactive projection is used with a whiteboard or screen, confirm image registration without requiring user adjustment.
- E. Install all associated software — monitoring, management, control, and user-facing applications — and commission per manufacturer recommendations.
- F. Equipment shall be furnished and installed in accordance with manufacturer recommendations and in compliance with all applicable local, city, state, and national codes.
- G. Provide all hardware, framing, backing, and blocking required for mounting equipment. Coordinate structural mounting points, blocking locations, and load requirements with the Architect and General Contractor.
- H. All penetrations in rated smoke or firewalls shall be sealed with a UL-listed firestop assembly rated for the assembly penetrated, per Section 07 84 13.
- I. Installation shall be neat and of professional quality. Cooperate with other trades to achieve well-coordinated progress and acceptable final results. Execute, without claim for additional payment, minor moves or changes in equipment locations to accommodate equipment of other trades or architectural symmetry.

- J. Furnish the system to facilitate expansion and servicing using modular, solid-state components. All equipment shall be UL-listed (or NRTL-certified) and rated for continuous operation.
- K. Contractor is responsible for all system programming (control system, DSP, AV-over-IP routing, scheduling, etc.) and shall deliver commented, exportable source code to the Owner at closeout.

### 3.02 FLAT-PANEL AND INTERACTIVE DISPLAY INSTALLATION

- A. Field-verify the location of each display against surrounding structural elements, casework, markerboards, and room furnishings prior to mounting. Where field conditions will not accommodate the proposed display type or mounting method, notify the Engineer and Architect in writing with proposed alternatives for review.
- B. Displays shall be mounted plumb, level, and true. Mounting heights shall be confirmed at the mock-up and comply with the following:
  - 1. **Classroom IFPs:** Centerline approximately 55" AFF, field-verified against grade-level ergonomic needs and DISCAS calculations.
  - 2. **Conference displays:** Centerline approximately 61" AFF.
  - 3. **Digital signage:** Per Drawings and ADA protrusion limits ( $\leq 4"$  projection from wall between 27" and 80" AFF).
- C. Field-configure each display's video, image, color, and system settings once the source equipment and AV system are operational. Store optimal settings for later recall. Flat panels with tuners shall have broadcast channels scanned and programmed once the head-end is active.
- D. Complete programming of displays and centralized control software — including network assignments, IP addresses, hostnames, VLAN/802.1X credentials, device passwords (non-default), schedules, and management-cloud enrollment.

### 3.03 WIRING AND CABLE INSTALLATION

- A. Observe proper circuit polarity and loudspeaker polarity. No cable shall be wired with a polarity reversal between connectors. Balanced audio connectors shall be wired with shield at Pin 1, hot/positive at Pin 2, cold/return at Pin 3 (AES14 / IEC 61938).
- B. All analog audio circuits shall be balanced and floating, except as specifically noted. Cable shields between active, interconnected equipment shall be grounded at the sending end only, in accordance with AES48 and AES54-3.
- C. All cables shall be installed in conduit, cable tray, or — above accessible ceilings — on J-hooks or bridle rings on maximum 5 ft centers. Cables shall never be supported from building structure elements such as beams, joists, sprinkler piping, ceiling-grid wires, or ductwork. Cable management hardware shall be UL-listed for its application.
- D. Maintain separate conduits and/or cable harnesses for cables of differing signal classes:
  - 1. Microphone level ( $\leq -20$  dBm).
  - 2. Line level ( $-20$  dBm to  $+30$  dBm).

3. Loudspeaker level.
4. Control / low-voltage.
5. Power.
6. Video / high-speed digital (HDMI, USB-C, HDBaseT, AV-over-IP).
- E. Group and route all cables within equipment racks according to type and function, separated by signal level. All cables shall be continuous lengths without splices.
- F. Handle and install cables with care. Use hook-and-loop (Velcro-type) straps; nylon cable ties are not permitted. Do not over-tighten. Maintain a minimum bend radius at all points of not less than four (4) times the cable outer diameter, and in all cases follow the manufacturer's recommended bend radius and maximum pulling tension. Failure to comply will result in removal and replacement at no cost to the Owner.
- G. Maintain the following minimum pathway clearances between AV cabling and the following sources (parallel or perpendicular runs):
  1. Motors and transformers — 48".
  2. Conduit/cable for electrical power distribution — 12".
  3. Fluorescent / LED lighting ballast — 5".
  4. Power lines up to 2 kVA — 5".
  5. Power lines above 5 kVA — 24".
  6. Hot-water/steam lines — bare: 18"; insulated: 6".
- H. All cabling installed in underground or wet-location conduits shall be manufacturer-rated for such application.
- I. All system wiring shall be terminated by approved soldered or mechanical means. No un-terminated wire ends shall be accepted. Use lead-free, rosin-core silver solder for all soldered joints. Lead-based solder is not acceptable.
- J. Mechanical connections shall be made with connectors of correct size and type. Wire nuts are not acceptable except for distributed constant-voltage (70 V / 100 V) loudspeaker circuits where specifically permitted.
- K. Use heat-shrink tubing to insulate and dress the ends of all ground and drain wires.
- L. All category cabling for AV-over-IP, HDBaseT, and control shall be field-certified to the applicable TIA-568 Channel or Permanent Link specification and test reports delivered to the Engineer for approval.

### **3.04 PROGRAMMING**

- A. Programming of AV distribution, DSP, and the touch-panel controller(s) shall be developed through a series of coordination meetings, storyboard submittals, and a final virtual run-through prior to deployment. Programming shall be submitted to the Owner for approval prior to release.
- B. Program-flow drawings shall be submitted for review prior to any programming. Not fewer than three (3) coordination meetings shall occur prior to programming commencement:

1. Program-flow review with follow-up email confirmation or in-person meeting, as necessary.
  2. Technical review of the touch-panel mock-up (functional mock-up required).
  3. End-user review of the touch-panel mock-up. Present shall be the AV Vendor Engineer, an Owner representative, and representative end users.
- C. If access to the Owner's network is required for programming, the Contractor shall submit a written request (including purpose, duration, personnel, and devices to be connected) not less than ten (10) business days prior to need. Remote access shall be conducted only through Owner-approved means (VPN with MFA or bastion host).
- D. Upon finalization, provide JPEG/PNG screenshots of all touch-panel pages so the Owner may prepare end-user quick-reference guides.
- E. **Touch-Panel Programming — Minimum Requirements:**
1. Welcome page with simple system on/off and Owner logo; home page with the most-used controls.
  2. Minimum ten (10) user pages and five (5) additional password-protected technician-level pages.
  3. Fixed hard (or persistent on-screen) buttons for system on/off, volume, mute, and "blackout/privacy."
  4. Full component-level control of all sources.
  5. DSP control with system-wide mute and volume.
  6. Password-protected technician pages providing complete access to all component features and manufacturer service menus.
  7. ADA-accessible UI design: minimum 4.5:1 contrast ratio, minimum 44 px target size, and support for alternate input methods.

### 3.05 CYBERSECURITY HARDENING AND NETWORK DEPLOYMENT

- A. All networked devices shall be deployed in accordance with ANSI/AVIXA RP-38-17 and the AVIXA AV Network Security Recommended Practice, and the Owner's IT security policy.
- B. At minimum:
1. Replace all default passwords with unique, strong credentials stored in an Owner-approved password manager.
  2. Disable unused services, ports, and protocols (Telnet, HTTP where HTTPS is available, UPnP, SNMPv1/v2c, etc.).
  3. Apply the latest stable firmware at commissioning; document firmware baseline for each device.
  4. Enable TLS 1.2 or higher and AES-128/256 encryption where supported.
  5. Integrate with Owner identity provider (Microsoft Entra ID / Google Workspace) via SAML or OIDC where supported.

6. Segment AV devices onto dedicated VLAN(s) provisioned by the Owner; coordinate multicast, IGMP snooping, and QoS requirements for AV-over-IP traffic.
7. Enable device-level logging and forward to the Owner's SIEM/syslog collector where available.
8. Deliver a device inventory spreadsheet with MAC address, IP, firmware version, VLAN, and service account (where applicable) at closeout.

### **3.06 TESTING AND COMMISSIONING**

- A. Commissioning shall follow ANSI/AVIXA 10:2013 (R2020) Audiovisual Systems Performance Verification. The Contractor shall prepare a project-specific verification plan with verification items, metrics, and acceptance criteria, submitted for Engineer approval prior to testing.
- B. Verify picture quality and color on all AV inputs; verify image contrast ratio compliance with ANSI/AVIXA V201.01.
- C. Test all associated software control programs and scheduling integrations.
- D. Measure and document acoustic performance where sound reinforcement is provided: SPL coverage uniformity, frequency response, STIPA (speech intelligibility)  $\geq 0.60$  in all learning/assembly listener areas, ambient noise, and gain-before-feedback.
- E. Upon completion of installation and satisfactory testing by the Contractor (in the presence of the manufacturer's representative), the Contractor shall test the system in the presence of the Owner and the Engineer to demonstrate satisfactory performance.
- F. A qualified manufacturer's representative or equipment vendor shall issue a certificate of inspection; submit the report to the Engineer.
- G. Installation must be complete in all respects before acceptance testing. Acceptance testing and Owner training shall be scheduled on separate dates to allow time for corrections. Once all functions and devices have been demonstrated to be working properly, the complete Owner's Manual shall be delivered, including:
  1. Comprehensive list of supplied equipment.
  2. Complete point-to-point system wiring diagram with "AS-BUILT" cable numbers.
  3. Build-out devices (active and passive).
  4. Control-system settings record.
  5. Final test results, including plotted frequency-response curves, impulse responses, and STIPA test data where applicable.
  6. Operation and maintenance manuals for each active device, including schematic diagrams and parts list.
  7. A completed Commissioning Checklist aligned with the AVIXA AV Installation Handbook — Audiovisual Systems Commissioning Tests Checklist.
- H. The Contractor shall be prepared to verify performance of any portion of the system by demonstration, listening tests, or instrument measurement.

- I. Measurement of frequency response, distortion, SNR, crosstalk, or other parameters shall be performed on request if deemed necessary to verify proper operation.
- J. The Contractor shall make additional mechanical and electrical adjustments within the Scope of Work as deemed necessary by the Engineer as a result of acceptance tests.
- K. Submit all test reports and written certification that the installation is complete and ready for Owner acceptance.

### **3.07 IDENTIFICATION AND LABELING**

- A. Labeling shall conform to ANSI/AVIXA F501.01:2015 (Cable Labeling for Audiovisual Systems) and ANSI/TIA-606-C (Administration).
- B. Identify all major items of equipment and tag all cables with machine-printed, permanent, abrasion-resistant labels denoting source, destination, cable type, and unique cable ID. Cables shall be tagged at both ends and at each intermediate termination.
- C. Hand-written or adhesive "P-touch" labels applied with pen or marker are not acceptable. Use thermal-transfer printers with laminated wire-marker media (e.g., Brady, Panduit, HellermannTyton).
- D. All labeling schemes and databases shall be approved by the Owner and Engineer prior to application.

### **3.08 WORK AREA**

- A. The Contractor shall provide a clean and orderly work area during system installation. The area shall be cleaned daily; all packaging and trash shall be removed at the end of each workday.
- B. Dust shall be minimized during installation. Perform thorough cleaning prior to system cutover and again prior to Project closeout.
- C. The Owner and Engineer shall have access to the work area at all times during normal working hours.
- D. The Owner and Engineer reserve the right to stop work to address questions and concerns that arise during installation.

### **3.09 TRAINING**

- A. Provide forty (40) hours of training delivered on-site by the manufacturer or a manufacturer-certified trainer.
- B. Training shall be distributed over the three-(3-)year warranty period (example: 8 hours at Project turnover; 8 hours at 3 months; 8 hours at 6 months; 8 hours at 12 months; 4 hours at 24 months; 4 hours at 36 months).
- C. Training sessions shall be delivered in increments of no more than two (2) hours.
- D. Provide separate curricula for:
  - 1. **End users (teachers / presenters)** — routine operation and common-fault resolution.

2. **Technical staff (IT / facilities)** — device management, firmware updates, log retrieval, and component replacement.
  3. **Administrators** — scheduling, cloud-management platforms, usage analytics, and cybersecurity posture.
- E. Provide a high-definition video recording of each training session (MP4, H.264, minimum 1080p) and deliver files to the Owner.
- F. Training shall utilize actual on-site installed equipment and shall be coordinated with the Owner's schedule. Provide printed and digital operator manuals and user quick-reference guides at the initial session.
- G. Warranty certificates and service agreements shall be provided to the Owner's IT personnel at the initial training session.
- H. Demonstrate adjustment, operation, and maintenance of the system, including each component and control.

### 3.10 AS-BUILT DOCUMENTATION

- A. Deliver two (2) USB drives containing the complete as-built manuals and drawings in indexed PDF format, together with all editable source files (AutoCAD / Revit / Visio). Drawings shall be minimum 11" × 17" engineering format. Provide, in addition, one (1) cloud-hosted copy to an Owner-specified repository. Legacy CD/DVD media shall not be provided.
- B. Documentation shall comply with ANSI/AVIXA D401.01:2023 and shall include:
1. System operating instructions.
  2. System functional block diagram(s).
  3. System schematic diagram(s).
  4. System wiring diagrams.
  5. As-built drawings of the entire system, including equipment rack elevations.
  6. Component technical operation manuals.
  7. Component service manuals.
  8. Software operating manuals and licenses (registered to the Owner).
  9. Port and switch labeling.
  10. Final endurance/burn-in test report (minimum 72-hour continuous operation).
  11. Cybersecurity device inventory and configuration baseline (per Article 3.05).
- C. **Maintenance Manual:** Describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, firmware update procedures, and repair/replacement of defective components.
- D. Provide an updated Owner network-topology diagram indicating all new AV devices included in this Scope, with equipment information, IP addresses, VLAN assignments, and MAC addresses. Diagram shall be prepared in AutoCAD or Visio and delivered in editable electronic format.

### 3.11 CERTIFICATION



|                                                                      |  |                                     |
|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- A. Upon completion of testing, the manufacturer (or authorized representative) shall issue to the Owner a letter of certification attesting that the system has been tested and adjusted, all components are properly installed and free of defects, and the system is in compliance with this Specification and with ANSI/AVIXA 10:2013 Performance Verification.

**END OF SECTION 27 41 19**

## **SECTION 27 51 23**

### **IP CENTRAL SOUND / MASTER CLOCK SYSTEM**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 27 05 00 — Common Work Results for Communications.
- C. Section 27 10 00 — Structured Cabling (Voice, Video, and Data).
- D. Section 27 05 26 — Grounding and Bonding for Communications Systems.
- E. Section 27 05 28 — Pathways for Communications Systems.

##### **1.02 SCOPE OF WORK**

- A. Furnish, install, configure, test, and commission a complete and operating IP-based central sound, intercom, paging, and master clock system in accordance with the specifications and Drawings, including but not limited to the following:
  - 1. A fully networked, IP-based communication platform that serves one or more buildings on a unified LAN/WAN. The system shall support facility-wide and district-wide mass notification, zone paging, all-call paging, and point-to-point intercom.
  - 2. Centralized, server-based system controller with browser-based administration (HTTPS/WebRTC). No proprietary client software shall be required for routine operation.
  - 3. VoIP administrative phone(s) with integrated color touchscreen display as shown on the Drawings.
  - 4. Analog Station Bridge appliance(s) located in each IDF/MDF to support 25 V analog classroom and corridor speakers and call switches over existing or new twisted-pair cabling.
  - 5. Classroom ceiling speakers, corridor speakers, surface-mounted speakers, pendant/hanging speakers, and call switches as shown on the floor plans, cabled back to the nearest IDF/MDF.
  - 6. Visual paging notification devices (LED strobes/beacons) in high-noise and acoustically isolated spaces, including but not limited to: gymnasiums, multi-purpose and weight rooms, locker rooms, student dining rooms, music rooms (orchestra/band/vocal), performing arts spaces (dressing rooms, make-up rooms, scene shop, storage), collaborative learning rooms, student (media) center, and as otherwise shown on the Drawings.
  - 7. Built-in master clock with unlimited event schedules, holiday schedules, automatic daylight saving time correction, and synchronization to NTP time sources.

8. Audio tie-in and muting interface to athletic stadium sound system and local program amplifiers in gymnasiums, cafeterias, and auditoria.
  9. Weather-resistant IP and 25 V paging horns at exterior areas: athletic fields, bus loading/drop-off, playgrounds, pool decks, courtyards, and other outdoor areas shown on the Drawings.
  10. SIP trunking and tie-line integration with the Owner's VoIP telephone system for paging, intercom, and emergency notification from telephone stations.
  11. Integration with fire alarm system via dry-contact closures for page exclusion (audio muting) during alarm conditions. Integration shall comply with NFPA 72 and shall not interfere with operation of the fire alarm system.
  12. Field quality control, performance verification, owner training, and as-built documentation as specified herein.
- B. The system shall be capable of fully and seamlessly integrating voice communications throughout the school district for mass notification and district-wide paging. The Owner may install the same manufacturer and platform in all buildings across the district, and all buildings shall interoperate as a unified, single-vendor ecosystem. The system shall scale to support an unlimited number of interconnected facilities.

### **1.03 REFERENCES AND APPLICABLE STANDARDS**

- A. The system shall be designed, installed, tested, and verified in accordance with the latest published edition of the following codes and standards:
1. NFPA 70 — National Electrical Code (NEC).
  2. NFPA 72 — National Fire Alarm and Signaling Code.
  3. Underwriters Laboratories (UL) listing for all active electronic equipment.
  4. ANSI/TIA-568 — Commercial Building Telecommunications Cabling Standard.
  5. ANSI/TIA-569 — Telecommunications Pathways and Spaces.
  6. ANSI/TIA-607 — Generic Telecommunications Bonding and Grounding.
  7. ANSI/TIA-606 — Administration Standard for Telecommunications Infrastructure (labeling and identification).
  8. BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition.
  9. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), latest edition.
  10. Americans with Disabilities Act (ADA) and ADA Accessibility Guidelines.
  11. Federal Communications Commission (FCC) Part 15, Class A or Class B as applicable.
- B. AVIXA (Audiovisual and Integrated Experience Association) Standards:
1. ANSI/AVIXA A102.01:2022 — Audio Coverage Uniformity (ACU) in Listener Areas. Sound coverage shall meet, at a minimum, ACU Class B across defined listener areas in classrooms, corridors, and assembly spaces, as verified by the field performance tests specified in Part 3.

2. ANSI/AVIXA A103.01:2017 — Sound System Spectral Balance.
  3. ANSI/AVIXA 10:2013 (R2019) — Audiovisual Systems Performance Verification.
  4. ANSI/AVIXA F501.01:2015 — Cable Labeling for Audiovisual Systems.
  5. ANSI/AVIXA F502.01:2018 — Rack Building for Audiovisual Systems.
  6. ANSI/AVIXA F502.02:2020 — Rack Design for Audiovisual Systems.
  7. ANSI/AVIXA D401.01:2023 — Documentation Requirements for Audiovisual Systems.
  8. AVIXA Standard Guide for Audiovisual Systems Design and Coordination Processes.
- C. Speech intelligibility: In assembly spaces, corridors, and other areas used for life-safety voice messaging, the installed system shall achieve a Speech Transmission Index (STI) of not less than 0.50 ("Fair" per IEC 60268-16) under normally occupied ambient noise conditions, or Common Intelligibility Scale (CIS) equivalent of 0.70 or greater. Higher performance is required where indicated on the Drawings.
- D. Sound pressure level: Paged and announced audio shall be a minimum of 15 dB above the average occupied ambient noise level, measured A-weighted at the listener plane, and shall not exceed 95 dBA in any normally occupied area.

#### 1.04 SYSTEM DESCRIPTION

- A. **System architecture.** The Central Sound System shall be a pure IP/VoIP, software-defined platform consisting of a networked system controller (server), network-attached audio appliances, analog station bridges, VoIP administrative phones and paging stations, ceiling and horn speakers, call switches, and associated wiring, pathways, and accessories. The central application shall reside on a purpose-built Nyquist System Controller appliance or, where specified, on a Contractor- or Owner-provided server meeting the minimum requirements of Article 2.03.C. The system shall utilize the Owner's existing LAN/WAN structured-cabling infrastructure and shall also support legacy "home-run" analog cabling to 25 V / 70 V speakers and call switches via the Analog Station Bridge (Article 2.05).
- B. **System functions.** The system shall be capable of performing the following functions at a minimum:
1. Full-duplex VoIP-based intercom communication between administrative stations and classroom/staff stations using G.722 wideband and Opus 48 kHz codecs with full-duplex acoustic echo cancellation (AEC).
  2. Amplified voice paging over system loudspeakers, including one-way paging, zone paging, all-call, emergency all-call, district-wide all-call, and district-wide emergency all-call.
  3. Priority-based paging with preemption. Emergency and life-safety announcements shall override lower-priority pages, background music, and program audio on all active zones.
  4. Unlimited addressable paging zones and unlimited addressable stations, limited only by network bandwidth and server capacity.

5. Integrated master clock with unlimited time events, unlimited schedules, unlimited holiday schedules, automatic daylight saving time correction, and NTP client/server capability.
  6. Background music and program audio distribution to individual stations, zones, or the entire facility, sourced from local inputs, network streams, and subscription streaming services.
  7. Emergency tones, pre-recorded messages, and text-to-speech (TTS) announcements, triggered manually, on schedule, or automatically via contact closure (for example, from a lockdown button, severe-weather alert, or National Weather Service alert).
  8. User-definable routines (macros) for lockdown, severe weather, fire drill, evacuation, shelter-in-place, and similar emergency operations, combining audio, visual, and third-party system actions in a single one-touch activation.
  9. Emergency Classroom Check-In allowing staff to report their check-in status for assigned classrooms or areas during an emergency using any intercom call switch or VoIP phone.
  10. NWS (National Weather Service) alert handling with routines configurable by latitude/longitude for precise geographic targeting.
  11. Audio muting (page exclusion) upon activation of the fire alarm system via supervised dry-contact closure.
  12. Supervision of all networked appliances, speakers where supported, and call switches, with email and dashboard alerting upon fault detection.
  13. Remote administration and diagnostics over the LAN/WAN via secure HTTPS browser interface supporting WebRTC. Systems requiring proprietary client applications, COM-port redirectors, or serial-to-Ethernet adapters for routine administration are not acceptable.
- C. **Administrative interface.** The Web-based User Interface (UI) shall provide, at a minimum: role-based user access (Administrator, Technician, Operator, and User roles, with the ability to create additional custom roles and Class-of-Service profiles); map-based paging and intercom views with hierarchical drill-down; directory and keypad dialing; call-forwarding; scheduled bell management; interactive weekly schedule view; audio distribution and source routing; tone/announcement playback; enable/disable audio (page exclusion); and live, pre-recorded, and TTS announcement creation.
- D. **Telephone-system interface.** The system shall support SIP trunking and SIP tie-line interconnection to the Owner's VoIP telephone system, allowing any authorized telephone station to initiate pages, call individual rooms or zones, trigger emergency tones, and activate routines using DTMF feature codes secured by password/PIN.
- E. **Wiring and zoning.** The system shall be configured as follows:
1. Each classroom, office, and occupiable space shall be an individually addressable station with one or more loudspeakers and a call switch, as shown on the Drawings.

2. Corridors, gymnasiums, auditoria, cafeteria, administrative areas, and other public or assembly areas shall be grouped into individually addressable paging zones as directed by the Architect/Engineer/Owner.
  3. All exterior horns (athletic fields, playgrounds, bus loading, courtyards, etc.) shall be on separate, dedicated, addressable zones.
- F. **Power and backup.** The central sound system controller, core network switches serving the sound system, and all IDF/MDF analog station bridges and amplifiers shall be powered from emergency/standby branch circuits where available, and shall be protected by UPS with a minimum of 30 minutes of runtime under full system load. Coordinate UPS sizing with the Electrical Contractor.

## 1.05 QUALITY ASSURANCE

- A. System contractor qualifications:
1. The Contractor shall be an electronic systems integrator factory-authorized by the basis-of-design manufacturer to sell, install, program, commission, and service the specified platform.
  2. The Contractor's primary service office shall be located within 60 miles (100 km) of the Project site.
  3. The Contractor shall have successfully completed, within the past three (3) years, at least three (3) installations of similar size, scope, and type to that specified herein. References shall be furnished on request.
  4. The Contractor shall employ technicians holding current manufacturer training certifications on the specified platform. At least one assigned technician shall hold AVIXA CTS (Certified Technology Specialist) certification, and at least one shall hold BICSI ITS Installer 2 (Copper) or equivalent certification.
  5. The Contractor shall maintain a factory-trained service department available 24 hours a day, 365 days a year, with guaranteed emergency on-site response within four (4) hours of dispatch.
- B. Manufacturer qualifications: The manufacturer shall have been regularly engaged in the design and manufacture of IP-based networked audio and paging/intercom systems for at least five (5) years and shall demonstrate at least five (5) satisfactory installations of comparable size and scope completed within the past two (2) years.
- C. Regulatory compliance: All active electronic equipment shall be UL listed or recognized, FCC Part 15 compliant, and RoHS compliant. Equipment installed in air-handling (plenum) spaces shall carry the appropriate UL plenum rating.
- D. Cybersecurity: The system shall support, at a minimum: HTTPS (TLS 1.2 or higher) for all browser administration; Secure SIP (SIP over TLS) and SRTP for VoIP signaling and media between appliances and supported third-party hardware; role-based access control; configurable password complexity and aging; audit logging; 802.1X supplicant support on networked appliances where available; and a documented process for timely application of manufacturer security patches through a vendor-supported software subscription.
- E. Cooperation and coordination: The Contractor shall cooperate and coordinate as required with other trades and with the Owner's IT department for network configuration, VLANs, QoS, multicast, DHCP options, NTP, firewall, and

cybersecurity review. The Contractor shall provide all information as required or requested by the Owner, Engineer, or General Contractor, in writing.

## **1.06 WARRANTY**

- A. Refer to warranty requirements in the General Requirements.
- B. The Contractor shall provide a minimum one (1) year parts-and-labor warranty on the complete installed system from the date of Substantial Completion. Where a manufacturer's standard warranty on a specific piece of equipment exceeds one (1) year, the installed warranty period for that equipment shall match the manufacturer's extended warranty period (typically five (5) years on core Nyquist appliances).
- C. The Contractor shall include, at minimum, a three (3) year manufacturer Software Update Subscription (SUS) covering all firmware and software feature releases, security patches, and major version upgrades for the central system controller and all networked appliances. An optional five (5) year SUS extension shall be offered as a bid alternate.

## **1.07 SUBMITTALS**

- A. Shop drawings and product data. Submit in accordance with Section 01 33 00 and ANSI/AVIXA D401.01:2023:
  - 1. Complete bill of materials with manufacturer, model/part number, quantity, and cross-reference to the Part 2 specification paragraph and Drawing callout.
  - 2. Manufacturer's current data sheets and cut sheets for every product, clearly marking the specific model, options, and accessories being provided.
  - 3. Contractor qualification statement documenting compliance with Article 1.05.A, including technician certifications.
  - 4. Project-specific block diagrams, point-to-point wiring diagrams, and riser diagrams showing all appliances, stations, speakers, cable types, pathway routes, and device labels.
  - 5. Details of all interconnections with other systems (fire alarm, VoIP telephone, stadium/athletic sound, access control/lockdown, clock synchronization, building automation, mass-notification).
  - 6. Rack elevations per ANSI/AVIXA F502.01 and F502.02, including front and rear elevations, thermal management, and cable management.
  - 7. Floor plans at a scale of not less than 1/8" = 1'-0" (or 1:100 metric) showing the location, mounting height, and orientation of every device, and every location where electrical power is required with voltage, receptacle type, and mounting height noted.
  - 8. Software data package including the basis-of-design software version, feature matrix, licensing model, and a list of third-party integrations to be configured.
  - 9. Network requirements document specifying VLAN, QoS/DSCP markings, multicast, bandwidth per zone and per intercom call, DHCP options (including DHCP Option 66), NTP, and firewall rules.

10. Acoustic coverage calculations or modeling (EASE, ODEON, or equivalent) for representative assembly spaces, demonstrating compliance with ANSI/AVIXA A102.01 ACU Class B (minimum) and required STI.
  11. Cybersecurity compliance statement addressing Article 1.05.D.
- B. Final documentation. Within forty-five (45) days after Substantial Completion, deliver two (2) hard-copy sets and one (1) electronic set (searchable PDF plus native CAD/BIM) of:
1. As-installed equipment list (by room), with manufacturer, model, serial number, firmware version, and MAC/IP address of each networked device.
  2. As-built system schematic and point-to-point wiring diagrams, including wire numbers, terminal-block numbers, and device labels per ANSI/AVIXA F501.01.
  3. Documented system performance measurements per Part 3, including SPL coverage, ACU classification, STI measurements in representative spaces, and final DSP settings (gain, EQ, limiter, delay).
  4. As-built rack elevations per ANSI/AVIXA F502.01 and F502.02.
  5. As-built floor plans at 1/8" = 1'-0" showing final speaker locations and orientation, wall plates, rack locations, and device labels.
  6. As-built riser diagrams with installed conduit, pull boxes, outlet boxes, cable types, and circuit counts.
  7. System operation and administration manuals.
  8. Network configuration documentation (VLAN, QoS, multicast, IP address plan, DHCP reservations).
  9. Training records per Article 3.07.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. All equipment shall be new, unused, of current manufacture, and the latest hardware revision and firmware release at the time of delivery.
- B. Where quantities are not explicitly stated, quantities shall be obtained from the Drawings. In the event of a discrepancy between the specifications and the Drawings, the greater quantity or higher quality shall be furnished.
- C. These specifications establish a standard of quality, function, features, and ecosystem interoperability. It is the Contractor's responsibility to ensure that the proposed system and every component meet or exceed every requirement set forth herein.
- D. Inclusion of a manufacturer in the list of acceptable manufacturers does not relieve the Contractor of strict compliance with the requirements of this Section.

### **2.02 MANUFACTURERS**

- A. Basis of design: AXIS, Carehawk, Bogen



- B. Approved equivalent manufacturers, subject to prior approval by the Engineer no less than ten (10) business days prior to bid.
- C. All substitutions shall meet or exceed every functional, performance, and interoperability requirement in this Section. Substitutions shall provide, at minimum, an equivalent feature set for: user-definable routines and routines API for third-party integration; Emergency Classroom Check-In; unlimited schedules, events, and holidays; native text-to-speech with SSML support; map-based user interface; SIP tie-line and SIP trunking; Secure SIP (TLS) with SRTP; NWS alert handling with latitude/longitude targeting; district-wide multi-site all-call and emergency all-call; automatic failover option; manufacturer-supported Software Update Subscription with defined security-patch cadence.

## **2.03 IP SYSTEM CONTROLLER**

- A. Provide a dedicated, factory-configured system controller appliance running the central sound system server software preinstalled. Basis of design: Bogen Nyquist NQ-SYCTRL System Controller.
- B. Minimum requirements:
  - 1. Purpose-built 1 RU appliance; wall-, rack-, or shelf-mountable. Provide Bogen NQ-RMK03 19" rack-mount kit for rack-mounted installations.
  - 2. Convection-cooled, fanless design for quiet, maintenance-free operation.
  - 3. Manufacturer-maintained Linux-based operating system with ongoing security patches via the Software Update Subscription.
  - 4. Preinstalled Nyquist E7000 application server software, licensed for the as-bid station and appliance count plus a minimum of 20 % spare capacity. Scalability shall support an essentially unlimited number of stations, facilities, zones, and bell schedules.
  - 5. Dual 10/100/1000 Mb Ethernet ports.
  - 6. USB host port for direct import of music files into the system music library.
  - 7. Continuous monitoring of stations and appliances with email and dashboard alerts upon device failure or offline condition.
  - 8. SIP tie-line and SIP trunking support for connection to external IP-PBX, VoIP service providers, and analog phone systems (analog support via third-party 24-port VoIP gateway).
  - 9. Multicast support for all zone paging and audio distribution.
  - 10. Simultaneous distribution of a virtually unlimited number of audio streams across the data network, limited only by network bandwidth.
  - 11. Pre-recorded and text-to-speech (optional license) announcement playback.
  - 12. Built-in streaming Internet radio program source and support for subscription-based premium streaming-music services.
  - 13. G.722 and Opus audio-codec support for HD audio quality.
  - 14. Ample onboard storage for music files, recorded announcements, call recordings, and audit logs.

15. Secure SIP (SIP over TLS) and SRTP between appliances and supported third-party hardware; HTTPS administration with TLS 1.2 or higher.
  16. NTP client and server capability; DHCP Option 66 for appliance auto-discovery.
  17. Support for automatic failover to a licensed secondary controller (bid alternate per Article 2.03.D).
- C. Contractor-supplied or Owner-supplied server alternative. In lieu of the NQ-SYSCTRL appliance, the system software may be installed on a Contractor- or Owner-supplied server meeting, at minimum:
1. Debian Linux OS (AMD 64-bit), release 11.9 or later, as supported by the current manufacturer release notes.
  2. Quad-core Intel-based processor at 3.0 GHz or higher; 8 GB RAM minimum; 250 GB disk storage minimum (RAID configuration recommended for redundancy).
  3. Dual 10/100/1000 Mb Ethernet ports.
  4. One or more PCI/PCIe slots only if direct FXO/FXS analog telephony connectivity is required in addition to SIP trunking.
- D. Automatic failover (optional). Where required by the Drawings or as a bid alternate, provide a second NQ-SYSCTRL appliance and the manufacturer Automatic Failover software license. The secondary controller shall automatically take over and restore normal service if the primary controller fails or goes offline.
- E. Preassembled alternative (Nyquist E7000MCR). Where indicated on the Drawings or as a bid alternate, the Contractor may furnish the Bogen Nyquist E7000MCR preassembled system in lieu of field-assembled head-end components. The E7000MCR preconfigured rack includes the NQ-SYSCTRL (DHCP enabled), one to four NQ-E7030 ASBs supporting 24/48/72/96 analog ports, one NQ-ZPMS paging microphone station, one NQ-E7010 I/O controller, one NQ-P0100 MMPA, a 16-port partial-PoE managed network switch, a Windows laptop for setup and administration, a locking keyboard drawer, and all filler panels and intra-cabinet patch cables in a 42 RU rack with locking rear door. All functional, performance, and warranty requirements of this Section apply regardless of whether the E7000MCR or field-assembled configuration is provided.
- F. The system controller shall be rack-mounted in the MDF and powered from an emergency/standby circuit with UPS backup as specified in Article 1.04.F.

## **2.04 CENTRAL SOUND SYSTEM SERVER APPLICATION**

- A. The central sound system software shall provide a browser-based user interface accessible over HTTPS from any WebRTC-capable browser. Systems requiring proprietary client software, COM-port redirectors, serial-to-Ethernet adapters, or local console access for routine administration are not acceptable.
- B. The Web UI shall provide, at minimum, role-based access with four default roles (Administrator, Technician, Operator, User) and shall allow the creation of custom roles and Class-of-Service (CoS) profiles. Only an Administrator shall be able to create, delete, or edit users and assign roles or CoS. Role and CoS changes shall take effect immediately without requiring a reboot.
- C. The Web UI Dashboard shall provide a single pane of glass for:

1. Calling/paging from the directory or dial pad; zone paging, all-call, emergency all-call, and prepending pages.
2. Call forwarding and call routing.
3. District-wide calling and paging: district facility page, district all-call, and district emergency all-call.
4. Tone, announcement, and alarm playback with priority queuing.
5. Live view of the active interactive bell schedule; schedule override and temporary schedule changes.
6. Audio distribution (background music and program audio) to the entire facility or selected zones.
7. Enable/disable audio (page exclusion) upon dry-contact closure from the fire alarm panel.
8. User-definable routines for lockdown, severe weather, evacuation, fire drill, shelter-in-place, automated notifications, and NWS alerts (using latitude/longitude configuration).
9. Map-based paging and intercom user interface with hierarchical drill-down from district → site → zone → station.
10. Live, pre-recorded, and text-to-speech (TTS) announcement creation and scheduling.
11. Integrated Internet Radio program source and optional subscription streaming-music service.
12. API (REST/JSON) for integration with third-party systems (mass notification, access control, VMS, building automation).

## **2.05 ANALOG STATION BRIDGE (ASB)**

- A. Provide one or more Analog Station Bridge appliances per IDF/MDF to interface the IP system to existing or new 25 V analog classroom and corridor speakers and call switches. Basis of design: Bogen Nyquist NQ-E7030 Analog Station Bridge.
- B. Minimum requirements per ASB:
  1. 10/100 Ethernet uplink.
  2. Twenty-four (24) analog station ports, each supporting one 25 V speaker connection and one dry-contact call switch.
  3. Half-duplex talkback using the speaker as the pickup element.
  4. One hundred twenty (120) watts of total embedded 25 V power, with a maximum of forty (40) watts per channel. Provide an additional networked paging amplifier where any zone requires more than 40 W at 25 V.
  5. RGB full-spectrum LED status indicators.
  6. USB 2.0 Type-A host port.
  7. Universal mains input (100-240 VAC), powered from UPS-protected IDF/MDF branch circuit.

8. Rack, wall, or shelf mountable; include all required mounting hardware.

C. Quantity: Provide the quantity of ASBs required to support all analog stations shown on the Drawings, plus a minimum of 20 % spare port capacity.

## **2.06 MATRIX MIXER PRE-AMPLIFIER (MMPA)**

A. Provide a networked matrix mixer pre-amplifier to bring external audio sources into the IP system and to drive local amplifiers in gyms, cafeterias, auditoria, and similar assembly spaces. Basis of design: Bogen Nyquist NQ-P0100 Matrix Mixer Pre-Amplifier.

B. Minimum requirements:

1. Four (4) software-selectable MIC or LINE input channels via three (3) XLR connectors and four (4) sets of screw terminals. Channel 1 shall be selectable as an AES/EBU (AES3) digital input. Any channel shall be configurable as a push-to-talk microphone input.
2. Line-level analog output to drive an external amplifier.
3. Pro-audio embedded Digital Signal Processing (DSP) including input/output gain, parametric EQ, compressor/limiter, and routing matrix.
4. Operation as a full station on the IP system so it can be called, included in Page/Time/Audio zones, or used as an audio source.
5. USB 2.0 Type-A host port.
6. Universal mains input (100-240 VAC).
7. Wall, rack, or shelf mountable; include all required mounting hardware.

C. Quantity and connections: Provide one (1) MMPA in the central office of each school and additional units as shown on the Drawings. Connect the following to each MMPA:

1. Remote source input plate(s) located per the Drawings, with connectors for XLR paging microphone, 3.5 mm (1/8") stereo mini, and dual RCA (active balun). Custom plate manufacturers include Liberty AV, ProCo, or RCI.
2. Announcement paging microphone: desktop microphone, cardioid pattern, with locking on/off switch. Provide one (1) Shure 522 (or approved equal by Audio-Technica, Electro-Voice, or Telex) with a 25 ft (7.6 m) microphone cable per MMPA.
3. Local program sources as shown on the Drawings (internet radio via the system controller, streaming-music service, or external source).

## **2.07 NETWORKED AUDIO POWER AMPLIFIERS**

A. Where additional amplification is required beyond the 40 W per-channel capacity of the ASB (for gymnasiums, auditoria, cafeterias, outdoor horn zones, or high-wattage speaker clusters), provide networked audio power amplifiers as a native station on the IP system. Basis of design: Bogen Nyquist NQ-A2060-G2, NQ-A2120-G2, NQ-A2300-G2 (two-channel) or NQ-A4060-G2, NQ-A4120-G2, NQ-A4300-G2 (four-channel) amplifiers.

B. Minimum requirements:

1. Two (2) or four (4) independent amplifier channels with selectable 4  $\Omega$ , 8  $\Omega$ , 25 V, or 70 V outputs.
  2. Rated continuous output power per channel: 60 W, 120 W, or 300 W as required to drive the connected loads at design SPL with at least 3 dB of headroom.
  3. Embedded pro-audio DSP (input/output gain, multi-band parametric EQ, compressor, limiter, delay, ducker/priority, ambient-noise-sensing compatibility when paired with ambient-sensing modules).
  4. Native IP/VoIP streaming endpoint with priority-based multicast and SIP endpoint capability.
  5. Front-panel and Web-UI diagnostics; amplifier protection (thermal, short-circuit, DC offset).
  6. 1RU rack-mount; universal mains input (100-240 VAC).
- C. Size and quantity: Select amplifier wattage and channel count based on speaker tap calculations with at least 20 % spare capacity. Submit calculations with shop drawings.

## **2.08 INPUT/OUTPUT (I/O) CONTROLLER**

- A. Provide networked I/O controller appliances to interface the IP system with external dry-contact inputs (fire alarm, lockdown buttons, sensors, timers) and to drive open-collector outputs (clock correction sync pulses, third-party relays, visual signaling). Basis of design: Bogen Nyquist NQ-E7010 I/O Controller.
- B. Minimum requirements:
1. 10/100 Ethernet with PoE Class-4, IEEE 802.3af compliant; optional 48 VDC / 15 W DC power supply where no PoE port is available.
  2. Eight (8) dry-contact closure inputs (one ground per four inputs) for fire-alarm override relays and external event triggers (lockdown buttons, sensors).
  3. Eight (8) open-collector relay-driver outputs, 50 VDC / 0.5 A maximum, for clock correction (sync pulse), response to contact-closure inputs, and third-party relay actuation.
  4. USB 2.0 Type-A host port (for future feature capabilities).
  5. Two (2) RGB full-spectrum LED power and status indicators.
  6. Wall or shelf mounting standard; optional rack-mount bracket available.
- C. Quantity: Provide I/O controllers as required to support all fire-alarm interface points, emergency-tone panels, lockdown interfaces, clock-correction outputs, and third-party interlocks shown on the Drawings, plus 20 % spare capacity.

## **2.09 VoIP ADMINISTRATIVE PHONE**

- A. Provide one (1) VoIP administrative phone in the central office of each school (minimum), and additional units as shown on the Drawings. Basis of design: Bogen Nyquist NQ-T1100 Color Touch Display VoIP Admin Phone.
- B. Minimum features:
1. 7-inch 800 × 480 pixel color touch screen with backlight.

2. One-touch operation for all-call, emergency all-call, zone paging, district paging, alarm activation, routine activation, audio distribution, and schedule override.
  3. Hearing-aid compatible (HAC) handset.
  4. Wideband HD audio using G.722 and Opus codecs; full-duplex hands-free speakerphone with AEC.
  5. Call hold, mute, redial, call return, auto-answer, call forward, call waiting, call transfer, text messaging, and group listening.
  6. Dual Gigabit Ethernet ports.
  7. Power via PoE (IEEE 802.3af) Class-3.
  8. Headset jack with EHS support.
  9. Desk mount standard; wall mount kit optional.
- C. Functionality. The admin phone display shall show time of day, day of week, the active bell schedule, system messages, incoming call identification, call-in priority, and active NWS alerts. Menus shall provide activation of zone paging, all-call, emergency all-call, district all-call and district emergency all-call, alarm signals, routines, and external functions per assigned CoS.
- D. Emergency 911 handling. If the Owner's telephone system is configured to integrate, the admin phone shall display the classroom number of any station that dials 911, and the system shall automatically record the call from the moment 911 is dialed until the call terminates. Recordings shall be retained on the system controller per the Owner's records-retention policy for later review by authorized personnel.

## **2.10 ZONE PAGING MICROPHONE STATION (OPTIONAL / AS SHOWN)**

- A. Where shown on the Drawings, provide a combination VoIP phone and zone paging microphone station in lieu of, or in addition to, the admin phone. Basis of design: Bogen Nyquist NQ-ZPMS Zone Paging Microphone Station.
- B. Minimum features:
1. 10.1-inch color touchscreen for visual zone selection and menu navigation.
  2. Flexible gooseneck microphone with push-to-talk operation.
  3. Up to 112 programmable one-touch Direct Station Selection (DSS) keys.
  4. G.722 wideband audio with noise reduction and full-duplex AEC.
  5. Operation as the primary or secondary administrative station.

## **2.11 VoIP NETWORKED SPEAKERS AND INTERCOM MODULES**

- A. Where shown on the Drawings as "IP" or "VoIP" speakers, provide native IP-addressable speakers with embedded amplification and DSP. Basis of design: Bogen Nyquist NQ-S1810CT-G2 Ceiling and NQ-S1810WT-G3 Wall Baffle VoIP speakers.
- B. Minimum features for native VoIP speakers:
1. PoE+ (IEEE 802.3at) powered.
  2. SIP endpoint and priority-based multicast streaming.

3. Onboard pro-audio DSP with EQ, limiter, and ambient-noise-sensing compatibility.
  4. G.722 and Opus codec support.
  5. Separate high-performance MEMS microphone for high-quality two-way talkback where that feature is specified (speaker-cone-as-microphone designs are not acceptable where talkback is required).
- C. VoIP intercom modules for passive-speaker retrofit. Where it is required to convert an existing 8-ohm speaker into an IP endpoint, or where plenum-rated intercom modules are shown, provide the Bogen NQ-GA10P (10 W PoE) or NQ-GA10PV (with integrated flasher/video support) Plenum-Rated VoIP Intercom Module, or the NQ-GA20P2 PoE+ (20 W) Integrated Amplifier for higher-output applications. Modules shall operate as full IP stations on the system.
- D. Combo clock/speaker/messaging display (where shown). Where the Drawings call for an integrated clock, speaker, and visual-message display in a single wall-mounted device, provide the Bogen Nyquist NQ-S1810WBC VoIP Wall Baffle Combo Speaker with Integrated LED Text Display and LED Flasher. The device shall provide two-way intercom, scrolling text messages, programmable standard and emergency messages, and a programmable multi-color LED flasher for attention-gaining alerts (configurable per alert type: fire, lockdown, severe weather, etc.), all controllable via scheduled events, routines, or the Routines API.
- E. HDMI messaging displays (where shown). Where visual messaging is extended to an external monitor (such as a classroom display, cafeteria display, or corridor TV), provide the Bogen NQ-GA10PV Plenum-Rated VoIP Intercom Module with HDMI output connected to an Owner- or Contractor-furnished HDMI-capable monitor. The module shall drive the monitor with text and graphic messages based on priority, zone assignment, and routine activation.

## 2.12 CLASSROOM AND CORRIDOR ANALOG CEILING SPEAKERS

- A. **Recessed tile-mount (lay-in) ceiling speakers:** Provide a pre-assembled ceiling speaker consisting of an 8-inch dual-cone speaker with a 25/70 V multi-tap line-matching transformer with taps of 1/8, 1/4, 1/2, 1, 2, and 4 W, enclosed in a 2 ft × 2 ft fully enclosed steel tile assembly with an integral back can and seismic attachment points. Basis of design: Bogen CSD2X2VR 2'×2' Drop-In Ceiling Speaker with Back Can. Acceptable equivalents: Atlas Sound, Lowell, or Quam-Nichols. Off-white grille finish standard; verify with Architect.
- B. **Recessed round ceiling speakers (where shown):** Provide an 8-inch speaker with a 4 W (minimum) 25/70 V multi-tap line-matching transformer, mounted in a 13-inch round white enamel steel grille with matching back box and T-bar support. Basis of design: Bogen S86T725PG8WVK. Provide 275 cubic inch steel back box with acoustical damping and T-bar bridge support where shown on the Drawings. Acceptable equivalents: Atlas Sound, Lowell, or Quam-Nichols.
- C. **Surface-mounted ceiling or wall speakers:** Provide an 8-inch speaker with a 25/70 V multi-tap transformer (taps of 5/16, 5/8, 1-1/4, 2-1/2, 5 W; program rating 15 W continuous) in a .030 zinc-treated steel enclosure finished in white baked powder epoxy with matching steel baffle. Basis of design: Bogen ASC8T725PG8WVK

surface-mount ceiling speaker assembly, or approved equivalent by Atlas Sound, Lowell, or Quam-Nichols.

- D. **Pendant (hanging) speakers:** Provide an 8-inch speaker with a 25/70 V multi-tap transformer (taps of 5/16, 5/8, 1-1/4, 2-1/2, 5 W; program rating 15 W continuous) in a surface-mount cylindrical spun-aluminum enclosure with undercoated/jute-lined interior, contrasting canopy, and recessed grille. Basis of design: Atlas Sound AH-SPK cylindrical pendant speaker, or approved equivalent by Bogen or Lowell. Mount with suspension hangers in the length required to achieve the ceiling height shown on the Drawings. Finish: white or aluminum as directed by the Architect.

## 2.13 HORN SPEAKERS (INTERIOR AND EXTERIOR)

- A. **Re-entrant horn speakers:** Provide 30 W re-entrant horn speakers with 25/70 V multi-tap line-matching transformer, compression driver, and all-weather ABS/aluminum housing with stainless-steel mounting bracket. Basis of design: Bogen SPT30A (30 W, 25 V / 70 V). Acceptable equivalents: Atlas Sound, Lowell, or Quam-Nichols.
- B. Outdoor and pool-area horn speakers shall be fully weather-resistant (IP65 minimum), UV-stable, and furnished with stainless-steel hardware. Hardware exposed to chlorinated or saline atmospheres shall be Type 316 stainless steel.
- C. IP horn speaker with talkback (where shown): Where the Drawings call for an IP horn with two-way talkback, provide Bogen Nyquist NQ-IPHRN01 VoIP Indoor/Outdoor IP Horn with Talkback, PoE powered, with web-based configuration, or approved equivalent.

## 2.14 VOLUME CONTROLS, CALL SWITCHES, AND REMOTE DISPLAYS

- A. Wall-mounted analog volume attenuator (where shown on legacy analog zones): 20 W continuous, 10-step L-pad with an additional OFF position; total attenuation –36 dB in 6 dB steps 1 and 2, continuing through position 10. One-gang stainless-steel trim plate with embossed position indicators. Basis of design: Atlas Sound AT10 or Lowell equivalent.
- B. Digital remote volume-control/call switch: Where shown, provide a wall-mounted digital call switch/volume control with multifunction knob, mute, call-initiation, and alert-trigger keys with LED status feedback. Basis of design: Bogen Nyquist NQ-VCTRL Digital Remote Volume-Control Call Switch. Systems shall integrate natively with the IP system.
- C. Standard call switch: Where shown, provide a single-gang stainless-steel call switch compatible with the ASB. Basis of design: Bogen Nyquist-compatible call switch, model as recommended by the manufacturer for the ASB platform.
- D. Wall-mounted remote display / messaging display: Where shown, provide a VoIP LED message display from the same manufacturer as the system controller. The display shall be semi-flush or surface-mounted with a matching back box, and shall provide:
1. Alphanumeric text display with 100 % queuing of call-in stations.
  2. Audible annunciation of incoming calls.
  3. Sequential display of waiting calls and priority calls.



- 4. Display of current time when idle, and display of the active bell schedule.
- 5. PoE powered.
- E. Basis of design: Bogen Nyquist NQ-GA10PV Plenum-Rated VoIP Intercom Module with attached LED messaging display, or Bogen VoIP LED Message Display as released.

## **2.15 DIGITAL DISPLAY CLOCKS (HALLWAY)**

- A. Provide dual-mount hallway digital display clocks with a minimum 4-inch, 4-digit display, synchronized to the central sound master clock via PoE/Ethernet (IP clocks) or hardwired clock-correction loop (legacy). Basis of design: IP-based PoE digital clock by American Time, Primex, Inova, or approved equivalent, compatible with NTP synchronization provided by the NQ-SYSCTRL.
- B. Quantity and locations per the Drawings. Coordinate mounting height and orientation with the Architect.

## **2.16 EMERGENCY TONE / ROUTINE ACTIVATION PANEL**

- A. Provide an emergency tone/routine activation panel where shown on the Drawings. The panel shall be programmed to activate four (4) unique user-selected routines or tones (for example: severe weather, lockdown, evacuation, all-clear). Button functions shall be user-selectable and relabelable, with tactile buttons, protective covers on emergency functions, and clear engraved labels.
- B. The panel shall be connected to the IP system via the NQ-E7010 I/O Controller or a dedicated networked input appliance.

## **2.17 AUDIO MUTING / SEND INTERFACE TO LOCAL SOUND SYSTEMS**

- A. Interface to gymnasium, cafeteria, and auditorium local sound systems. The Central Sound System shall provide a page-send interface that converts the distributed-audio signal to a balanced or unbalanced line-level signal for insertion into the mute-send / priority input of the local mixer-amplifier. The preferred implementation is a networked station (NQ-P0100 MMPA line-out) feeding the local mixer's priority input with supervisory muting. Where a speaker-level conversion is required in a retrofit scenario, provide one (1) Radio Design Labs (RDL) TX-70A 25 V interface or approved equivalent by FSR or Jensen.
- B. The mute-send line input at the local mixer shall be set so that paging signals pass at the correct intelligibility level without feedback or saturation. The local system shall automatically duck and mute program audio during a page and shall restore to previous state at end of page.

## **2.18 VISUAL PAGING NOTIFICATION (STROBES / BEACONS)**

- A. Provide high-visibility LED strobes and/or beacons to supplement audible paging in high-noise and acoustically isolated areas. Devices shall be:
  - 1. High-intensity LED, blue lens (or color as directed by the Architect/Owner), listed for indoor or outdoor use as required by location.
  - 2. Controllable by the IP system via the NQ-E7010 I/O Controller or equivalent networked output appliance.

3. Equipped with a control module with a local disable/silence button.
  4. Configurable for steady, flash, or ring-cadence follow via DIP switch or software.
- B. Locate strobes in the areas listed in Article 1.02.A and as shown on the Drawings. Visual signaling devices installed as part of the fire alarm life-safety system shall comply with NFPA 72 and are not superseded by this Section.

## **2.19 MICROPHONE AND SOURCE INPUT PLATES**

- A. Provide single-gang stainless-steel microphone input plates where shown on the Drawings with two (2) 3-pin XLR-F balanced microphone receptacles, wired back to the MMPA or to a dedicated ASB channel for insertion of paging microphones and local program sources.
- B. Source input plates shall provide, at minimum: XLR-F balanced microphone, 3.5 mm (1/8") stereo mini, and dual RCA (active balun) connectors. Custom plates by Liberty AV, ProCo, or RCI as shown on the Drawings.

## **2.20 EQUIPMENT RACKS AND CABINETS**

- A. Rack design shall comply with ANSI/AVIXA F502.01 (Rack Building) and F502.02 (Rack Design):
1. Minimum 20 % spare rack space at Substantial Completion.
  2. Vertical and horizontal cable management for power and signal cables; no intermingling of power and low-voltage cables.
  3. Proper thermal management with intake/exhaust clearance and active cooling where heat load exceeds passive dissipation.
  4. Dedicated isolated equipment ground conductor to the telecommunications grounding busbar (TGB) per ANSI/TIA-607.
  5. Power distribution via managed rack-mount PDU with surge protection.
  6. All filler panels, blanking panels, cable lacing bars, and labeling per ANSI/AVIXA F501.01.

## **2.21 WIRING AND CABLING**

- A. All system wiring shall comply with NFPA 70, TIA/EIA, BICSI TDMM/ITSIMM, and manufacturer's installation requirements. All wiring shall test free of grounds, shorts, and opens prior to acceptance.
- B. Ethernet (network) cabling: Category 6A UTP or better, minimum. Plenum-rated (CMP) cable in air-handling spaces. All cable shall be terminated on modular patch panels and RJ45 outlets tested and certified to Cat 6A Channel per TIA-568. Refer to Section 27 10 00 for structured cabling requirements.
- C. Speaker and control cabling (low voltage):
1. 25 V speaker runs: 18 AWG twisted pair, plenum-rated where required, CL2P or CMP rated.
  2. Call switch / dry-contact runs: 22 AWG twisted pair, CL2P or CMP rated.
  3. 70 V paging runs to outdoor horns: 16 AWG direct-burial rated where installed underground, in rigid conduit per NEC requirements.

- D. Acceptable cable manufacturers: West Penn Wire, Belden, CommScope, Berk-Tek, Mohawk, or approved equivalent. All cable shall carry appropriate UL listing for the installed environment.
- E. All communication-system cables shall be labeled at both ends per ANSI/AVIXA F501.01 and ANSI/TIA-606, using machine-printed labels keyed to the room numbers shown in the Architectural Drawings.
- F. Cable may be installed in conduit or, above accessible ceilings, in a listed plenum-rated cable tray or on J-hooks/bridle rings at a maximum spacing of 4 ft (1.2 m). Provide an electrical wall box with a conduit stub above the accessible ceiling for all wall-mounted peripheral devices. Splices in conduit or raceway are prohibited; all splices shall be made in accessible junction boxes.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Equipment shall be installed in accordance with the manufacturer's current installation and configuration manuals, with AVIXA Recommended Practices for AV installation, and with BICSI TDM/ITSIMM installation methods. Only first-quality workmanship will be accepted.
- B. All cables shall be tagged and labeled at both ends with permanent machine-printed labels that identify the room served and the cable function, per ANSI/AVIXA F501.01 and ANSI/TIA-606.
- C. All splices shall be made in an approved manner inside accessible junction boxes. No splices are permitted in conduit or raceway. When splicing shielded cable, continuity and isolation of the shield shall be maintained throughout the circuit.
- D. All cables shall be installed in conduit except above accessible ceilings, where they may be installed on J-hooks or bridle rings at no more than 4 ft (1.2 m) on center, or in listed cable tray where available. Cables in return-air plenums shall be UL-listed for plenum use (CMP/CL2P). Provide an electrical wall box with conduit stub above the accessible ceiling for every wall-mounted device.
- E. Coordinate all penetrations and firestopping with the General Contractor and comply with the applicable firestop assembly listings. Maintain the fire-resistance rating of all rated barriers.

#### **3.02 SPEAKER TAP SETTINGS**

- A. In no case shall the average audio level be less than 15 dB above the average occupied ambient noise level of the served space, measured A-weighted at the listener plane. Speakers may be re-tapped as necessary to accommodate special conditions (high-noise areas, non-standard ceiling heights, atypical room geometry) at no additional cost to the Owner. In the absence of special conditions, tap settings shall begin as follows and shall be adjusted during commissioning:

| Speaker Location / Type                                | Initial Tap Setting |
|--------------------------------------------------------|---------------------|
| 8-inch / 25 V classroom, restroom, and office speakers | 1/2 W               |
| 8-inch / 25 V corridor and public-area speakers        | 1 W                 |

| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|
| Speaker Location / Type                                              |  | Initial Tap Setting                 |
| 8-inch / 25 V cafeteria / dining-room speakers                       |  | 2 W                                 |
| Gymnasium paging horns                                               |  | 4 W                                 |
| Shop and maintenance area paging horns                               |  | 4 W                                 |
| Exterior / weather-resistant horns                                   |  | 4 W                                 |
| Auditorium / performing-arts paging supplemental                     |  | Per DSP + coverage calc             |

### 3.03 FIELD QUALITY CONTROL AND PERFORMANCE VERIFICATION

- A. Perform verification per ANSI/AVIXA 10:2013 (R2019) — Audiovisual Systems Performance Verification. Prepare and submit a Verification Plan identifying the scope, items, metrics, test procedures, acceptance criteria, and reporting format for review prior to testing.
- B. At a minimum, the following tests shall be performed and documented in the Verification Report:
  1. Ethernet channel/link certification per TIA-568 for all new structured cabling serving the sound system.
  2. Visual and mechanical inspection of every device, bracket, plate, rack, and termination.
  3. 100 % continuity, short, and ground-fault testing on all speaker and call-switch wiring.
  4. Device-by-device registration and supervision check on the system controller dashboard.
  5. Speaker polarity verification (all cones moving in-phase within a zone).
  6. Sound Pressure Level (SPL) measurement at a representative grid of listener positions in each zone, using a calibrated Type 1 or Type 2 sound-level meter. Record A-weighted average SPL and signal-to-noise ratio versus occupied ambient.
  7. Audio Coverage Uniformity (ACU) measurement per ANSI/AVIXA A102.01:2022. Minimum acceptance: ACU Class B across defined listener areas in classrooms, corridors, and assembly spaces. Submit measurement grid, raw data, and classification results.
  8. Speech Transmission Index (STI) measurement per IEC 60268-16 in representative corridors, gymnasiums, cafeteria, and assembly spaces. Minimum acceptance STI  $\geq 0.50$  under occupied or simulated-occupied ambient conditions.
  9. Intercom two-way functionality test from every staff station to the admin phone.
  10. Paging priority and preemption test (zone → all-call → emergency all-call → district emergency all-call).
  11. Fire-alarm page-exclusion (muting) test. Coordinate with the Fire Alarm Contractor.

12. Bell schedule, holiday schedule, and DST test. Verify NTP synchronization.
  13. Routine activation test for each programmed routine (lockdown, severe weather, evacuation, etc.), including third-party interlocks.
  14. Backup power test: verify full system operation on UPS and standby-generator power (if applicable) for the duration specified in 1.04.F.
  15. Cybersecurity verification: confirm default credentials have been changed, TLS is enforced, audit logging is enabled, and the software is at the latest manufacturer-supported release.
- C. Correct all deficiencies identified during verification at no additional cost to the Owner, and retest until the system meets all acceptance criteria.

### **3.04 AS-BUILT DOCUMENTATION**

- A. The Contractor shall furnish to the Owner two (2) hard-copy O&M manuals in 3-ring binders and one (1) complete electronic set on USB drive, cloud share, or Owner-designated repository. Contents per Article 1.07.B, including at a minimum:
1. System operating instructions and quick-reference guides for administrators and daily users.
  2. System functional block diagrams.
  3. System schematic and point-to-point wiring diagrams.
  4. System operating, administration, and API-integration manuals.
  5. System wiring schedule and cable schedule.
  6. As-built floor plans, rack elevations, and riser diagrams.
  7. Verification Report per Article 3.03.
  8. Network configuration documentation (VLAN, QoS, IP plan, DHCP, NTP).
  9. Cybersecurity configuration record.

### **3.05 PROGRAMMING**

- A. Coordinate all programming with the Owner and Owner's IT department. Programming shall include, but not be limited to:
1. Network configuration, VLAN assignment, QoS/DSCP marking, multicast configuration, DHCP reservations, and NTP synchronization.
  2. Staff station and admin station access levels (CoS), call routing, and signaling.
  3. Classroom numbering, station labeling, and zone assignment for all-call and zone paging.
  4. Mass notification routines, NWS alert routines, and external event triggers.
  5. Paging and time zone definitions.
  6. Bell schedules, holiday schedules, DST correction, and tone duration.
  7. Role definitions and user accounts per the Owner's access policy.
  8. API integrations with Owner's VoIP phone system, access control, VMS, and mass notification platforms as required.

### **3.06 FINAL CHECKOUT, ACCEPTANCE, AND DEMONSTRATION**

- A. The Contractor shall verify that the system is complete, fully operational, and meets all acceptance criteria before requesting final acceptance or scheduling the system demonstration.
- B. The Contractor shall be available to demonstrate the operation and use of the system to the Architect, Engineer, Owner, and Owner's representatives.
- C. At the time of demonstration, the Contractor shall furnish the Owner with the two (2) complete record manuals specified in Article 3.04.
- D. Final acceptance of the system will be granted upon satisfactory completion of all the requirements of this Section.

### **3.07 OWNER TRAINING AND FAMILIARIZATION**

- A. Training shall be conducted by factory-trained personnel from the Contractor (or directly from the manufacturer) and shall cover system operation, administration, daily use, routine and schedule management, emergency routines, and basic troubleshooting.
- B. Provide a minimum of sixteen (16) hours of on-site instruction and familiarization, broken into sessions appropriate for daily-user staff (administrators, front-office staff) and for technical/IT staff. Additional sessions may be scheduled during actual use of the system. Multiple trainees per session are expected and encouraged.
- C. Record all training sessions in high-definition digital video and provide two (2) electronic copies to the Owner on USB drive or the Owner's designated cloud share. Provide the custom Technical System Operation Manual at the time of training. Review of the manual and demonstration of all system functions is required.
- D. The Engineer or the Engineer's representative may participate during training.
- E. Comply with the Operating Demonstration and Instructions requirements in General Requirements.

**END OF SECTION 27 51 23**

## **SECTION 27 53 13**

### **CLOCK SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

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

##### **1.02 SUMMARY**

**A. Section Includes:**

1. IP Power-over-Ethernet (PoE) network synchronized clock system, including analog and digital clocks, Network Time Protocol (NTP) time source, and supervisory monitoring software.
2. GPS satellite-referenced master clock with wireless or wired distribution as an alternate or supplemental time source where indicated on Drawings.
3. Integration with the Central Sound System specified in Section 27 51 23 for synchronized bell scheduling, tone generation, and time-of-day announcements.
4. Programmable bell/tone scheduling, alternate schedule selection, and manual class-change activation.
5. Configuration, programming, testing, training, documentation, and warranty services.

**B. Related Sections:**

1. Section 27 05 26 – Grounding and Bonding for Communications Systems.
2. Section 27 05 28 – Pathways for Communications Systems.
3. Section 27 05 53 – Identification for Communications Systems.
4. Section 27 11 00 – Communications Equipment Room Fittings.
5. Section 27 15 00 – Communications Horizontal Cabling.
6. Section 27 51 23 – Central Sound System.

- C. Work specified in this Section shall be furnished and installed by the Communications/Systems Contractor. Conduit, outlet boxes, and terminal cabinets, where required for a complete and operable system, shall be furnished and installed under Division 26 unless otherwise indicated.

##### **1.03 REFERENCES**

- A. Comply with the latest editions of the following standards in effect at the time of bid, except where superseded by a more stringent requirement of the contract documents or the Authority Having Jurisdiction (AHJ).

**B. ANSI / TIA / EIA Standards:**

1. ANSI/TIA-568 Series – Generic Telecommunications Cabling for Customer Premises.
2. ANSI/TIA-569 Series – Telecommunications Pathways and Spaces.
3. ANSI/TIA-606-D – Administration Standard for Telecommunications Infrastructure.
4. ANSI/TIA-607-E – Generic Telecommunications Bonding and Grounding (Earthing).
5. ANSI/TIA-1005-A – Telecommunications Infrastructure Standard for Industrial Premises.

**C. IEEE Standards:**

1. IEEE 802.3 – Ethernet, including 802.3af (PoE), 802.3at (PoE+), and 802.3bt (PoE++).
2. IEEE 1588 – Precision Time Protocol (PTP) for Networked Measurement and Control Systems.

**D. IETF (Internet Engineering Task Force):**

1. RFC 5905 – Network Time Protocol (NTP), Version 4.
2. RFC 4330 – Simple Network Time Protocol (SNTP), Version 4.
3. RFC 2131 – Dynamic Host Configuration Protocol (DHCP).

**E. Other Standards and References:**

1. NFPA 70 – National Electrical Code (NEC).
2. NECA 1 – Standard for Good Workmanship in Electrical Construction.
3. BICSI Telecommunications Distribution Methods Manual (TDMM), current edition.
4. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), current edition.
5. ANSI/BICSI 005 – Electronic Safety and Security (ESS) System Design and Implementation Best Practices.
6. UL 60950-1 / UL 62368-1 – Audio/Video, Information, and Communication Technology Equipment.
7. UL 2043 – Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
8. FCC Part 15 – Radio Frequency Devices (Class A and Class B Digital Devices).
9. FCC Part 90 – Private Land Mobile Radio Services (where applicable to wireless clock distribution).
10. NIST – Time and Frequency Services (Coordinated Universal Time, UTC[NIST]).

**1.04 DEFINITIONS**

- A. **DHCP:** Dynamic Host Configuration Protocol; automatic IP address assignment per RFC 2131.



- B. **GPS:** Global Positioning System; constellation of US Government satellites broadcasting precise time referenced to UTC.
- C. **IP Clock:** Network-connected clock that obtains time data over an Ethernet/IP network from an NTP or SNTP server.
- D. **NTP:** Network Time Protocol per RFC 5905; provides time synchronization with millisecond accuracy over IP networks.
- E. **PoE:** Power-over-Ethernet per IEEE 802.3af (Type 1, 15.4 W), 802.3at (Type 2, 30 W), or 802.3bt (Type 3/4).
- F. **PTP:** Precision Time Protocol per IEEE 1588; provides sub-microsecond clock synchronization over Ethernet.
- G. **SNTP:** Simple Network Time Protocol per RFC 4330; subset of NTP for clients not requiring full NTP statistical processing.
- H. **Stratum:** NTP hierarchy level. Stratum 0 = reference clock (e.g., GPS, atomic); Stratum 1 = directly connected to Stratum 0; lower numbers indicate closer proximity to the reference.
- I. **UTC:** Coordinated Universal Time; the primary time standard maintained by NIST and broadcast via GPS, NTP, and other services.

#### 1.05 SYSTEM DESCRIPTION

- A. **General:** Provide a complete and operable synchronized time system in which all clocks display Coordinated Universal Time (UTC) referenced to NIST. The system shall be one of the following two architectures, as indicated on Drawings:
  - 1. **IP/PoE Architecture (Primary):** Each clock is an independent network endpoint, powered and synchronized over Category 6A horizontal cabling from an IEEE 802.3af PoE switch or midspan injector. Each clock obtains UTC from a designated NTP/SNTP time source and applies the configured time zone, daylight saving time, and display rules locally.
  - 2. **GPS Master-Distributed Architecture (Alternate):** A roof-mounted GPS receiver feeds a Stratum 1 master clock that distributes time to wireless or wired secondary clocks and serves as a Stratum 1 NTP server for the Owner network. Provide where indicated on Drawings or where reliable network time service is not available.
- B. **Time Source Hierarchy:** Configure each clock with a minimum of three NTP server addresses in priority order:
  - 1. **Primary:** Owner-designated internal NTP server (e.g., Active Directory domain controller, dedicated NTP appliance, or GPS-disciplined Stratum 1 server).
  - 2. **Secondary:** Public NIST or pool.ntp.org server cluster (where outbound UDP port 123 is permitted by the Owner firewall).
  - 3. **Tertiary:** Manufacturer-configured fallback or second internal NTP source.
- C. **Holdover:** Upon loss of synchronization signal, each clock shall continue to operate as an accurate independent quartz-disciplined clock and shall automatically resynchronize when the time source is restored.

- D. **Daylight Saving Time:** System shall automatically apply Daylight Saving Time transitions per current US rules, with administrator-configurable override.
- E. **Central Sound System Integration:** The IP/GPS clock system and the Central Sound System (Section 27 51 23) shall share a common UTC time reference. Bell scheduling, class-change tones, and program-source events shall be coordinated such that audible signals occur simultaneously with displayed time.
  - 1. Where the Central Sound System provides native NTP/SNTP server capability, the IP clock system shall use the Central Sound System as its primary time source.
  - 2. Where the Central Sound System requires an external time reference, the GPS Master Clock or Owner NTP server shall serve both systems.
  - 3. Where bell scheduling is required, the scheduling function shall be performed by the Central Sound System; the clock system shall display synchronized time and, where indicated, provide programmable contact closures or IP relay events for alternate signaling.

## 1.06 PERFORMANCE REQUIREMENTS

### A. Time Accuracy:

- 1. Synchronized accuracy of all displayed clocks to UTC shall be within  $\pm 1$  second under normal operating conditions when synchronized via NTP.
- 2. GPS-disciplined master clock accuracy to UTC shall be within  $\pm 50$  microseconds.
- 3. Free-running quartz holdover (post-synchronization loss) shall maintain accuracy within  $\pm 2$  seconds per 24-hour period.

### B. Network Performance:

- 1. Each PoE/IP clock shall consume not more than 6.5 W (Class 2) under IEEE 802.3af.
- 2. Network bandwidth utilization per clock during normal operation shall not exceed 1 kbps average.
- 3. System shall function on Owner data network with VLAN segregation as coordinated with the Owner.

### C. Resynchronization Time:

- 1. Following power-on or network restoration, each clock shall achieve correct displayed time within five (5) minutes.
- 2. Following Daylight Saving Time transition, all clocks shall correct within fifteen (15) minutes.

### D. Environmental:

- 1. Indoor operating temperature: 32°F to 122°F (0°C to 50°C).
- 2. Indoor operating humidity: 5% to 95% non-condensing.
- 3. Outdoor GPS receiver operating temperature: -40°F to 158°F (-40°C to 70°C); IP66 enclosure rating minimum.

## 1.07 SUBMITTALS

### A. Action Submittals: Comply with Section 01 33 00.

1. **Product Data:** Manufacturer's current data sheets for each product specified, with model numbers and accessories clearly identified. Include:
  - a. Electrical, mechanical, and environmental specifications.
  - b. PoE classification and power draw.
  - c. Network protocols supported (NTP, SNTP, DHCP, HTTPS, SNMP).
  - d. Cybersecurity features, including supported authentication and encryption methods.
  - e. FCC certification and UL listing information.
  - f. Mounting accessories and dimensional drawings.
2. **Shop Drawings:**
  - a. System block diagram showing all major components, time sources, network interconnections, and integration with the Central Sound System.
  - b. Floor plans indicating each clock location, type, mounting height, and unique identifier.
  - c. Equipment rack elevations for any rack-mounted master clock, NTP server, or PoE switch furnished under this Section.
  - d. Network architecture diagram showing IP addressing scheme (or DHCP scope), VLAN assignment, and firewall rules required for NTP and management traffic.
3. **Equipment Schedule:** Tabulated list of all clocks and ancillary equipment cross-referenced to drawings, with manufacturer, model, location, IP address (if static), and PoE port assignment.
4. **Cable Schedule:** Each cable run with origin, destination, cable type, length, label, and termination details.
5. **Samples:** One (1) of each clock type for review. Returned samples may be installed in the project.

### B. Informational Submittals:

1. **Qualification Statements:** Manufacturer and Contractor qualifications per Article 1.08.
2. **Manufacturer's Certifications:** Current authorization letters confirming the Contractor is a manufacturer-authorized installer for each specified product line.
3. **Field Quality Control Reports:** Test and inspection reports per Article 3.04.
4. **Network Security Documentation:** Manufacturer's hardening guide, list of open ports, default credentials change procedure, and firmware update policy.

### C. Closeout Submittals:

1. **Operation and Maintenance Manuals:** Two (2) printed sets and electronic (PDF) copies in indexed format. Include:

- a. Final as-built equipment list with serial numbers.
  - b. Operations instructions for each major component.
  - c. Manufacturer warranties.
  - d. Final program schedule and IP/network configuration.
  - e. System block diagram and as-built drawings.
  - f. Custom Technical Systems Operations Manual prepared by the Contractor for step-by-step operation and preventive maintenance.
  - g. Network map showing all clocks with model, location, MAC address, IP address, VLAN, and PoE port assignment, prepared in AutoCAD or Visio in electronic format.
2. **Training Records:** Attendance log and video recording of training session(s) per Article 3.05.
  3. **Certification Letter:** Manufacturer's or representative's letter certifying installation, testing, and compliance with this Section.

#### 1.08 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Firms regularly engaged in the manufacture of synchronized time and audio communications equipment for not less than five (5) years, with documented evidence of at least five (5) installations of similar size and type completed within the past five (5) years.
- B. **Installer Qualifications:** Communications Systems Contractor that:
  1. Is manufacturer-authorized for each specified product line and qualified in installation, programming, and service of the system.
  2. Has completed at least three (3) installations of comparable scope and complexity within the past five (5) years.
  3. Maintains a factory-trained service department available 24 hours a day, 365 days a year.
  4. Employs at minimum one BICSI-credentialed Installer (INST1, INST2, or TECH) on the project.
- C. **Regulatory Requirements:**
  1. All system components shall be Listed by a Nationally Recognized Testing Laboratory (NRTL) and labeled per UL 62368-1 or UL 60950-1.
  2. Wireless GPS receivers and any RF transmitters/repeaters shall comply with FCC Part 15 and, where applicable, FCC Part 90. Contractor shall obtain and furnish any required FCC operating license to the Owner.
  3. Plenum-rated equipment installed in air-handling spaces shall comply with UL 2043.
  4. Installation shall comply with NFPA 70 and all local and State authorities having jurisdiction.
- D. **Cybersecurity:** System components and configuration shall conform to the following minimum requirements:

1. Default administrator passwords shall be changed prior to placing any device on the production network.
2. Web-based configuration shall support HTTPS with current TLS (TLS 1.2 or higher).
3. Firmware shall be the latest stable release at the time of substantial completion.
4. Unused services and ports (Telnet, FTP, HTTP-only) shall be disabled where supported by the device.

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products in manufacturer's original, unopened, labeled packaging.
- B. Store products in a clean, dry, conditioned space free from temperature and humidity extremes until installation.
- C. Handle equipment to prevent damage to enclosures, lenses, and connectors. Damaged equipment shall be replaced at no cost to the Owner.

#### **1.10 PROJECT CONDITIONS**

- A. **Coordinate with Owner's IT department and other trades for:**
  1. PoE switch port availability, configuration, and VLAN assignment.
  2. DHCP scope or static IP address assignments.
  3. NTP time source(s) and firewall rules permitting UDP port 123.
  4. Network bandwidth and Quality-of-Service (QoS) requirements.
  5. Cable pathways and equipment room provisions specified in Section 27 05 28 and Section 27 11 00.
- B. **GPS Receiver Site Conditions:** Where GPS reception is required, verify clear sky exposure, absence of nearby RF interference sources, and roof access for installation and maintenance prior to ordering equipment.

#### **1.11 WARRANTY**

- A. **Special Warranty:** Contractor shall warrant all workmanship, equipment, and material for a period of not less than three (3) years from the date of Substantial Completion or beneficial use, whichever occurs first. Defective materials or equipment shall be replaced or repaired without expense to the Owner.
- B. **Manufacturers' Warranties:** Where manufacturers' warranties exceed three (3) years, the longer warranty shall apply to that equipment.
- C. **Inspection Visits:** During the warranty period, Contractor shall perform two (2) inspection and preventive maintenance visits at intervals not exceeding six (6) months. Resolve all outstanding issues during each visit.
- D. **Service Response:** Contractor shall be available during normal business hours and shall respond on-site within four (4) hours for normal service calls and within two (2) hours for emergency service. "Emergency" is defined as the loss of 25 percent or more of system components or any failure that renders the system more than 50 percent inoperative. Provide an on-site authorized factory technician within twenty-

four (24) hours when required. Provide loaner equipment at no charge if repairs cannot be completed within twenty-four (24) hours.

- E. **Service Contract:** Contractor shall offer the Owner a continuing factory-authorized service contract for the period after the initial warranty.
- F. This Article supplements warranty provisions of the General Conditions.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. **Acceptable Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. AXIS
  - 2. Carehawk
  - 3. Valcom
- B. **Substitutions:** Products specified by manufacturer name and model number establish a minimum level of quality, performance, and function. Substitute products by listed manufacturers shall be equal in all respects. Submit substitution requests in accordance with Section 01 25 00.
- C. **Single-Source Responsibility:** Furnish each principal subsystem (clocks, master clock, NTP server, monitoring software) by a single manufacturer to ensure interoperability.

### 2.02 IP / POE ANALOG CLOCKS

- A. **General:**
  - 1. Network-synchronized analog clock with internal NTP/SNTP client and integrated 802.3af PoE network interface.
  - 2. Each clock shall operate as an independent network endpoint and shall not require a master clock for synchronization.
  - 3. Each clock shall provide an internal web server for browser-based configuration and shall be discoverable by manufacturer's monitoring software.
- B. **Performance:**
  - 1. **Network Interface:** 10/100 Mbps Ethernet, RJ-45; IEEE 802.3af PoE Class 2 (6.5 W maximum).
  - 2. **IP Addressing:** DHCP (default) or static; configurable via web interface.
  - 3. **Time Source:** NTP and SNTP; minimum of three (3) configurable NTP server addresses with automatic failover.
  - 4. **Time Display Accuracy:**  $\pm 1$  second to UTC.
  - 5. **Holdover:** Internal quartz movement maintains time within  $\pm 2$  seconds per 24 hours during loss of network sync.
  - 6. **Time Zone / DST:** Configurable; automatic DST.
  - 7. **Diagnostics:** Built-in event log, email alert, and web status page.

**C. Construction:**

1. **Movement:** Stepper or sweep, manufacturer's standard for the model.
2. **Dial:** White, 12-hour Arabic numeral; black hour and minute hands; red sweep second hand.
3. **Lens:** Shatter-resistant polycarbonate.
4. **Case:** Molded polycarbonate or powder-coated steel; manufacturer's standard color (white).
5. **Mounting:** Surface-mount on single-gang outlet box; double-sided clocks shall include manufacturer's ceiling pendant or wall stem assembly.

**D. Sizes:**

1. Single-sided 12-inch (305 mm) nominal diameter at corridors, classrooms, offices, and similar spaces.
2. Single-sided 16-inch (406 mm) nominal diameter at gymnasiums, auxiliary gymnasiums, multi-purpose rooms, dining/auditeria, and locations indicated.
3. Double-sided 12.5-inch (318 mm) nominal diameter pendant-mounted at corridors where indicated.
4. Provide impact-resistant polycarbonate (Lexan® or equal) shields or wire guards on clocks installed in gymnasiums, auxiliary gymnasiums, locker rooms, and similar high-activity spaces.

**E. Reference Products:**

1. Sapling SAP-2WS-16R-0 (16-inch single-sided), SAP-2WS-12R-0 (12-inch single-sided), SAP-2WS-16DR-0 (16-inch double-sided).
2. Valcom VIP-A12A (12-inch single-sided), VIP-A16A (16-inch single-sided), VIP-A16ADS (16-inch double-sided).
3. Primex OneVue Sync PoE Analog (single-sided 12-inch and 16-inch; double-sided 16-inch).
4. Bogen Nyquist NQ-GAxxxxC analog clocks or NTP-synchronized clocks of equal performance.

**2.03 IP / POE DIGITAL CLOCKS**

- A. General:** Network-synchronized digital clock with internal NTP/SNTP client, integrated 802.3af PoE interface, and high-brightness 7-segment LED display.

**B. Performance:**

1. **Network Interface:** 10/100 Mbps Ethernet, RJ-45; IEEE 802.3af PoE Class 3 (12.95 W maximum).
2. **Time Source:** NTP and SNTP; minimum three (3) configurable NTP server addresses.
3. **Display Modes:** 12-hour and 24-hour selectable; date and seconds optional; configurable display dimming and time-based blanking schedule for energy management.

4. **Optional Features:** Elapsed timer / count-up / count-down; ambient light-sensing brightness; dry-contact input for nurse-call or third-party trigger.
- C. **Construction:**
1. **Display:** 7-segment LED, red high-brightness; alternative colors (amber, green, blue, white) where indicated.
  2. **Sizes:** 2.5-inch (64 mm) digit height with 4 or 6 digits; 4.0-inch (102 mm) digit height with 4 or 6 digits.
  3. **Lens:** Shatter-resistant polycarbonate filter.
  4. **Case:** Two-tone ABS or powder-coated steel housing; manufacturer's standard.
  5. **Mounting:** Surface or flush-mount; ceiling-suspended pendant for double-sided application; tilt bracket where indicated.
- D. **Reference Products:**
1. Sapling SBP 3000 series (SBP-33F-404 / 406, SBP-34F-404 / 406).
  2. Valcom VIP-D425A, VIP-D440A (4-inch); VIP-D625A, VIP-D640A (2.5-inch); double-sided VIP-D425ADS / D440ADS / D625ADS / D640ADS.
  3. Primex OneVue Sync PoE Digital (2.5-inch and 4-inch; 4 and 6 digit; elapsed timer optional).
  4. Bogen Nyquist NQ digital clock with NTP synchronization or equivalent.

## 2.04 GPS MASTER CLOCK AND TIME SERVER

- A. **Application:** Provide where indicated on Drawings; required where the Owner does not maintain a reliable internal NTP infrastructure or where Stratum 1 NTP service is required for the project.
- B. **GPS Receiver:**
1. Roof-mounted antenna with weatherproof housing rated minimum IP66.
  2. Operating temperature: -40°F to 158°F.
  3. Receives signals from minimum eight (8) GPS satellites simultaneously.
  4. Furnish coaxial cable rated for outdoor installation, lightning suppressor at building entry, and grounding kit per Section 27 05 26.
- C. **Master Clock / NTP Server:**
1. **Form Factor:** 1 RU rack-mount or wall-mount; 100–240 VAC, 50/60 Hz.
  2. **GPS Discipline:** Stratum 1 accuracy to UTC within ±50 microseconds while disciplined.
  3. **Network Interface:** Two (2) 10/100/1000 Mbps Ethernet ports for redundant network connections; supports IPv4 and IPv6.
  4. **Protocols:** NTP v3/v4 server (RFC 5905); SNTP server; IEEE 1588 PTP boundary clock (where indicated).
  5. **Capacity:** Serve a minimum of 1,000 simultaneous NTP client requests per second.



6. **Holdover:** Disciplined oscillator (TCXO or OCXO) maintains  $\pm 1$  ms accuracy for 24 hours after loss of GPS.
  7. **Programmable Relays:** Minimum of four (4) Form-C relays for bell scheduling and integration with Central Sound System; rated 2 A at 30 VDC.
  8. **Web Interface:** HTTPS configuration, status display, and event log.
- D. **Reference Products:**
1. Sapling SMA 3000 series with NTP option and GPS receiver.
  2. American Time AllSync IQ Master Clock with GPS receiver and NTP option.
  3. Primex OneVue Sync GPS Bridge with NTP server option.
  4. Symmetricom/Microchip SyncServer S-series, Meinberg LANTIME, or equivalent enterprise NTP appliance.

## 2.05 NETWORK INFRASTRUCTURE REQUIREMENTS

- A. **PoE Source:** Coordinate with Owner's IT department for PoE switch port availability. Where Owner-provided PoE infrastructure is not available, furnish IEEE 802.3af midspan injectors or unmanaged PoE switches under this Section.
- B. **Cabling:** Each clock shall be served by a dedicated Category 6A unshielded twisted-pair (UTP) horizontal cable from the nearest telecommunications room (TR), terminated on RJ-45 outlet at the clock location and on patch panel at the TR. Cable, pathways, and identification shall comply with Sections 27 05 28, 27 05 53, 27 11 00, and 27 15 00.
- C. **VLAN:** Where required by the Owner's network policy, place IP clocks on a dedicated voice/IoT VLAN with appropriate access control list (ACL) permitting outbound NTP and inbound HTTPS management traffic only.

## 2.06 INTEGRATION WITH CENTRAL SOUND SYSTEM

- A. **Time Source Sharing:** The IP clock system and the Central Sound System (Section 27 51 23) shall reference the same UTC time source. Coordinate with Section 27 51 23 supplier to confirm method of time exchange:
1. Where the Central Sound System has a built-in NTP server, configure the IP clocks to use that server as primary NTP source.
  2. Where the GPS Master Clock is provided, configure both the IP clocks and the Central Sound System to use it as their primary NTP source.
  3. Where the Owner's data network provides authoritative NTP, both systems shall use that source.
- B. **Bell Scheduling:** The Central Sound System shall provide all bell scheduling, class-change tones, and program-source automation. The clock system shall display synchronized time during these events.
- C. **Auxiliary Signaling:** Where indicated on Drawings, the GPS Master Clock or designated IP clock shall provide programmable contact closures or IP relay events to trigger auxiliary signaling, supplementing the Central Sound System.

- D. **Audio over IP Coordination:** Where the Central Sound System uses Audio-over-IP (Dante, AES67, or manufacturer-proprietary), the master time reference shall be common between the AoIP network (PTPv2 / IEEE 1588) and the clock system. Coordinate with Section 27 51 23 supplier so that the PTP grandmaster and the NTP source are disciplined from the same UTC reference.

## 2.07 MONITORING AND MANAGEMENT SOFTWARE

- A. **General:** Furnish manufacturer's monitoring and management software for centralized administration of all IP clocks. Software shall be web-based or installable on Windows 10/11 and shall be licensed for unlimited clocks at the project facility.
- B. **Functions:**
1. Auto-discovery of all IP clocks on the network.
  2. Display of operating status, current displayed time, NTP server in use, and last sync timestamp for each clock.
  3. Bulk configuration changes (NTP servers, time zone, DST rule, display options) applied to selected clocks or system-wide.
  4. Email alert notifications for offline clocks, NTP failures, and other warning conditions.
  5. Firmware update management.
  6. Historical event log with exportable report.
- C. **Cloud-Based Platforms:** Where Primex OneVue, Sapling Cloud, or similar cloud-hosted platform is offered, coordinate Owner approval and identify required outbound firewall rules, encryption (TLS 1.2 or higher), and data-handling provisions in submittals.

## 2.08 ACCESSORIES

- A. **Wire Guards / Lens Shields:** Heavy-gauge steel wire guard or impact-resistant polycarbonate lens shield by clock manufacturer; furnish for all clocks in gymnasiums, auxiliary gymnasiums, locker rooms, multi-purpose rooms, and at locations indicated.
- B. **Mounting Brackets:** Manufacturer's standard surface, flush, ceiling pendant, and tilt brackets as required by application.
- C. **Patch Cords:** Factory-terminated Category 6A patch cords, length as required, color-coded per Section 27 05 53.
- D. **Surge Protection:** Network-side surge protection on GPS coaxial down-lead at building entry per Section 27 05 26.

## 2.09 IDENTIFICATION

- A. Identify all clocks, equipment, cables, and patch-panel ports per Section 27 05 53 and ANSI/TIA-606-D.
- B. Each clock shall be assigned a unique identifier matching the Owner's naming convention (e.g., building-floor-room-sequence). Configure identifier in clock firmware so it appears in monitoring software.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances, network availability, and other conditions affecting performance.
- B. Verify that PoE switch ports, NTP source(s), and DHCP scope are available and correctly configured prior to installation.
- C. Verify roof access, sky exposure, and pathway provisions for GPS antenna installation where applicable.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION – GENERAL**

- A. Install all components in compliance with manufacturer's published instructions, NFPA 70, BICSI TDM, ANSI/TIA standards, and applicable local codes.
- B. Mount all clocks plumb and level, with face plane perpendicular to the wall, true and uniform with adjacent installations.
- C. **Mounting Heights** (centerline of clock face above finished floor unless otherwise indicated):
  - 1. Corridors, classrooms, offices: 84 inches (2,135 mm).
  - 2. Gymnasiums, auxiliary gymnasiums, multi-purpose rooms: 12 feet (3,660 mm) minimum, or as indicated on drawings.
  - 3. Dining / auditoria: 10 feet (3,050 mm) or as indicated.
  - 4. Verify ADA reach-range requirements where the clock is also intended to convey time information for accessibility.
- D. Provide wire guards or impact-resistant lens shields on clocks installed in gymnasiums, auxiliary gymnasiums, locker rooms, multi-purpose rooms, and at all locations indicated.

### **3.03 INSTALLATION – IP / POE CLOCKS**

- A. Terminate horizontal cable on RJ-45 outlet at clock location with manufacturer's recommended jack or direct-attached patch cord; comply with ANSI/TIA-568 termination requirements.
- B. **Configure each clock with:**
  - 1. DHCP-assigned IP address (preferred) or static IP per Owner's assignment schedule.
  - 2. Three (3) NTP server addresses in priority order.
  - 3. Correct time zone and DST rule for the project location.
  - 4. Unique device name matching the Owner naming convention.
  - 5. HTTPS administrator credentials per the Owner's password policy; default passwords shall not remain in service.

- C. Verify successful NTP synchronization and correct displayed time at each clock prior to substantial completion.
- D. Add each clock to the manufacturer's monitoring software and to the Owner's network management database.

### **3.04 INSTALLATION – GPS MASTER CLOCK**

#### **A. GPS Antenna:**

- 1. Mount roof receiver in location with unobstructed sky exposure; coordinate with roofing contractor so all penetrations and bracket fasteners are weather-tight.
- 2. Locate above expected accumulations of snow, water, and debris.
- 3. Seal cable connections with manufacturer-approved sealant; provide drip loop at building entry.
- 4. Install lightning protector and ground per Section 27 05 26.

#### **B. Master Clock / NTP Server:**

- 1. Install in equipment rack as indicated on Drawings, on Owner-approved UPS-protected branch circuit.
- 2. Connect to two (2) Owner-designated network ports for redundancy; coordinate with Owner IT for IP, gateway, and DNS configuration.
- 3. Verify Stratum 1 lock to GPS within four (4) hours of initial power-up.

### **3.05 INTEGRATION WITH CENTRAL SOUND SYSTEM**

#### **A. Coordinate with the Section 27 51 23 supplier and installer for:**

- 1. Common UTC time source as defined in Article 2.06.
- 2. Audio output(s) from the Central Sound System for class-change tones and program audio as indicated.
- 3. Bell schedule programming and verification with the Owner's administrative personnel.

- B. Where contact-closure or IP relay outputs are provided by the master clock for auxiliary signaling, terminate, label, and document each circuit per Sections 27 05 53 and 27 51 23.

### **3.06 FIELD QUALITY CONTROL**

#### **A. Pre-Functional Tests:**

- 1. Verify each cable run with continuity, length, and ANSI/TIA-568 Permanent Link or Channel test using a Level III or higher tester. Submit test results.
- 2. Verify each PoE port delivers compliant 802.3af power.

#### **B. Functional Tests:**

- 1. Verify each IP clock has acquired a valid IP address, completed NTP synchronization, and displays time within  $\pm 1$  second of the master time source.
- 2. Simulate NTP server failure and verify automatic failover to secondary server.

3. Verify automatic Daylight Saving Time transition (using temporary clock acceleration where feature is provided by the manufacturer).
  4. Verify monitoring software reports correct status for every clock.
  5. Verify integration with Central Sound System: bell tones occur within  $\pm 1$  second of the displayed minute change.
  6. Where GPS Master is provided, verify Stratum 1 lock and successful NTP service to internal clients.
- C. **Documentation:** Submit Test and Inspection Reports listing each clock by ID, MAC address, IP address, NTP server in use, last-sync timestamp, and pass/fail result.

### 3.07 DEMONSTRATION AND TRAINING

- A. Demonstrate the operating system to the Owner's representatives prior to final acceptance.
- B. **Provide a minimum of four (4) hours of training to designated Owner personnel, covering:**
1. Daily operation, status interpretation, and troubleshooting.
  2. Use of monitoring/management software, including bell schedule modification through the Central Sound System interface.
  3. Replacement of batteries (where applicable), clock movements, and lens shields.
  4. Procedure for adding, removing, or relocating clocks.
- C. Video record the training session and furnish two (2) copies as part of the O&M Manuals.

### 3.08 CLOSEOUT ACTIVITIES

- A. Furnish all closeout submittals required by Article 1.07.C.
- B. **Furnish two (2) copies of the as-built record drawings, including:**
1. Floor plans with each clock location, type, ID, IP address, and PoE port.
  2. System block diagram, schematic diagram, and wiring diagrams.
  3. Equipment rack elevations.
  4. Network map prepared in AutoCAD or Visio.
  5. Component technical and service manuals.
  6. Software operating manuals.
  7. Port and switch labeling matrix.
  8. Final endurance test report.
- C. **Manufacturer's Certification:** Upon completion of testing, the manufacturer or authorized representative shall issue to the Owner a letter of certification attesting that the system has been tested and adjusted, that all components are properly installed and free of defects, and that the system complies with this Section.

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**END OF SECTION 27 53 13**

## **SECTION 28 05 13**

### **CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

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

##### **1.02 SUMMARY**

A. Section Includes:

1. Conductors and cables serving electronic safety and security systems, including access control, video surveillance, intrusion detection, door entry / video intercom, and area of refuge two-way communication systems.
2. Composite and individual cables for access-controlled openings (reader, lock power, door position, request-to-exit).
3. Cable for OSDP field-device communication and supervised alarm circuits.
4. Coordination of Category 6A and optical fiber cabling furnished under Division 27 for IP-connected security devices.
5. Identification, firestopping coordination, grounding of cable shields, and field testing of security cabling.

B. Related Sections:

1. Section 26 05 00 — Common Work Results for Electrical.
2. Section 27 05 00 — Common Work Results for Communications.
3. Section 27 05 25 — Firestopping.
4. Section 27 05 26 — Grounding and Bonding for Communications Systems.
5. Section 27 05 28 — Pathways for Communications Systems.
6. Section 27 05 53 — Identification for Communications Systems.
7. Section 27 13 00 — Communications Backbone Cabling.
8. Section 27 15 00 — Communications Horizontal Cabling.
9. Section 28 13 00 — Access Control System.
10. Section 28 13 33 — Door Entry Video Intercom System.
11. Section 28 16 00 — Intrusion Detection System.
12. Section 28 23 00 — Video Surveillance.
13. Section 28 26 00 — Area of Refuge.
14. Section 28 48 00 — Emergency Responder Communications Enhancement System (ERCES).

### 1.03 REFERENCES

A. National Fire Protection Association (NFPA):

1. NFPA 70 — National Electrical Code, 2026 Edition, including Article 722 (Cables for Power-Limited Circuits and Fault-Managed Power Circuits), Article 725 (Class 2 and Class 3 Power-Limited Circuits), Article 726 (Class 4 Fault-Managed Power Systems), Article 750 (Grounding and Bonding for Limited-Energy Systems), and the restructured Chapter 8, as adopted by the Authority Having Jurisdiction.
2. NFPA 731 — Standard for the Installation of Premises Security Systems, 2026 Edition.
3. NFPA 262 — Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

B. Underwriters Laboratories (UL):

1. UL 13 — Power-Limited Circuit Cables.
2. UL 444 — Communications Cables.
3. UL 1666 — Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
4. UL 294 — Access Control System Units (7th Edition), and UL 294B — PoE-Powered Access Control Equipment, for listed equipment served by cabling of this Section.
5. UL 1400-2 — Fault-Managed Power Systems: Cables and Connecting Hardware (where Class 4 circuits are indicated).

C. Telecommunications Industry Association (TIA):

1. ANSI/TIA-568.0-E, ANSI/TIA-568.1-E, and ANSI/TIA-568.2-E (October 2024) — Balanced Twisted-Pair Cabling, including Annex H remote-powering and DC Resistance Unbalance (DCRU) requirements.
2. ANSI/TIA-568.3-E — Optical Fiber Cabling and Components Standard.
3. ANSI/TIA-569-E — Telecommunications Pathways and Spaces.
4. ANSI/TIA-606-D — Administration Standard for Telecommunications Infrastructure.
5. ANSI/TIA-607-E — Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
6. ANSI/TIA TSB-184-A — Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling.

D. Security Industry Association (SIA):

1. SIA OSDP v2.2.2 — Open Supervised Device Protocol (October 2024); adopted internationally as IEC 60839-11-5.
2. SIA AG-01 — OSDP Application Guideline.

E. Institute of Electrical and Electronics Engineers (IEEE): IEEE 802.3bt — Power over Ethernet, Types 1 through 4 (up to 90 W).



- F. BICSI: Telecommunications Distribution Methods Manual (TDMM), 15th Edition; Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; ANSI/BICSI 005 — Electronic Safety and Security (ESS) System Design and Implementation Best Practices, latest edition.

#### **1.04 DEFINITIONS**

- A. CMP / CMR / CM: Communications cable listed for plenum, riser, or general-purpose use per NFPA 70.
- B. CL2P / CL3P / CL2R / CL3R: Class 2 or Class 3 power-limited circuit cable listed for plenum or riser use per NFPA 70 Article 722.
- C. DCRU: DC Resistance Unbalance, measured within and between pairs per ANSI/TIA-568.2-E, for balanced power delivery.
- D. EOL: End-of-Line supervision device (resistor) installed at the field device for circuit supervision.
- E. FMP: Fault-Managed Power (NEC Class 4) per NFPA 70 Article 726.
- F. OSDP: Open Supervised Device Protocol; supervised, encrypted RS-485-based field-device communication per SIA OSDP v2.2.2.
- G. PoE: Power over Ethernet per IEEE 802.3af/at/bt, Types 1 through 4.

#### **1.05 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS**

- A. Security cabling shall form complete, supervised, code-compliant signal and power paths between head-end equipment, controllers, and field devices, coordinated with the structured cabling system specified in Division 27.
- B. IP-connected security devices (readers with IP interface, controllers, cameras, intercoms) shall be served by Category 6A channels per Section 27 15 00, supporting IEEE 802.3bt Type 3 and Type 4 PoE with DCRU compliance and Annex H bundle/temperature derating.
- C. Reader communication for new work shall be OSDP with Secure Channel enabled. Wiegand wiring is permitted only where specifically indicated to match existing equipment, and shall follow SIA AG-01 distance and gauge limits.
- D. OSDP RS-485 circuits shall use twisted, shielded pairs; total bus length shall not exceed 4,000 ft (1,220 m), with topology, baud rate, and termination per SIA OSDP v2.2.2 and controller manufacturer requirements.
- E. Supervised alarm circuits shall carry EOL supervision located at the field device, with wiring class per NFPA 731 and the equipment listing.

#### **1.06 ACTION SUBMITTALS**

- A. Product Data: For each cable type, including conductor count and gauge, insulation and jacket materials, shielding, NRTL listing (CMP/CMR/CL2P/CL3P or higher), and manufacturer.
- B. Riser and point-to-point wiring diagrams showing conductor counts, gauges, shield treatment, and EOL locations at each device type; coordinate with device schedules in Sections 28 13 00, 28 16 00, 28 23 00, 28 13 33, and 28 26 00.

- C. Voltage-drop calculations for lock power and other power-limited DC circuits, demonstrating not more than 10 percent drop at maximum load, and PoE power budgets per ANSI/TIA TSB-184-A for Type 3 and Type 4 loads.
- D. Cable color and identification schedule per Section 27 05 53, coordinated with Owner.

#### **1.07 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Installer and installation supervisor per the Quality Assurance article.
- B. Source quality-control reports for cable delivered to the Project site.

#### **1.08 CLOSEOUT SUBMITTALS**

- A. Field test reports for 100 percent of installed security cabling, in the formats required by the Field Quality Control article.
- B. As-built wiring diagrams and cable records per ANSI/TIA-606-D, integrated with the Division 27 administration records.

#### **1.09 QUALITY ASSURANCE**

- A. All cable shall be listed and labeled by an NRTL as defined in NFPA 70 and marked for the intended location and application.
- B. Installer Qualifications: Firm with documented experience on electronic safety and security projects of comparable size; installation supervised by a BICSI-credentialed Technician (TECH) or Installer 2, or manufacturer-certified security technician, present whenever Work of this Section is performed.
- C. Install security systems cabling in accordance with NFPA 731, ANSI/BICSI 005, and the equipment manufacturers' published instructions. Where requirements conflict, the more stringent governs.
- D. Where federal funding applies, provide cabling and connectivity from sources compliant with NDAA Section 889 requirements as they apply to the connected equipment.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver cable on reels or in boxes with intact manufacturer labels showing listing type and date of manufacture. Store indoors, protected from moisture and temperature extremes, per manufacturer requirements.
- B. Test cable on receipt for continuity and shield integrity; reject damaged reels.

#### **1.11 WARRANTY**

- A. Warrant cabling installation of this Section for two (2) years from Substantial Completion, in addition to manufacturers' standard warranties.
- B. Category 6A and optical fiber channels furnished under Division 27 carry the 25-year system performance warranty specified in Section 27 15 00; do not mix component manufacturers within those channels.

### **PART 2 - PRODUCTS**

## **2.01 GENERAL CABLE REQUIREMENTS**

- A. Provide cable types, conductor sizes, shielding, and listings required by the connected equipment manufacturer, NFPA 70, and NFPA 731. In air-handling plenums provide CMP / CL2P (or higher) cable; in risers provide CMR / CL2R (or higher); general-purpose listings only where permitted by NFPA 70 and the AHJ.
- B. Acceptable Manufacturers: Belden; West Penn Wire; Windy City Wire; Genesis Cable (Resideo); Superior Essex; or approved equal. Single-source each cable family to the extent practical.
- C. Conductors: Solid or stranded annealed copper per the equipment manufacturer's termination requirements. Copper-clad aluminum (CCA) conductors are prohibited.
- D. Jacket colors per the approved identification schedule; imprint manufacturer, listing type, and footage markers along the jacket.

## **2.02 ACCESS CONTROL CABLES**

- A. OSDP Reader Cable: Category 6A, shielded (F/UTP), plenum-rated (CMP) cable complying with ANSI/TIA-568.2-E and Section 27 15 00, from the same system manufacturer as the structured cabling system. For OSDP RS-485 circuits, terminate one pair for data and use the remaining pairs for reader power, subject to the approved voltage-drop calculation and SIA AG-01 distance limits.
- B. Composite Door Cable: Where indicated or approved, a single plenum-rated composite cable serving the opening per Section 28 13 00, with elements equivalent to: one 22 AWG six-conductor element with overall foil shield and drain wire (reader or auxiliary device wiring), one 18 AWG 2-conductor (lock power), one 22 AWG 2-conductor (door position), and one 22 AWG 2-conductor (REX). Elements individually jacketed and color coded.
- C. Lock Power Cable: 18 AWG, 2-conductor minimum, plenum rated; increase gauge as required so voltage drop does not exceed 10 percent at maximum load per the approved calculations.
- D. Door Position and REX Cable: 22 AWG, 2-conductor, plenum rated; shielded where the manufacturer requires.
- E. IP Controller / PoE Reader Cable: Category 6A per Section 27 15 00, including MPTL terminations where device-direct connection is indicated.

## **2.03 VIDEO SURVEILLANCE CABLES**

- A. Camera Drops: Category 6A per Section 27 15 00. Cameras drawing IEEE 802.3bt Type 3 or Type 4 power (multisensor, PTZ, illuminated models) require full DCRU compliance; 28 AWG cordage is prohibited for Type 3/4 service.
- B. Runs Exceeding 295 ft (90 m): OS2 singlemode or OM4 multimode optical fiber per Section 27 13 00, with listed media converters or PoE extenders as indicated.

## **2.04 INTRUSION DETECTION CABLES**

- A. Zone and Device Wiring: 22 AWG 2-conductor and 22 AWG 4-conductor CL2P (plenum) or CL2R (riser) cable per Section 28 16 00, shielded where the manufacturer requires; EOL supervision at the protected device.

- B. Keypads and Addressable Bus Devices: Cable per manufacturer's published bus requirements; maintain segregation from line-voltage wiring per NFPA 70.

## **2.05 DOOR ENTRY / INTERCOM AND AREA OF REFUGE CABLES**

- A. Door Entry Video Intercom: Category 6A per Section 27 15 00 for IP/PoE stations per Section 28 13 33.
- B. Area of Refuge Two-Way Communication: Cable types, supervision, and circuit survivability per Section 28 26 00, the equipment listing, and the requirements of the AHJ, including protected routing or listed survivable cable where required by the adopted code.

## **2.06 CLASS 4 FAULT-MANAGED POWER CABLE**

- A. Where Class 4 FMP circuits are indicated on the Drawings, provide cable and connecting hardware listed to UL 1400-2 as part of a matched, single-manufacturer FMP system, installed per NFPA 70 Article 726 and Section 27 05 00.

## **2.07 CONNECTORS AND TERMINATION HARDWARE**

- A. Category 6A jacks, plugs, and patch cords per Section 27 15 00 (same system manufacturer as the structured cabling).
- B. Terminate stranded conductors at screw terminals with insulated ferrules or manufacturer-supplied terminal hardware. Twist-on (wire-nut) and insulation-piercing splices are prohibited in security circuits.

# **PART 3 - EXECUTION**

## **3.01 EXAMINATION**

- A. Verify pathway readiness, plenum/riser conditions, and EMI separation per Sections 27 05 28 and 27 15 00 before pulling cable. Do not proceed until unsatisfactory conditions are corrected.

## **3.02 INSTALLATION**

- A. Comply with NECA 1, NFPA 731, ANSI/BICSI 005, the BICSI ITSIMM (8th Edition), and manufacturers' published instructions.
- B. Install cabling in pathways per Section 27 05 28. Support open cabling at not more than 60 in. (1.5 m) with engineered supports; do not exceed 24-cable bundles for PoE circuits; do not support cable from ceiling grid wires, ductwork, piping, or conduit of other systems.
- C. Maintain EMI separation distances per Section 27 15 00. Maintain manufacturer bend radius; do not exceed 25 lbf pulling tension on 4-pair cables.
- D. Conceal all cabling in finished spaces. Provide conduit or armored protection for cabling exposed to physical damage and for all exterior or publicly accessible locations serving security devices.
- E. No splices. Terminate conductors only at devices, controllers, and listed junction or terminal enclosures with terminal strips; label junction enclosures with the security system legend per Section 27 05 53.

- F. OSDP Circuits: Install per SIA OSDP v2.2.2 and AG-01 — maintain pair twist to the terminal, land shields per the controller manufacturer, terminate the bus at the last device where required, and do not mix OSDP and Wiegand devices on the same circuit.
- G. Provide service loops: minimum 12 in. at devices and 10 ft at controller and head-end locations.
- H. Provide EOL supervision devices at the protected field device, never at the panel, unless the equipment listing directs otherwise.

### **3.03 GROUNDING AND BONDING**

- A. Bond cable shields and security equipment enclosures per ANSI/TIA-607-E and Section 27 05 26. Ground each shield at one end only (controller end) unless the manufacturer requires otherwise; insulate the far-end shield and drain.
- B. Provide surge protection on circuits leaving or entering the building per NFPA 70 and the equipment listing, bonded to the nearest TGB/SBB.

### **3.04 FIRESTOPPING**

- A. Firestop all penetrations of fire-rated assemblies per Section 27 05 25 and Section 07 84 13 — Penetration Firestopping. Use fire-rated pathway devices where security cabling shares communications penetrations.

### **3.05 IDENTIFICATION**

- A. Identify cables, terminal blocks, and junction boxes per Section 27 05 53 and ANSI/TIA-606-D. Label every cable within 4 in. of each termination with a unique identifier matching the record drawings, and label door cables with the door number served.

### **3.06 FIELD QUALITY CONTROL**

- A. Test 100 percent of installed security cabling before device termination: continuity, shorts, grounds, and shield continuity. Correct and retest failures.
- B. Category 6A channels and MPTL links: certify per Section 27 15 00 Article 3.08, including DCRU testing on every link carrying PoE Type 3 or Type 4 loads.
- C. Lock power circuits: measure voltage at the device under maximum load and record; drop shall not exceed 10 percent.
- D. OSDP circuits: verify Secure Channel communication and supervision reporting at every device; record bus address, baud rate, and signal quality where reported by the controller.
- E. Supervised alarm circuits: verify EOL values and alarm/trouble reporting for open, short, and ground faults at each zone.
- F. Submit test documentation per Section 27 15 00 formats, identified per ANSI/TIA-606-D, with pass/fail status; cabling that does not pass is defective and shall be replaced in complete runs (no in-line repairs).

## **END OF SECTION 28 05 13**

**SECTION 28 13 00**

**ACCESS CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Furnish, install, configure, integrate, test, and commission a complete IP-based Access Control System (ACS) including head-end servers, intelligent door controllers, readers, credentials, software, ancillary devices, and all programming and training required for a fully operational system.
2. Components, materials, equipment, hardware, and labor required for a complete and operating system as described in Contract Documents.
3. Coordination with related work, including but not limited to:
  - a. Section 08 71 00 — Door Hardware (electrified hardware, exit devices, electric strikes, electromagnetic locks, REX devices).
  - b. Section 26 05 00 — Common Work Results for Electrical (120 VAC service to ACS power supplies and head-end).
  - c. Section 27 05 00 — Common Work Results for Communications (pathways, grounding, identification).
  - d. Section 27 05 28 — Pathways for Communications.
  - e. Section 27 15 00 — Communications Horizontal Cabling (Cat 6A horizontal cabling).
  - f. Section 28 16 00 — Intrusion Detection (integration with intrusion alarm system).
  - g. Section 28 23 00 — Video Surveillance (bi-directional integration with Video Management System).
  - h. Section 28 31 00 — Fire Detection and Alarm (interface for door release upon fire alarm activation).

**B. Related Sections:**

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

**1.02 SYSTEM DESCRIPTION**

- A. General:** The Access Control System shall be a fully integrated, IP-based electronic security platform providing identification, authentication, authorization, monitoring, and audit-trail capability at controlled portals throughout the facility. The system shall be designed around open-architecture intelligent controllers and shall support both on-premises and cloud deployment models, as specified.

**B. System Architecture:**

1. Head-end management software and database hosted on enterprise-class server hardware or in a manufacturer-supported cloud environment.
2. Intelligent door controllers connecting to the head-end via Ethernet (TCP/IP) and to field devices via SIA OSDP (Open Supervised Device Protocol) v2.2.2 with Secure Channel (AES-128 encryption).
3. Readers, request-to-exit (REX) devices, door position switches (DPS), electrified locking hardware, and ancillary input/output devices located at each controlled portal.
4. Operator workstations and mobile clients providing real-time monitoring, alarm response, badge management, and reporting.
5. Bi-directional integration with the Video Management System (VMS) for event-driven video call-up and unified alarm response.
6. Network infrastructure on an isolated Access Control VLAN with 802.1X port authentication and TLS 1.2 or higher transport security.

C. Performance Requirements:

1. **System Capacity:** Scalable to a minimum of 50,000 cardholders, 250 controlled doors, and 1,000,000 stored events without performance degradation.
2. **Response Time:** Door grant decision within 0.5 seconds of credential presentation.
3. **Offline Operation:** Each intelligent controller shall continue to grant, deny, and log access decisions based on its local database in the event of network or server loss; full system functionality shall resume automatically upon restoration of communication.
4. **Database Capacity:** Minimum 500,000 credentials and 50,000 offline events per intelligent controller.
5. **Availability:** System shall be designed for a minimum 99.9% annual uptime, exclusive of scheduled maintenance windows.
6. **Encryption:** AES-128 minimum between server and intelligent controllers; OSDP Secure Channel between controllers and readers; TLS 1.2 or higher for all browser and API connections.
7. **Audit Trail:** All system activity (cardholder access events, operator actions, alarms, system status changes) shall be logged with date, time, location, cardholder/operator identity, and result. Audit data shall be retained for a minimum of one (1) year online and shall be exportable to standard formats (CSV, PDF).

### 1.03 REFERENCES

- A. Reference Standards: Comply with the latest editions of the following standards in effect at the date of Contract Documents, except where a specific edition is named.
- B. Underwriters Laboratories (UL):
  1. UL 294 — Access Control System Units (7th Edition).
  2. UL 294B — Power Over Ethernet (PoE) Powered Access Control Equipment.

3. UL 1034 — Burglary-Resistant Electric Locking Mechanisms.
  4. UL 1076 — Proprietary Burglar Alarm Units and Systems.
  5. UL 1981 — Central-Station Automation Systems.
- C. Security Industry Association (SIA):
1. SIA OSDP v2.2.2 — Open Supervised Device Protocol (October 2024); also published as IEC 60839-11-5.
  2. SIA AG-01 — Application Guideline for OSDP.
- D. Telecommunications Industry Association (TIA):
1. ANSI/TIA-568.0-E — Generic Telecommunications Cabling for Customer Premises.
  2. ANSI/TIA-568.1-E — Commercial Building Telecommunications Cabling Standard.
  3. ANSI/TIA-568.2-E — Balanced Twisted-Pair Telecommunications Cabling and Components.
  4. ANSI/TIA-569-E — Telecommunications Pathways and Spaces.
  5. ANSI/TIA-606-D — Administration Standard for Telecommunications Infrastructure.
  6. ANSI/TIA-607-E — Generic Telecommunications Bonding and Grounding for Customer Premises.
  7. ANSI/TIA-862-B — Building Automation Systems Cabling for Commercial Buildings.
- E. BICSI:
1. BICSI TDMM — Telecommunications Distribution Methods Manual, 14th Edition.
  2. ANSI/BICSI 005 — Electronic Safety and Security (ESS) System Design and Implementation Best Practices.
  3. ANSI/BICSI 007 — Information Communication Technology Design and Implementation Practices for Intelligent Buildings.
- F. National Fire Protection Association (NFPA):
1. NFPA 70 — National Electrical Code, 2026 Edition (including new Article 750 for Communications Systems).
  2. NFPA 72 — National Fire Alarm and Signaling Code, 2025 Edition.
  3. NFPA 101 — Life Safety Code, 2024 Edition.
  4. NFPA 731 — Standard for the Installation of Premises Security Systems, 2023 Edition.
- G. National Institute of Standards and Technology (NIST):
1. NIST SP 800-53 Rev. 5 — Security and Privacy Controls for Information Systems and Organizations.



2. NIST SP 800-116 Rev. 1 — Guidelines for the Use of PIV Credentials in Facility Access.
  3. FIPS 197 — Advanced Encryption Standard (AES).
  4. FIPS 201-3 — Personal Identity Verification (PIV) of Federal Employees and Contractors.
- H. International Standards:
1. ISO/IEC 14443 (Parts 1–4) — Contactless Integrated Circuit Cards — Proximity Cards.
  2. ISO/IEC 7816 — Identification Cards — Integrated Circuit Cards.
  3. ISO/IEC 27001 — Information Security Management Systems.
- I. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 802.3 — Ethernet, including 802.3af (PoE Type 1), 802.3at (PoE Type 2), and 802.3bt (PoE Type 3 and Type 4).
  2. IEEE 802.1X — Port-Based Network Access Control.
- J. Codes and Other Regulations:
1. International Building Code (IBC), 2024 Edition — Egress and special locking arrangements.
  2. Americans with Disabilities Act Accessibility Guidelines (ADAAG / 2010 ADA Standards) — Reader heights and operating force.
  3. Federal Communications Commission (FCC) Part 15 — Radio frequency devices.
  4. Section 889 of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Public Law 115-232) — Prohibition on certain telecommunications and surveillance equipment.
  5. Authority Having Jurisdiction (AHJ) requirements.

## 1.04 DEFINITIONS

- A. Definitions:
1. **ACS:** Access Control System.
  2. **ACPS:** Access Control Power Supply — UL 294 listed power supply with battery backup for door equipment.
  3. **AES:** Advanced Encryption Standard, per FIPS 197.
  4. **AHJ:** Authority Having Jurisdiction.
  5. **API:** Application Programming Interface.
  6. **BLE:** Bluetooth Low Energy (mobile credential transport).
  7. **Cardholder:** An individual issued one or more access credentials.
  8. **Controller:** Intelligent network device that makes access-grant decisions, monitors door state, and communicates with readers and the head-end.

9. **DPS:** Door Position Switch — supervised magnetic contact monitoring door open/closed status.
10. **Credential:** Card, fob, mobile device, biometric template, or other token used to authenticate a cardholder.
11. **Head-End:** Server, database, and management software comprising the central management point of the ACS.
12. **NFC:** Near Field Communication — short-range wireless credential transport (ISO/IEC 14443 / ISO/IEC 18092).
13. **OSDP:** Open Supervised Device Protocol (SIA standard; also IEC 60839-11-5) — encrypted, supervised, bi-directional reader-to-controller communication.
14. **PACS:** Physical Access Control System.
15. **PIV / PIV-I:** Personal Identity Verification credential issued per FIPS 201-3, or its Interoperable equivalent.
16. **PoE:** Power over Ethernet, per IEEE 802.3af / 802.3at / 802.3bt.
17. **REX:** Request-to-Exit — device (push button, motion sensor, or panic bar contact) signaling intentional egress.
18. **RDBMS:** Relational Database Management System.
19. **Secure Channel:** Encrypted, mutually-authenticated session between OSDP reader and controller per SIA OSDP specification.
20. **TLS:** Transport Layer Security (cryptographic protocol).
21. **VMS:** Video Management System.

## 1.05 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 — Submittal Procedures.
- B. Product Data: Manufacturer's printed product data, technical specifications, performance characteristics, and installation instructions for each component furnished. Indicate the specific item proposed by marking, highlighting, or by similar means.
- C. Shop Drawings:
  1. Block diagrams of system architecture, indicating all major components, their interconnection, network topology, VLAN assignments, and power sources.
  2. Door schedules indicating, for each controlled portal: door identification, function (mode of operation), credentialed side, reader type, lock type, REX type, DPS, controller assignment, and PoE classification (where applicable).
  3. Wiring diagrams showing all cabling between controllers and field devices, including conductor counts, gauges, shielding, end-of-line resistor values, and terminal-strip connections.
  4. Rack elevations showing equipment placement, port assignments, cable management, and ventilation provisions.
  5. Mounting details for readers, lockdown buttons, and exterior equipment, indicating mounting heights consistent with ADA requirements.

6. Floor plans showing reader locations, door identifications, and controller locations.
- D. Cybersecurity Documentation:
1. Network topology drawing showing VLANs, firewall rules, and points of integration with Owner network.
  2. Hardening checklist documenting actions taken to secure servers, controllers, and edge devices (default-password changes, port-disablement, certificate replacement, OSDP key rotation, etc.).
  3. Certificate-of-compliance with Section 889 of the FY2019 NDAA for all hardware furnished.
  4. List of network ports, protocols, and services required by the system.
- E. Samples: Provide samples of each reader, credential, and lockdown button proposed.
- F. Quality Assurance Submittals:
1. Manufacturer's documentation that the installing Contractor is a current Certified, Authorized, or Factory-Trained Integrator for the proposed platform.
  2. Project list demonstrating not fewer than three (3) installations of similar size and complexity completed by the installing Contractor within the past five (5) years.
  3. Resumes of project manager, lead technician, and commissioning agent identifying current manufacturer certifications.
  4. Manufacturer's written authorization for the installing Contractor to furnish equipment, software, and warranty service for this Project.
- G. Software Submittals:
1. List of all software components proposed, including version numbers, license types, and quantities.
  2. Database schema documentation (sufficient for Owner IT to plan backup and disaster-recovery).
  3. API and SDK documentation for any integration developed for this Project.
- H. Test Documentation:
1. Pre-commissioning checklist.
  2. Functional acceptance test plan, including pass/fail criteria for each door, each operator function, each integration, and each alarm condition.
  3. Completed acceptance test report, signed by the Contractor, manufacturer's representative, and Owner.
- I. Operation and Maintenance Manuals: Submit in accordance with Section 01 78 23 — Operation and Maintenance Data.
1. As-built drawings (PDF and editable format, e.g., AutoCAD .dwg or Revit .rvt as required by Contract).
  2. Programming sheets indicating, for each door: access levels, time zones, holiday schedules, anti-passback configuration, and special locking arrangements.

3. Cardholder import templates and instructions.
  4. Operating procedures for routine and emergency operation.
  5. Maintenance schedule for preventive maintenance and battery replacement.
  6. Manufacturer warranty documents.
- J. Training Documentation:
1. Training plan identifying topics, duration, attendees, and instructor qualifications.
  2. Training materials (printed and electronic).
  3. Sign-in sheets and certificates of attendance.

## 1.06 QUALITY ASSURANCE

- A. Qualifications:
1. **Manufacturer:** Regularly engaged in the manufacture of access-control hardware and software for a minimum of five (5) years; ISO 9001 certified; and supporting the proposed product line with publicly-listed software release notes and security advisories.
  2. **Installer:** Currently certified by the proposed platform manufacturer; staffed with technicians holding BICSI INST1, INST2, or TECH credentials, or equivalent; and capable of providing 24-hour emergency service within the project locality.
  3. **Commissioning Agent:** May be the same firm as the Installer; commissioning agent shall hold current manufacturer certification and shall not have been involved in installation of components being tested where Owner separation-of-duties is required.
- B. Regulatory Requirements:
1. Comply with all applicable national, state, and local codes, with the more stringent requirement governing where conflicts occur.
  2. Equipment used to enforce life-safety locking conditions shall be listed by a Nationally Recognized Testing Laboratory (NRTL) under UL 294 (7th Edition), UL 1034, or UL 10C as appropriate.
- C. Pre-Installation Conference: Schedule and conduct a pre-installation conference, attended by the Owner, Architect, Engineer, Contractor, installing subcontractor, IT representative, manufacturer's representative, and any required integrators of related systems.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original, unopened packaging with manufacturer's labels intact.
- B. Store in clean, dry, and conditioned space at temperatures between 50 and 85 degrees Fahrenheit (10 and 29 degrees Celsius) and relative humidity below 80 percent.
- C. Handle and install in accordance with manufacturer's written instructions.

## 1.08 WARRANTY

- A. **Manufacturer Warranty:** Provide manufacturer's standard warranty against defects in materials and workmanship for a period of not less than two (2) years from date of Substantial Completion.
- B. **Installer Warranty:** Provide installer's labor warranty for a period of not less than one (1) year from date of Substantial Completion.
- C. **Software Updates:** Provide all manufacturer-published software updates, security patches, and bug fixes at no additional cost for a period of not less than one (1) year from date of Substantial Completion. Critical security patches shall be made available to the Owner within thirty (30) days of public release by the manufacturer.

## **1.09 MAINTENANCE**

- A. **Maintenance Service:** At Owner's option, provide a written annual maintenance agreement quotation with submittals. Quotation is for Owner reference and shall not be construed as a contract.
- B. **Spare Parts:** Furnish the following spare parts, packaged in labeled boxes, at Substantial Completion:
  - 1. Five (5) percent of installed quantity of each reader type, minimum one (1) of each type.
  - 2. Two (2) percent of installed quantity of each credential type, minimum twenty-five (25) of each type.
  - 3. One (1) intelligent controller of each model installed.
  - 4. Five (5) percent of installed quantity of door position switches, REX devices, and lockdown buttons, minimum two (2) of each type.
  - 5. One (1) complete set of replacement batteries for each access control power supply.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. **Acceptable Manufacturers — Access Control Platform:** Subject to compliance with requirements, provide products from one of the following manufacturers. Substitutions shall be considered only as provided in Section 01 25 00 — Substitution Procedures.
  - 1. Axis Communications AB (Lund, Sweden) — A1210 / A1610 series edge controllers with AXIS Camera Station Pro Secure Entry, or partner integration via Genetec, Milestone, or other listed VMS.
  - 2. LenelS2 (a Honeywell brand) — OnGuard, NetBox, or Elements platform with Mercury Security MP-Series or LNL-X-Series intelligent controllers.
  - 3. Motorola Solutions — Avigilon Unity Access (formerly Access Control Manager, on-premises) or Avigilon Alta Access (formerly Openpath, cloud-native).
  - 4. RS2 Technologies (a part of dormakaba) — Access It! Universal.NET platform with Mercury Security MP-Series intelligent controllers.

5. Approved equal demonstrating compliance with all requirements of this Section, including open-architecture controllers (Mercury or equivalent), current UL 294 (7th Edition) listing, OSDP v2.2.2 Secure Channel support, and NDAA Section 889 compliance.
- B. Standardization: All proposed equipment shall be from a single primary manufacturer to the maximum extent practical; mixing primary platforms within a single project is not acceptable except as authorized by the Owner.
- C. Compliance Requirements (Applicable to All Manufacturers):
  1. All hardware shall be NDAA Section 889 compliant.
  2. All controllers shall be UL 294 (7th Edition) listed. PoE-powered controllers and readers shall additionally be UL 294B listed.
  3. All reader-to-controller communication shall be SIA OSDP v2.2.2 with Secure Channel (AES-128 minimum); Wiegand shall be acceptable only for temporary legacy migration and shall be replaced within the migration plan submitted to the Owner.
  4. All manufacturer software platforms shall be supported by their publisher's current release cycle at time of Substantial Completion; end-of-life or end-of-support versions are not acceptable.
  5. All cryptographic functions shall use FIPS 197 (AES) or FIPS 140-2 / 140-3 validated modules where required by the Owner.

## 2.02 HEAD-END SOFTWARE

- A. General: Access Control Software shall be a unified, multi-user, server-based platform providing real-time monitoring, alarm management, cardholder administration, badging, reporting, and integration with the Video Management System and other security subsystems.
- B. Architecture:
  1. Client/server architecture with thick-client (Windows 11 Pro) and/or thin-client (HTML5 browser) operator interfaces.
  2. Server-side application shall run on Microsoft Windows Server 2019, 2022, or 2025 (or a current Linux distribution supported by the manufacturer).
  3. Database: Microsoft SQL Server 2019 or 2022 (Express, Standard, or Enterprise edition as required by deployment scale); PostgreSQL where supported by the manufacturer; or other RDBMS within the manufacturer's currently supported release list.
  4. Database shall support Transparent Data Encryption (TDE) or equivalent at-rest encryption, encrypted backups, and connections over TLS 1.2 or higher.
  5. Web-client browser support: current versions of Microsoft Edge, Google Chrome, and Mozilla Firefox at time of Substantial Completion.
  6. Cloud-deployment option (e.g., Avigilon Alta Access, LenelS2 Elements, or OnGuard Cloud on AWS) shall be acceptable where authorized by the Owner; cloud deployment shall meet all encryption, redundancy, and data-residency requirements specified herein.

C. Functional Requirements:

1. **Real-Time Monitoring:** Display of all door status, alarms, and cardholder activity with operator-configurable filters and views.
2. **Cardholder Management:** Add, modify, delete, suspend, and reinstate cardholders with bulk-import capability (CSV or LDAP/AD sync). Each cardholder shall support multiple credentials, access levels, time zones, and custom data fields.
3. **Access Levels:** Hierarchical or matrix-based access-level configuration with support for time zones, holiday schedules, and door-group definitions.
4. **Threat Levels / Lockdown:** System-wide or area-specific lockdown mode invocable from operator workstation, badge reader, panic button, or external API call.
5. **Anti-Passback:** Hard, soft, and timed anti-passback configurable per door or area.
6. **Two-Person Rule:** Configurable per door where required.
7. **Visitor Management:** Built-in or integrated visitor pre-enrollment, sign-in, badge printing, and expiration.
8. **ID Badging:** Built-in or integrated badge design, photo capture, and printing using dye-sublimation card printers.
9. **Mobile Credentials:** Support for Bluetooth Low Energy (BLE) and NFC mobile credentials via the manufacturer's mobile-credential portal (e.g., HID Origo, LenelS2 BlueDiamond, Avigilon Alta mobile).
10. **Reporting:** Pre-built and custom reports for cardholder activity, door history, alarm history, system status, and audit trail. Reports exportable to PDF, CSV, and XLSX formats.
11. **Graphics Maps:** Operator-configurable graphical floor plans with live door status, camera icons, and alarm indication.
12. **API / SDK:** Open, documented REST API and/or SDK for integration with Owner systems (HR, identity-management, building automation).
13. **Audit Logging:** Comprehensive audit trail of all operator actions, configuration changes, and system events; tamper-evident logging where supported.

D. Redundancy and High Availability:

1. Hot-standby or warm-standby server option with database replication and automatic failover.
2. Server backup to network-attached storage or cloud, with retention and rotation as required by Owner IT.
3. Disaster-recovery configuration documented in submittals.

## 2.03 INTELLIGENT CONTROLLERS

- A. General: Intelligent controllers shall be UL 294 (7th Edition) listed; field-upgradeable via firmware; equipped with non-volatile storage for cardholder and event databases; and capable of independent decision-making in the event of server or network loss.

B. Functional Requirements:

1. **Network Interface:** 10/100/1000 BASE-T Ethernet with TCP/IP communication, AES-128 minimum host encryption, and TLS 1.2 or higher transport security.
2. **Reader Interface:** SIA OSDP v2.2.2 with Secure Channel; minimum of two (2) reader ports per door supported.
3. **Input/Output:** Supervised inputs (end-of-line resistor monitored) for door position, REX, and auxiliary devices; Form C relay outputs for lock control and auxiliary signaling.
4. **Power:** 12 or 24 VDC from UL 294 listed Access Control Power Supply, or Power over Ethernet per IEEE 802.3af / 802.3at / 802.3bt as applicable (PoE-powered models shall be UL 294B listed).
5. **Local Storage:** Minimum 500,000 credentials and 50,000 events stored locally; minimum 250,000 for edge-controller architectures.
6. **Tamper Detection:** Cabinet tamper switch reporting to head-end.
7. **Diagnostic Indication:** Visible status indicators for power, communication, and fault.
8. **Environmental:** Operating temperature range of not less than 32 to 122 degrees Fahrenheit (0 to 50 degrees Celsius) for indoor controllers; -40 to 158 degrees Fahrenheit (-40 to 70 degrees Celsius) for plenum-rated or outdoor-rated edge controllers.

C. Acceptable Controller Models (Provide One of the Following or Manufacturer's Current Equivalent):

1. Axis Communications: A1210 (single-door, IEEE 802.3af PoE) or A1610 (two-door, IEEE 802.3at PoE+). UL 294 and UL 294B listed.
2. LenelS2: LNL-X4420 series with Mercury Security MP-2500 / MP-4502 sub-controllers; or NetBox Node-2P / Node-4P (for NetBox platform).
3. Motorola Solutions Avigilon: Mercury Security MP-2500 / MP-4502 (Unity Access); Avigilon Alta Smart Hub (Alta Access cloud platform).
4. RS2 Technologies: Mercury Security MP-1502 / MP-2500 / MP-4502 with Access It! Universal.NET firmware.

## 2.04 READERS

- A. General: Provide multi-technology readers supporting, at a minimum: 13.56 MHz contactless smart cards (ISO/IEC 14443A/B; including MIFARE Classic 1K/4K and MIFARE DESFire EV2/EV3); 125 kHz proximity for legacy migration only; and mobile credentials via Bluetooth Low Energy 5.x and NFC.

B. Performance Requirements:

1. **Communication:** SIA OSDP v2.2.2 with Secure Channel (AES-128 minimum) to controller; Wiegand acceptable only for legacy compatibility.
2. **Read Range:** Minimum two (2) inches (50 mm) for smart cards; minimum eight (8) inches (200 mm) for long-range readers where specified.
3. **Listings:** UL 294 (7th Edition) and FCC Part 15 Class B.



4. **Environmental:** IP65 rated minimum for exterior readers and IP55 for interior readers.
  5. **Operating Temperature:** -22 to 150 degrees Fahrenheit (-30 to 65 degrees Celsius).
  6. **Audio/Visual Feedback:** Multi-color LED and audible signaling for read, grant, deny, and fault conditions.
  7. **Tamper Detection:** Optical or magnetic tamper switch reporting to controller.
  8. **Vandal Resistance:** Polycarbonate or metal housing rated IK08 minimum for exterior locations.
- C. Acceptable Reader Models:
1. HID Global: Signo Series 20, 40, 40K (keypad), or 80 (long-range); UL 294 and UL 294B listed; OSDP v2.2 Secure Channel; HID Mobile Access and Apple Wallet Employee Badge compatible.
  2. Allegion (Schlage): MT-Series (MTK15, MTKB15) and MTB-Series multi-technology readers.
  3. Axis Communications: A4020-E and A4120-E network readers (where Axis A1210 / A1610 controllers are provided).
  4. LenelS2: BlueDiamond readers (where LenelS2 platform is provided).
  5. Identiv or Kantech: ioSmart Series multi-technology readers (compatible with selected platform).
- D. Keypad Readers: Where card-plus-PIN authentication is specified, provide reader integrating numeric keypad with backlit weatherproof keys and tamper protection.
- E. Biometric Readers: Where biometric authentication is specified, provide fingerprint, iris, or facial-recognition reader compatible with the access-control platform, UL 294 listed, and ISO/IEC 19794 template-compatible.

## 2.05 CREDENTIALS

- A. Smart Cards: Provide 13.56 MHz contactless smart cards compliant with ISO/IEC 14443A/B; MIFARE DESFire EV2 or EV3, or HID iCLASS Seos, with mutually authenticated encrypted communication and protection against cloning.
- B. Mobile Credentials: Provide subscriptions to the manufacturer's mobile-credential service (HID Origo, LenelS2 BlueDiamond, Avigilon Alta Mobile, or equivalent) and confirm support on iOS and Android devices, including Apple Wallet and Google Wallet where the platform supports them.
- C. PIV / PIV-I Credentials: Where required, support FIPS 201-3 compliant PIV or PIV-I credentials, including PIV authentication keys, card authentication keys (CAK), and PIV middleware on workstations.
- D. Visitor Credentials: Provide disposable adhesive visitor passes or rewritable visitor cards with date-and-time printing capability.
- E. Credential Programming: All credentials shall be pre-programmed at the factory with a unique customer-specific facility code or, where available, programmed in the field using manufacturer-provided enrollment software with secure key management.

## **2.06 ELECTRIC LOCKING HARDWARE**

- A. Electric Strikes: Provide UL 1034 or UL 294 listed electric strikes compatible with door hardware specified in Section 08 71 00. Coordinate fail-safe / fail-secure operation with life-safety requirements.
- B. Electrified Mortise Locks: Provide UL listed electrified mortise locks compatible with door hardware specified in Section 08 71 00.
- C. Electromagnetic Locks: Provide UL 294 listed electromagnetic locks with holding force not less than 1,200 pounds (5,338 newtons), built-in door-status and bond-sensor outputs, and surge protection. Where electromagnetic locks are used, coordinate with applicable special-locking-arrangement provisions of IBC and NFPA 101.
- D. Coordination: All electric locking hardware shall be furnished and coordinated with Section 08 71 00 — Door Hardware. Verify voltage, current, fail-safe / fail-secure operation, and physical compatibility prior to installation.

## **2.07 REQUEST-TO-EXIT (REX) DEVICES**

- A. Passive Infrared (PIR) REX: Provide PIR motion sensor with adjustable detection pattern, Form C relay output, latching contact mode, and integrated request-to-exit annunciation.
- B. Push-Button REX: Provide stainless-steel or aluminum push-button mounted in single-gang box with engraved "PUSH TO EXIT" or ADA-compliant graphic, momentary contact, and tamper-resistant fasteners.
- C. Panic-Bar REX: Provide microswitch contact integral with panic exit device specified in Section 08 71 00.

## **2.08 DOOR POSITION SWITCHES**

- A. Provide concealed magnetic contacts with single-pole, double-throw (Form C) reed switches, end-of-line supervision compatible with controller, and operating gap not less than 1 inch (25 mm) for standard doors and 1.5 inches (38 mm) for high-gap installations. Provide armored cable or conduit protection for all exposed installations.

## **2.09 ACCESS CONTROL POWER SUPPLIES**

- A. General: Provide UL 294 listed Access Control Power Supplies (ACPS) for lock and accessory power, with the following features:
  - 1. Input: 120 VAC, 60 Hz.
  - 2. Output: 12 or 24 VDC, sized for connected load with not less than 25 percent spare capacity.
  - 3. Battery Backup: Sealed lead-acid or lithium-iron-phosphate (LiFePO4) battery sized for not less than four (4) hours of standby operation following AC failure.
  - 4. Fire Alarm Interface: Input from fire alarm system (Section 28 31 00) to release fail-safe locks upon fire alarm activation, with manual reset.
  - 5. Tamper Detection: Cabinet tamper switch reporting to controller.
  - 6. Form C Relay Outputs: Independently fused per door.

7. Network Communication (where furnished): SNMP or proprietary protocol for status reporting.

B. Acceptable Manufacturers: Altronix, LifeSafety Power, Securitron, or approved equal.

## **2.10 POWER OVER ETHERNET (PoE) POWER INFRASTRUCTURE**

A. General: Where PoE is used to power access-control equipment, comply with the following:

1. All PoE-powered access-control devices shall be UL 294B listed.
2. PoE-source equipment (switches and midspans) shall comply with IEEE 802.3af (Type 1, 15.4 W), IEEE 802.3at (Type 2, 30 W), or IEEE 802.3bt (Type 3, 60 W; or Type 4, 90 W) as required.
3. Provide adequate PoE budget on switch with not less than 25 percent spare capacity for future devices and inrush current.
4. Where PoE switch is not furnished under this Section, coordinate with Section 27 11 00 — Communications Equipment Room Fittings and Section 27 13 00 — Communications Backbone Cabling.
5. Standby Power: PoE switches serving access-control devices shall be powered from UPS-backed circuits with not less than thirty (30) minutes of runtime.

B. Network Segmentation:

1. PoE-powered access-control devices shall reside on a dedicated Access Control VLAN, logically separated from general data, voice, and guest VLANs.
2. IEEE 802.1X port-based authentication or MAC-based authentication shall be enforced at the network access port.
3. Inter-VLAN access shall be permitted only as required for integration (e.g., VMS), and shall be governed by firewall rules documented in submittals.

## **2.11 WIRE AND CABLE**

A. Cable for Readers and OSDP: Provide Category 6A, shielded (F/UTP), plenum-rated (CMP) cable complying with ANSI/TIA-568.2-E and Section 27 15 00 — Communications Horizontal Cabling, from the same system manufacturer as the structured cabling system. For OSDP RS-485 circuits, terminate one pair for data and use the remaining pairs for reader power, subject to the approved voltage-drop calculation and SIA AG-01 distance limits.

B. Composite Access Control Cable: Where indicated or approved for access-controlled openings, provide a single plenum-rated (CMP) composite cable including, as a minimum: one 22 AWG six (6) conductor element with overall foil shield and drain wire (reader or auxiliary device wiring), one 18 AWG two (2) conductor element (lock power), one 22 AWG two (2) conductor element (door position), and one 22 AWG two (2) conductor element (request-to-exit). Elements shall be individually jacketed and color coded. Acceptable manufacturers: Belden; West Penn Wire; Windy City Wire; Genesis Cable (Resideo); or approved equal.

C. Cable for Lock Power: Provide two (2) conductor, 18 AWG, plenum-rated cable; size for voltage-drop calculation not exceeding 10 percent at maximum load.

- D. Cable for Door Position and REX: Provide two (2) conductor, 22 AWG, plenum-rated cable.
- E. Cable for Ethernet: Provide Category 6A or better, plenum-rated cable per Section 27 15 00 — Communications Horizontal Cabling.
- F. Cable for Fiber Backbone: Provide multi-mode OM4 or single-mode OS2 fiber per Section 27 13 00 — Communications Backbone Cabling.
- G. All cabling shall comply with NFPA 70 (NEC), and shall be installed in pathways per Section 27 05 28 — Pathways for Communications.

## **2.12 SERVERS AND WORKSTATIONS**

- A. Access Control Server: Enterprise-class rack-mount server with the following minimum specifications:
  - 1. Processor: Intel Xeon Silver or AMD EPYC, minimum 8 cores, 2.4 GHz base clock.
  - 2. Memory: 32 GB DDR5 ECC RAM (expandable).
  - 3. Storage: Dual 480 GB or larger SSD configured as RAID 1 for OS; dual 2 TB or larger SSD configured as RAID 1 or RAID 10 for database (sized for capacity and growth).
  - 4. Network: Dual 1 GbE NICs (10 GbE where required by manufacturer).
  - 5. Power: Dual redundant power supplies.
  - 6. Operating System: Microsoft Windows Server 2022 or 2025 (or current Linux distribution where required by manufacturer).
  - 7. Examples: Dell PowerEdge R660xs, HP ProLiant DL360 Gen11, or approved equal.
- B. Operator Workstation: Business-class desktop or workstation with the following minimum specifications:
  - 1. Processor: Intel Core i5 (13th generation or later) or AMD Ryzen 5 (7000 series or later).
  - 2. Memory: 16 GB DDR5 RAM.
  - 3. Storage: 512 GB or larger NVMe SSD.
  - 4. Network: 1 GbE NIC; Wi-Fi 6E where wireless is required.
  - 5. Display: Dual 24-inch or larger, 1920×1080 minimum resolution.
  - 6. Operating System: Microsoft Windows 11 Pro (current release).
  - 7. Examples: Dell OptiPlex 7020, HP EliteDesk 800 G9, or approved equal.
- C. ID Badging Station: Provide complete badging workstation with photo-capture camera (USB or IP), signature pad, and dye-sublimation card printer (e.g., Fargo HDP6600, Entrust Sigma DS3, or Zebra ZC350).

## **2.13 NETWORK INFRASTRUCTURE**

- A. Network Switches (where furnished under this Section):

1. Managed Layer 2/3 Ethernet switches supporting IEEE 802.3at PoE+ or IEEE 802.3bt PoE++ as required.
  2. VLAN support per IEEE 802.1Q; 802.1X authentication; SNMPv3 monitoring; encrypted (SSH / HTTPS) management; NTP time synchronization.
  3. PoE budget sized for connected load plus 25 percent spare capacity.
  4. Acceptable manufacturers: Cisco (Catalyst 9300 or 9200 Series), Aruba (CX 6300 or 6200 Series), Juniper (EX Series), or approved equal.
- B. Uninterruptible Power Supply (UPS):
1. Online double-conversion UPS for head-end servers with minimum thirty (30) minute runtime at full load.
  2. Line-interactive UPS for edge switches and IDF equipment with minimum fifteen (15) minute runtime at full load.
  3. Network management card for SNMP monitoring and graceful shutdown.
  4. Acceptable manufacturers: APC (Smart-UPS), Eaton (5PX, 9PX), Vertiv (Liebert), or approved equal.

## **2.14 ANCILLARY DEVICES**

- A. Lockdown Buttons: Provide latching contact pushbutton with plastic stopper cover (e.g., Safety Technology International SS-2455 with Stopper Station) at locations indicated on Drawings. Buttons shall report to controller and shall, upon activation, place the system in Lockdown mode and lock all configured doors.
- B. Duress Buttons: Where required, provide silent panic / duress button with latching or momentary contact reporting a discrete alarm to the head-end and configurable response actions (e.g., camera call-up, intrusion-system activation).
- C. Fire-Alarm Interface Relay: Provide UL 864 listed relay (e.g., Altronix RB1224, Functional Devices RIBT24P) for interface between Fire Alarm Control Panel (Section 28 31 00) and ACS power supplies. Coordinate operation (fail-safe locks release on fire alarm; fail-secure locks remain locked) with life-safety design.

## **2.15 VIDEO MANAGEMENT SYSTEM (VMS) INTEGRATION**

- A. General: Provide bi-directional integration between the Access Control System and the Video Management System specified in Section 28 23 00 — Video Surveillance. Integration shall:
1. Associate one or more cameras with each controlled door, automatically displaying live and recorded video upon any access-control event.
  2. Bookmark recorded video upon alarm or event of interest.
  3. Provide unified alarm queue and operator workflow.
  4. Permit VMS-side searches by cardholder name, badge number, or door event.
  5. Use the manufacturer's documented integration (REST API, SDK, ONVIF Profile A, or native plugin); custom-coded integration shall be acceptable only with Owner approval and shall include source-code escrow.
- B. Compatible VMS Platforms (current versions):

1. Milestone Systems XProtect (Corporate, Expert, Professional+, or Express+).
2. Genetec Security Center (Omnicast video module).
3. Motorola Solutions Avigilon Unity Video (formerly Avigilon Control Center) or Avigilon Alta Video (formerly Ava Aware).
4. LenelS2 NetVR or VRx (where LenelS2 platform is provided).
5. Hanwha Vision Wisenet WAVE.
6. Bosch BVMS.
7. i-PRO Video Insight.
8. Exacq Vision.
9. Salient CompleteView.
10. Axis Camera Station Pro (Secure Entry).

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify field conditions are acceptable and that all required services (electrical, network, conditioned space, conduit pathways, mounting backing) have been installed prior to commencing work of this Section.
- B. Notify Architect and Engineer in writing of any unsatisfactory conditions. Commencement of work signifies acceptance of conditions.

#### **3.02 INSTALLATION — GENERAL**

- A. Install in accordance with manufacturer's written instructions; applicable provisions of NFPA 70 (NEC), TIA, BICSI, and NFPA 731; Authority Having Jurisdiction; and Contract Documents.
- B. Use trained, certified technicians under the supervision of a qualified project manager.
- C. Conceal all cabling in walls, ceilings, conduits, and cable trays. Exposed cabling shall be permitted only in mechanical, electrical, and telecommunications rooms, and shall be supported and bundled per BICSI TDMM.
- D. Provide pull strings in all conduits and pathways.
- E. Maintain bend radii, pull tensions, and separation distances per manufacturer and TIA-568.2-E.
- F. Ground and bond all equipment per ANSI/TIA-607-E and Section 27 05 26 — Grounding and Bonding for Communications Systems.

#### **3.03 INSTALLATION — READERS**

- A. Mount readers at 40 to 48 inches (1,016 to 1,219 mm) above finished floor to the center of the reader, in compliance with ADA reach-range requirements.
- B. Mount readers on strike side of door, between 4 and 8 inches (102 to 203 mm) from the door frame, unless otherwise indicated.

- C. For exterior readers, provide weatherproof gasket, drip loop, and silicone sealant at penetrations. Verify IP rating consistent with environmental exposure.
- D. Set OSDP address, baud rate, and Secure Channel keys per manufacturer instructions; document settings on as-built drawings.

### **3.04 INSTALLATION — CONTROLLERS**

- A. Install controllers in UL 294 listed enclosures in environmentally-controlled telecommunications rooms or designated locations. Edge controllers (e.g., AXIS A1210/A1610) may be installed in plenum spaces, ceiling locations, or DIN-rail enclosures consistent with manufacturer rating.
- B. Label all controllers with unique controller identification per ANSI/TIA-606-D and as indicated in Submittal D.
- C. Configure all controllers with non-default administrative passwords, current firmware, and Secure Channel keys.

### **3.05 NETWORK CONFIGURATION**

- A. Coordinate Access Control VLAN, IP address assignment, DHCP scopes (or static assignments), DNS, and firewall rules with Owner's IT department prior to physical installation.
- B. Implement IEEE 802.1X port-based authentication where Owner's network supports it; configure MAC-based authentication as fallback.
- C. Disable all unused network services on controllers, readers, and servers; document remaining open ports in submittals.
- D. Replace all default certificates with Owner-provided or commercially-signed certificates; configure TLS 1.2 minimum on all management interfaces.

### **3.06 SOFTWARE CONFIGURATION**

- A. Install head-end software on Owner-provided or Contractor-furnished server per manufacturer's installation guide.
- B. Configure access levels, time zones, holiday calendars, door behaviors, and reader-to-door associations per programming sheets in Submittal I.
- C. Import cardholder data from Owner-provided file (CSV or LDAP / Active Directory) or as directed by Owner.
- D. Configure all operator roles, permissions, and audit logging.
- E. Configure database backup to Owner-provided network storage location; verify successful restoration prior to Substantial Completion.
- F. Configure VMS integration per Section 28 23 00.

### **3.07 FIELD QUALITY CONTROL**

- A. Pre-Commissioning Tests:
  - 1. Continuity, polarity, and insulation-resistance testing of all cabling prior to termination.
  - 2. OSDP reader-to-controller communication verified with Secure Channel enabled.

3. Lock voltage and current verified at lock; voltage drop within manufacturer's tolerance.
  4. Battery-backup runtime verified under simulated AC loss for each ACPS.
- B. Functional Acceptance Test (FAT):
1. For each door: verify card-in-grant; verify card-in-deny (with invalid credential); verify REX operation; verify DPS reporting; verify door-held-open alarm; verify door-forced alarm.
  2. For each operator function: verify add / modify / delete cardholder; verify access-level assignment; verify reports generation.
  3. For each integration: verify VMS event-driven video; verify fire-alarm interface release; verify intrusion-system handoff.
  4. For each special configuration: verify anti-passback; verify two-person rule; verify lockdown.
  5. Document all results in the acceptance test report. Failed items shall be corrected and re-tested prior to Substantial Completion.
- C. Cybersecurity Verification:
1. Verify no default passwords remain on any device, server, or service.
  2. Verify OSDP Secure Channel is enabled and base keys have been rotated from default.
  3. Verify TLS 1.2 minimum on all management interfaces.
  4. Provide Nmap scan or equivalent output showing only documented network ports are open on each system component.

### 3.08 TRAINING

- A. Provide on-site training for Owner-designated personnel, covering, at a minimum:
1. **System Administrator (sixteen [16] hours minimum):** system architecture; cardholder management; access-level configuration; reporting; database backup and restore; user-account administration; security best practices.
  2. **Control Center Operator (eight [8] hours minimum):** real-time monitoring; alarm response; lockdown procedures; visitor management; ID badging; integrated video workflow.
  3. **IT Administrator (four [4] hours minimum):** network configuration; server administration; backup; integration touch-points; software updates.
- B. Provide training materials (printed and electronic) and certificates of attendance to each attendee.
- C. Record at least one full training session (audio and video) and provide to Owner as part of O&M deliverables.

### 3.09 CLOSEOUT

- A. Furnish all Closeout Submittals per Section 01 78 00 — Closeout Submittals, and complete acceptance testing prior to Owner acceptance.



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- B. Provide a transition meeting between Contractor, manufacturer's representative, and Owner to confirm warranty terms, service-contract options, and support contacts.
- C. Register all equipment for warranty in the Owner's name.

**END OF SECTION 28 13 00**

**SECTION 28 16 00**

**INTRUSION DETECTION SYSTEM**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 RELATED SECTIONS**

- A. Section 27 05 00 — Common Work Results for Communications.
- B. Section 27 05 26 — Grounding and Bonding for Communications Systems.
- C. Section 27 05 28 — Pathways for Communications Systems.
- D. Section 27 05 43 — Underground Ducts and Raceways for Communications Systems.
- E. Section 27 05 53 — Identification for Communications Systems.
- F. Section 28 05 00 — Common Work Results for Electronic Safety and Security.
- G. Section 28 13 00 — Access Control.
- H. Section 28 23 00 — Video Surveillance.
- I. Section 28 31 00 — Fire Detection and Alarm.

**1.03 SUMMARY**

- A. Section includes a complete, supervised, addressable intrusion detection system (IDS) with communication links to perform monitoring, alarm, supervisory, and control functions.
- B. The IDS shall be furnished and installed as a complete and operational system, including but not limited to the following:
  - 1. Control panel and required expansion modules.
  - 2. Equipment enclosure(s) with tamper protection.
  - 3. Primary and secondary (battery) power supplies.
  - 4. Addressable keypads and remote annunciators.
  - 5. Initiating devices: balanced magnetic door contacts, glass-break sensors, passive infrared (PIR) and dual-technology motion sensors, shock and vibration sensors, and duress devices as indicated on Drawings.
  - 6. Communicator(s) for primary and backup signal paths to the supervising station (IP/Ethernet, cellular LTE/5G, and POTS as required).
  - 7. Audible/visual notification appliances.
  - 8. Wiring, terminations, raceways, and supports.

9. Programming, configuration, testing, training, and documentation.
- C. The IDS shall integrate with the access control system specified in Section 28 13 00 and with the video surveillance system specified in Section 28 23 00.

#### 1.04 DEFINITIONS

- A. **AHJ:** Authority Having Jurisdiction.
- B. **Addressable Device:** A device that communicates a unique identifier and status information to the control unit over a multiplexed signaling line.
- C. **Antimasking:** Capability of a sensor to detect attempts to block, cover, or otherwise defeat its detection function.
- D. **Control Unit:** System component that monitors initiating device circuits and controls notification and output circuits.
- E. **Initiating Device:** A manually or automatically actuated device that, when operated, causes the system to enter an alarm, supervisory, or trouble state.
- F. **Master Control Unit:** Primary system component that accepts inputs from local control units and performs system-wide control and reporting functions.
- G. **Partition (Area):** A logical grouping of zones that can be independently armed and disarmed.
- H. **Protected Zone:** An area of the building or grounds containing one or more initiating devices that report to a common point at the control unit.
- I. **Standard Intruder:** A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less, wearing a long-sleeved shirt, slacks, and shoes.
- J. **Standard-Intruder Movement:** Any movement, such as walking, running, crawling, rolling, or jumping, of a standard intruder within a protected zone.
- K. **Supervising Station:** A facility that receives signals from protected premises and at which personnel are in attendance at all times to respond to those signals.
- L. **Supervised Circuit:** A circuit arranged so that a fault condition (open, short, or ground) is automatically indicated at the control unit.
- M. **Zone:** A defined area within the protected premises associated with one or more initiating devices.

#### 1.05 REFERENCE STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. Comply with the latest published edition in effect at the time of bid, including all addenda and errata, unless otherwise noted.
- B. **American National Standards Institute / Security Industry Association (ANSI/SIA):**
1. ANSI/SIA CP-01 — Control Panel Standard — Features for False Alarm Reduction.
  2. ANSI/SIA PIR-01 — Passive Infrared Motion Detector Standard — Features for Enhancing False Alarm Immunity.

3. ANSI/SIA DC-09 — Internet Protocol Event Reporting.
- C. American Society for Testing and Materials International (ASTM):**
1. ASTM A574 — Standard Specification for Alloy Steel Socket-Head Cap Screws.
  2. ASTM F835 — Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
  3. ASTM F837 — Standard Specification for Stainless Steel Socket Head Cap Screws.
  4. ASTM F879 — Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
  5. ASTM F1135 — Standard Specification for Chromium and Cadmium Diffusion Coatings for Threaded and Non-Threaded Fasteners.
  6. ASTM F1137 — Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- D. Building Industry Consulting Service International (BICSI):**
1. ANSI/BICSI 005 — Electronic Safety and Security (ESS) System Design and Implementation Best Practices.
  2. BICSI TDMM — Telecommunications Distribution Methods Manual, current edition.
- E. Federal Communications Commission (FCC):**
1. 47 CFR Part 15 — Radio Frequency Devices.
- F. Institute of Electrical and Electronics Engineers (IEEE):**
1. IEEE 802.3 — Ethernet.
  2. IEEE 802.3at / 802.3bt — Power over Ethernet (PoE / PoE+ / PoE++).
- G. National Electrical Manufacturers Association (NEMA):**
1. ANSI/NEMA 250 — Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association (NFPA):**
1. NFPA 70 — National Electrical Code (NEC).
  2. NFPA 72 — National Fire Alarm and Signaling Code.
  3. NFPA 730 — Guide for Premises Security.
  4. NFPA 731 — Standard for the Installation of Premises Security Systems.
- I. Telecommunications Industry Association (TIA):**
1. ANSI/TIA-568 — Generic Telecommunications Cabling for Customer Premises (series).
  2. ANSI/TIA-569 — Telecommunications Pathways and Spaces.
  3. ANSI/TIA-606 — Administration Standard for Telecommunications Infrastructure.
  4. ANSI/TIA-607 — Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

**J. UL LLC (UL):**

1. UL 50 — Enclosures for Electrical Equipment, Non-Environmental Considerations.
2. UL 50E — Enclosures for Electrical Equipment, Environmental Considerations.
3. UL 294 — Access Control System Units.
4. UL 464 — Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
5. UL 634 — Connectors and Switches for Use with Burglar-Alarm Systems.
6. UL 639 — Intrusion-Detection Units.
7. UL 681 — Installation and Classification of Burglar and Holdup Alarm Systems.
8. UL 2610 — Commercial Premises Security Alarm Units and Systems (supersedes UL 365, UL 603, UL 609, UL 1076, UL 1610, and UL 1635).

**K. Americans with Disabilities Act (ADA):** Comply with current ADA Standards for Accessible Design for mounting heights and reach ranges of user-operable devices.

**1.06 SUBMITTALS**

**A. General:** Submit in accordance with Section 01 33 00 and Section 28 05 00.

**B. Product Data:** For each type of product specified. Include manufacturer's catalog data, technical specifications, performance ratings, listing/labeling information, mounting requirements, electrical and environmental data, and dimensioned drawings.

**C. Shop Drawings:**

1. System functional block diagram showing all components, communication paths, and interfaces with other systems.
2. Riser diagrams showing raceways, cable types and quantities, pull-box locations, and equipment locations.
3. Floor plans showing final device locations, mounting heights, detection patterns, cable routing, and zoning.
4. Point-to-point wiring diagrams showing terminal designations, conductor counts, conductor sizes, and shield/drain treatment at each end.
5. Equipment enclosure layouts and component arrangement drawings.
6. Keypad and annunciator layouts including labeling and engraving details.
7. Surge protection device installation details.
8. Sensor coverage patterns and adjustment ranges, including walk-test results expected at commissioning.
9. Battery sizing calculations demonstrating compliance with the standby-power requirements of this Section.

**D. Sequence of Operations:** Project-specific written description of system operation under each defined arm/disarm state, alarm, supervisory, and trouble condition. Manufacturer's generic descriptions are not acceptable.

- E. **Programming Submittal:** Zone list, partition assignments, user code structure, schedules, output programming, communicator programming, event-code mapping, and integration logic. Submit for Owner review and approval prior to system commissioning.
- F. **Samples:** For devices with factory-applied color finishes when requested by the Architect.
- G. **Test Reports:** Manufacturer's certification of UL/ETL listing for each component and listing certificate(s) covering the integrated system.
- H. **Qualifications Data:** Documentation of installer and manufacturer qualifications meeting the requirements of this Section.
- I. **Operation and Maintenance Data:** Submit in accordance with Section 01 78 23.
- J. **Record Documents:** As-built drawings showing final installed conditions, programming records, and system passwords/credentials (provided separately under sealed cover to the Owner).

#### 1.07 QUALITY ASSURANCE

- A. **Regulatory Requirements:** Provide products and installation in accordance with NFPA 70, NFPA 72, NFPA 731, applicable state and local codes, and requirements of the AHJ.
- B. **Listing and Labeling:**
  - 1. All system components shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the intended application.
  - 2. The intrusion control unit and supervising station communicator shall be listed under UL 2610 (or an applicable predecessor standard if installed prior to the effective replacement date of UL 2610).
  - 3. Intrusion detection sensors and balanced magnetic switches shall be listed under UL 639 and UL 634 respectively.
  - 4. Access control components, where integrated, shall be listed under UL 294.
  - 5. Control panels shall be listed to ANSI/SIA CP-01.
- C. **Single Source Responsibility:** Provide major system components from a single manufacturer or its authorized integration partners to ensure compatibility and consistent support.
- D. **Manufacturer Qualifications:** A firm regularly engaged in the manufacture of intrusion detection equipment of the types specified, with a minimum of five (5) years of documented experience and an established service organization able to provide parts, technical support, and field service.
- E. **Installer Qualifications:**
  - 1. Firm with a minimum of three (3) years' documented experience installing and servicing intrusion detection systems of similar size, scope, and complexity, and currently authorized by the equipment manufacturer.
  - 2. Employ technicians factory-trained and currently certified by the manufacturer of the installed equipment.

3. Hold all licenses required by the State and local jurisdiction for installation of low-voltage and security systems.
4. Maintain a fully equipped service facility capable of providing emergency service within twenty-four (24) hours of notification.
5. Provide a minimum of three (3) verifiable references for completed installations of comparable size and scope within the past 36 months.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products in manufacturer's original, unopened, undamaged packaging with identification labels intact.
- B. Store products in a clean, dry, indoor location within the manufacturer's published environmental limits until ready for installation.
- C. Handle products in accordance with manufacturer's written instructions to avoid damage to components, finishes, and electronic assemblies.

#### **1.09 PROJECT/SITE CONDITIONS**

- A. **Environmental Conditions:** System components shall be rated for continuous operation under the following conditions without mechanical or electrical damage or degradation:
  1. **Altitude:** Sea level to 6,560 feet (2,000 m).
  2. **Interior, Controlled Environment:** 32 to 120 deg F (0 to 49 deg C); 10 to 95 percent relative humidity, non-condensing.
  3. **Interior, Uncontrolled Environment:** -22 to 122 deg F (-30 to 50 deg C); 5 to 95 percent relative humidity, non-condensing.
  4. **Exterior Environment:** -40 to 150 deg F (-40 to 66 deg C); 0 to 100 percent relative humidity, condensing. Exterior equipment shall be rated NEMA 250, Type 4X.
- B. Coordinate installation with other trades to avoid conflicts and to ensure proper sequencing of work.

#### **1.10 WARRANTY**

- A. Furnish the manufacturer's standard warranty covering parts and workmanship for a minimum of two (2) years from the date of Substantial Completion.
- B. Furnish the Installer's warranty covering installation labor and on-site service for a minimum of one (1) year from the date of Substantial Completion.
- C. Promptly correct, at no cost to the Owner, any defects in materials, workmanship, or operation that arise during the warranty period under normal use.

#### **1.11 MAINTENANCE**

- A. **Maintenance Materials:** Furnish extra materials matching products installed, packaged and labeled for storage:
  1. Door contacts and balanced magnetic switches: 10 percent of installed quantity of each type, but not fewer than two (2) of each type.

2. Motion sensors: 10 percent of each type, but not fewer than one (1) of each type.
  3. Glass-break sensors: 10 percent of installed quantity, but not fewer than one (1).
  4. Keypads/annunciators: One (1) of each type.
  5. Standby batteries: One (1) complete set sized for the largest installed power supply.
  6. Fuses: Three (3) of each kind and size used in the system.
- B. **Service Contract:** Provide a proposal for an extended service and maintenance contract for Owner consideration prior to expiration of the initial warranty period.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. **Basis-of-Design Products:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:
1. **Control Panels and Master Control Units:** Bosch Security Systems; DMP (Digital Monitoring Products); Honeywell Commercial Security; Johnson Controls (DSC / Tyco); Napco Security Technologies; Resideo (formerly Honeywell Home).
  2. **Initiating Devices (Contacts, Motion, Glass-Break):** Bosch Security Systems; GE Interlogix; Honeywell Commercial Security; Optex; Potter Electric Signal; Sentrol/Interlogix; Takex.
  3. **Keypads and Annunciators:** Same manufacturer as control panel.
  4. **Wire and Cable:** Belden; CommScope; General Cable; Genesis Cable; Superior Essex; West Penn Wire.
- B. **Product Equivalency:** Where products are listed with multiple manufacturers, those manufacturers will be approved as equals only if all specified features, listings, and performance characteristics are provided. Substitutions shall be submitted in accordance with Section 01 25 00.
- C. Different manufacturers may require various options, accessories, interfaces, and licenses to provide the specified features. All such items necessary for proper operation shall be deemed part of these specifications and provided at no additional cost.

### 2.02 SYSTEM DESCRIPTION

- A. **General:** Provide a microprocessor-based, addressable, supervised intrusion detection system consisting of a master control unit, expansion modules, addressable initiating devices, keypads/annunciators, communicators, power supplies, and associated wiring.
- B. **Architecture:** System shall be modular and field-expandable. Quantity of supported zones, partitions, users, and event-log entries shall provide a minimum of 25 percent spare capacity beyond the configured load.



- C. **Supervision:** All initiating device circuits, signaling line circuits, communication links, power supplies, batteries, and tamper points shall be electrically supervised. Faults shall be annunciated within twenty (20) seconds of occurrence and shall identify the affected device or circuit.
- D. **Response Time:** Maximum elapsed time between alarm initiation and annunciation at the master control unit shall not exceed two (2) seconds.
- E. **Tamper Protection:** Tamper switches shall be provided on control units, expansion modules, power supplies, junction boxes, and field devices. Tamper alarms shall be reported as a distinct event identifying the affected component.
- F. **Operator Functions:** The system shall provide the following operator commands from authorized keypads/annunciators, secured by individual user PIN or credential:
  - 1. Arm and disarm individual partitions, groups of partitions, or the entire system.
  - 2. Bypass and un-bypass individual zones (with appropriate authority level).
  - 3. View current system status, zone status, and trouble conditions.
  - 4. View and print the system event log.
  - 5. Initiate walk-test of one or more zones.
  - 6. Initiate communication test to the supervising station.
  - 7. Silence local audible annunciators (without clearing alarm condition).
- G. **Event Logging:** Maintain a non-volatile event log of all alarm, supervisory, trouble, arming, disarming, programming, and access events with date, time, zone/device, partition, and user identification. Minimum 1,000-event capacity. Log shall be retrievable locally and remotely.
- H. **Scheduling:** Provide programmable schedules for automatic arming/disarming, holiday exceptions, and access privilege windows.
- I. **Integration:**
  - 1. Provide bidirectional integration with the access control system specified in Section 28 13 00 so that authorized credential reads may arm or disarm assigned partitions and so that intrusion events may modify access privileges and unlock/lockdown doors as programmed.
  - 2. Provide event-driven integration with the video surveillance system specified in Section 28 23 00 to call up associated camera views, initiate recording at elevated frame rates, and bookmark recorded video on alarm events.
  - 3. Provide dry-contact or IP-based interface points to building systems (lighting, audio, signage) for alarm-responsive control where indicated.

## 2.03 MASTER CONTROL UNIT

- A. **General:** Microprocessor-based, addressable, listed to UL 2610 (or applicable predecessor) and ANSI/SIA CP-01, housed in a wall-mounted enclosure with locking cover and tamper switch.
- B. **Memory:** Program and configuration data shall be retained in non-volatile memory through complete loss of primary and secondary power.

- C. **Real-Time Clock:** Battery-backed real-time clock for time-stamping all events. Provide automatic synchronization with a network time source where IP communication is available.
- D. **Capacity (minimum):**
  - 1. **Hardwired Zones:** 16, expandable to not less than 96.
  - 2. **Wireless Zones:** Supports a minimum of 64 supervised wireless zones (where wireless devices are utilized).
  - 3. **Partitions (Areas):** Not less than 8 independently armable partitions.
  - 4. **User Codes:** Not less than 100, each with individually assignable authority levels and partition access.
  - 5. **Keypads/Annunciators:** Not less than 8 supervised devices on a single bus.
  - 6. **Event Log:** 1,000 events, first-in-first-out.
- E. **Zone Types:** Each zone shall be field-programmable to operate in any of the following configurations: Instant, Entry/Exit Delay, Interior Follower, 24-Hour Burglary, 24-Hour Silent, Panic, Duress, Fire, Auxiliary, Supervisory, Key Switch, and Cross-Zone.
- F. **Outputs:** Provide programmable supervised notification outputs and dry-contact or open-collector relay outputs for control of associated systems.
- G. **Communication:** Refer to Article "COMMUNICATION" in this Section.
- H. **Self-Diagnostics:** Continuously monitor and report status of AC power, battery voltage, battery charging, communication paths, enclosure tamper, bell/siren circuit, and supervised expansion bus.
- I. **Reset and Reboot:** System shall automatically restart following any power or processor disturbance without loss of programming, event log, or alarm-state status.

## 2.04 KEYPADS AND REMOTE ANNUNCIATORS

- A. **General:** Addressable, supervised, with backlit alphanumeric LCD or capacitive touchscreen display, integrated tamper switch, and audible status tone.
- B. **Display:** Minimum of two lines of sixteen characters each (alphanumeric LCD) or 4 in. (100 mm) diagonal color touchscreen, capable of displaying zone descriptors of not less than sixteen (16) characters.
- C. **User Interface:** Provide soft-key or capacitive-touch navigation, audible key-press confirmation, and adjustable backlight.
- D. **Functions:** Arm, disarm, bypass, silence, walk-test, system status, event log review, and user code management.
- E. **Panic Functions:** Support keypad-initiated police, fire, and medical panic alarms. Two-button panic operation shall require press-and-hold of two designated keys for a programmable interval before generating an alarm.
- F. **Mounting:** Surface or semi-flush at heights complying with current ADA Standards (operable parts mounted between 15 in. (380 mm) and 48 in. (1220 mm) above finished floor).

- G. **Wiring:** Operate on the manufacturer's standard supervised bus at a wiring distance of not less than 2,500 ft (760 m) from the control unit on unshielded cable, extendable through bus repeaters or fiber media converters.

## **2.05 INITIATING DEVICES**

### **A. Balanced Magnetic Door Switches:**

1. Listed and labeled to UL 634, Grade 1 or higher as indicated on the Drawings.
2. Bias magnet and not fewer than three (3) encapsulated reed switches resistant to compromise by introduction of external magnetic fields.
3. Flush-mounted units shall be unobtrusive and flush with the surface of the door and frame after installation.
4. Provide overhead door switches listed for outdoor use, with door-mounted magnet and floor- or jamb-mounted switch as required by door type.
5. Provide armored or stainless-steel cable assemblies as required by application.

### **B. Passive Infrared (PIR) Motion Sensors:**

1. Listed and labeled to UL 639 and ANSI/SIA PIR-01.
2. Detect a temperature differential of 2 deg F (1 deg C) or less and standard-intruder movement at speeds between 0.3 and 7.5 fps (0.09 to 2.3 m/s) across not fewer than two (2) adjacent zones of the sensor field of view.
3. Wall-mounted units: Maximum detection range as scheduled, but not less than 50 ft (15 m) for standard wide-angle units.
4. Provide pet-immune, anti-mask, and anti-block features for sensors located in areas subject to such conditions.
5. LED indicator shall be programmable to disable during normal operation; locate test-enable switch beneath sensor housing cover.

### **C. Dual-Technology (PIR/Microwave) Motion Sensors:**

1. Listed and labeled to UL 639.
2. Require simultaneous trip of both technologies before initiating an alarm, with independent sensitivity adjustment for each technology.
3. Detection range and pattern as scheduled. Provide anti-mask and self-test features.

### **D. Glass-Break Sensors:**

1. Listed and labeled to UL 639, acoustic dual-technology type employing both shock (flexural wave) and sound-frequency analysis to discriminate between actual glass breakage and incidental noise.
2. Coverage range adjustable to a minimum of 25 ft (7.6 m) for standard plate, tempered, laminated, and wired glass.
3. Provide latching LED indicator and test mode.

### **E. Shock and Vibration Sensors:**

1. Listed and labeled to UL 639, piezoelectric or accelerometer-based, with adjustable sensitivity and count windowing to discriminate between routine impacts and actual attack.

**F. Duress and Holdup Devices:**

1. Fixed-in-place devices: Listed and labeled per NFPA 731, installed within 4 ft (1.2 m) of the protected workstation, accessible to the operator from the normal work position, and located so as not to be observable by the public.
2. Devices shall latch in the alarm position or provide a positive visual indication of operation, requiring manual reset by an authorized user.

**G. Sensor-General Requirements:**

1. **Self-Testing:** Sensors shall automatically self-test at intervals not exceeding one (1) hour and shall transmit any test failure to the master control unit as a trouble signal.
2. **Anti-Masking:** Sensors so equipped shall continuously or periodically (not less than once per minute) verify operation and shall transmit any masking, blocking, jamming, or tampering condition as an alarm or trouble signal.
3. **Addressable Devices:** Where addressable devices are used, each shall communicate a unique identifier and full status information to the master control unit.
4. **Remote Adjustment:** Where supported, sensors shall be remotely configurable for sensitivity and shall be individually monitored for calibration and alarm state at the master control unit.
5. **Interference Immunity:** Unaffected by radiated RFI and electromagnetic induction of 15 V/m over a frequency range of 10 MHz to 10 GHz and by conducted interference up to 0.25 V rms on power supply lines over the same range.

**2.06 ENCLOSURES**

- A. **Interior Sensor Enclosures:** Designed to protect against dust, falling dirt, and dripping non-corrosive liquids. Minimum NEMA 250, Type 1.
- B. **Interior Electronics (control panels, expansion modules, power supplies):** NEMA 250, Type 12, with locking cover and tamper switch.
- C. **Exterior or Wet-Location Electronics:** NEMA 250, Type 4X, stainless steel.
- D. **Corrosive Environments:** NEMA 250, Type 4X, stainless steel or non-metallic as required by the application.
- E. **Fasteners:** Where enclosures are readily accessible to the public, secure covers with security fasteners as specified in this Section.

**2.07 POWER SUPPLIES AND BATTERIES**

- A. **Primary Power:** Each power supply shall operate from 120 VAC, 60 Hz, supplied through a dedicated, mechanically secured circuit. Coordinate with Division 26.
- B. **Power Supply Output:** Filtered, regulated, current-limited DC output with overload and short-circuit protection. Listed and labeled for the intended application.

**C. Standby Batteries:**

1. Sealed, valve-regulated, maintenance-free lead-acid type.
  2. Sized to maintain full system operation for a minimum of twenty-four (24) hours of supervisory load, followed by fifteen (15) minutes of full alarm load, with not less than 20 percent spare capacity. Verify per NFPA 731.
  3. Provide automatic, supervised, temperature-compensated charging. Batteries shall recharge to 80 percent of full capacity within twenty-four (24) hours.
  4. Battery date code shall be no more than six (6) months prior to date of installation.
- D. Transfer:** Transfer between primary and secondary power shall not initiate or interfere with any alarm condition. Loss of either source shall report as a supervisory or trouble condition as appropriate.
- E. Surge Protection:** Provide listed surge protective devices on all conductors entering the equipment enclosure from external sources, including power, communication, signal, and sensor circuits.
- F. Power over Ethernet (PoE):** Where PoE-powered devices are used, supply power from a listed PoE injector or switch complying with IEEE 802.3at or 802.3bt as required by the device load.

**2.08 COMMUNICATION**

- A. General:** Provide redundant supervised paths to the supervising station(s) using one or more of the following media as indicated and as required to meet the AHJ's response level:
1. IP/Ethernet via the building network and/or a dedicated data circuit, with encryption complying with AES 128 or higher and event reporting per ANSI/SIA DC-09.
  2. Cellular (LTE/5G) communicator with redundant carrier coverage where available.
  3. Public switched telephone network (POTS) dialer using Contact ID or SIA DC-05 format, where used as a tertiary path.
- B. Path Supervision:** All communication paths shall be supervised at an interval not exceeding the requirements of NFPA 731 and the AHJ for the level of service provided. Path failures shall be reported as a trouble condition.
- C. Adaptive Operation:** System shall be capable of automatically promoting the backup path to primary signaling check-in rate upon failure of the primary path, with seamless restoration on recovery.
- D. Multiple Receivers:** System shall be capable of reporting simultaneously or sequentially to at least two (2) separate supervising station receivers, with independently programmable account numbers and event-code mappings.
- E. Remote Programming and Diagnostics:** System shall support secure remote programming, software updates, and diagnostics by authorized users only, using authenticated and encrypted connections.

## 2.09 FALSE ALARM REDUCTION

### A. The system shall include the following ANSI/SIA CP-01 features:

1. **Entry and Exit Delay:** Programmable entry delay of 30 seconds to 4 minutes; programmable exit delay of 45 seconds to 4 minutes. Audible annunciation shall be provided during both intervals.
2. **Exit Error Detection:** System shall report an Exit Error condition when an entry/exit door is left open at the end of the exit delay.
3. **Abort Reporting:** When the system is disarmed during an active alarm, send an Abort or Cancel message to the supervising station after the alarm message.
4. **Cancel/Verify:** Provide programmable Cancel and Verify reports to indicate user response to an alarm condition.
5. **Cross-Zoning:** Capability to require two device trips within a programmable time window before transmitting an alarm.
6. **Swinger Bypass:** Automatic bypass of a zone that exceeds a programmable trip count within a one-hour window, with automatic restoration on disarm or after a programmable stable period.
7. **Recently Armed Report:** Send a Recently Armed indicator with any alarm occurring within five (5) minutes of arming.
8. **Transmit Delay:** Programmable delay of up to 60 seconds before transmitting burglary alarms, during which user disarm cancels the report. Local audible annunciation shall not be delayed.
9. **Duress (Ambush) Code:** Provide a duress-code arm/disarm feature that silently transmits a duress event without local indication.
10. **Two-Button Panic:** Require press-and-hold of two designated keys for a programmable interval before generating a keypad-initiated panic alarm.

## 2.10 WIRE AND CABLE

- A. **General:** Provide cable types, conductor sizes, shielding, and plenum/riser ratings as required by manufacturer's published instructions, NFPA 70, NFPA 72, and NFPA 731.
- B. **Plenum Spaces:** All cabling installed in air-handling plenums shall be listed CMP, CL2P, or higher per NFPA 70.
- C. **Shielded Cabling:** Provide shielded cable where required by manufacturer or by exposure to electromagnetic interference. Terminate shields per manufacturer's instructions to maintain effectiveness.
- D. **Network Cabling:** Where IP-connected devices are used, provide Category 6A or higher U/UTP or F/UTP cabling complying with the ANSI/TIA-568 series and terminated in accordance with Section 27 15 00.
- E. **Color and Identification:** Provide consistent color-coding throughout the project and labeling per Section 27 05 53.

## 2.11 SECURITY FASTENERS

- A. **General:** Fasteners shall be operable only by tools produced for the specific type of fastener by the fastener manufacturer or licensed fabricator. Drive system type, head style, material, and protective coating as required for the assembly, installation, and strength.
- B. **Drive System:** Pinned Torx or equivalent tamper-resistant type.
- C. **Socket Flat Countersunk Head Fasteners:**
  - 1. Heat-treated alloy steel, ASTM F835.
  - 2. Stainless steel, ASTM F879, Group 1 CW.
- D. **Socket Button Head Fasteners:**
  - 1. Heat-treated alloy steel, ASTM F835.
  - 2. Stainless steel, ASTM F879, Group 1 CW.
- E. **Socket Head Cap Fasteners:**
  - 1. Heat-treated alloy steel, ASTM A574.
  - 2. Stainless steel, ASTM F837, Group 1 CW.
- F. **Protective Coatings for Heat-Treated Alloy Steel:**
  - 1. Zinc chromate, ASTM F1135, Grade 3 or Grade 4, for exterior applications and where indicated.
  - 2. Zinc phosphate with oil, ASTM F1137, Grade I, or black oxide unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that electrical service, raceways, backboxes, and grounding provisions are in place and properly sized.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 OWNER COORDINATION**

- A. Prior to system programming, obtain from the Owner the following information:
  - 1. Supervising station account number(s), receiver identification, communication format, and signaling path requirements.
  - 2. User name list, user codes, authority levels, and partition assignments.
  - 3. Arming/disarming schedules, holiday exception calendars, and area-specific operational requirements.
  - 4. Notification recipient list and escalation procedures.
  - 5. Coordination requirements with access control, video surveillance, and fire alarm systems.

### 3.03 INSTALLATION

- A. Install system in accordance with NFPA 70, NFPA 731, manufacturer's published instructions, AHJ requirements, approved shop drawings, and applicable provisions of Section 28 05 00 and Section 27 05 00.
- B. **Equipment Installation:**
  - 1. Mount control units and power supplies in accessible locations protected from physical damage, water, and excessive temperature.
  - 2. Mount keypads and annunciators at heights complying with current ADA Standards.
  - 3. Install sensors plumb, square, and at the manufacturer's recommended height and orientation for the intended detection pattern.
  - 4. Install balanced magnetic switches with magnet and switch alignment within manufacturer's published tolerances; do not install in locations subject to direct sunlight, water infiltration, or mechanical damage without appropriately rated enclosures.
- C. **Coordination:** Field-coordinate device locations shown on Drawings to ensure proper coverage, avoid conflicts with finishes, lighting, HVAC diffusers, and other systems, and to optimize detection performance.
- D. **Tamper Protection:** Connect tamper switches on all enclosures, junction boxes, and devices to supervised tamper zones.
- E. No device or component shall be installed in a manner that compromises its listed performance characteristics or the operation of the system.

### 3.04 WIRING INSTALLATION

- A. Install wiring in raceways or open-cabled in accessible ceilings as permitted by NFPA 70 and the project documents. Provide independent J-hooks, cable trays, or other listed support systems at intervals not exceeding 5 ft (1.5 m).
- B. Cables in air-handling plenums shall be listed plenum-rated.
- C. Maintain separation between IDS cabling and AC power, fluorescent ballasts, motor circuits, and other sources of electromagnetic interference per ANSI/TIA-569 and manufacturer's instructions.
- D. Provide service loops at each device of not less than 12 in. (300 mm) and at each junction box, terminal cabinet, and control unit of not less than 36 in. (900 mm).
- E. Terminate conductors using manufacturer-supplied terminal blocks. Do not splice conductors except at listed junction boxes with terminal strips.
- F. Where penetrating fire-rated assemblies, firestop in accordance with Section 07 84 00.

### 3.05 GROUNDING AND BONDING

- A. Ground and bond all equipment in accordance with NFPA 70, Article 250, and ANSI/TIA-607.



- B. Connect each control unit and major equipment enclosure to the telecommunications grounding system using a #6 AWG (or larger as required) green-insulated copper bonding conductor.
- C. Do not compromise the integrity of the building electrical or telecommunications grounding system.

### 3.06 IDENTIFICATION

- A. Identify all major equipment, cables, terminals, and zones in accordance with Section 27 05 53 and ANSI/TIA-606.
- B. Label each cable at both ends and at each accessible intermediate point with permanent, machine-printed labels indicating cable identifier, origin, and destination.
- C. Submit labeling scheme for Owner review prior to application.

### 3.07 PROGRAMMING

- A. Program the system based on the approved Programming Submittal and final coordination with the Owner.
- B. Programming shall include zone names, partition assignments, user codes and authority levels, schedules, communicator account information, event-code mapping, and integration logic with related systems.
- C. Provide the Owner with editable record copies of all programming in both human-readable form and the manufacturer's native programming-tool format.

### 3.08 FIELD QUALITY CONTROL

- A. **Pre-Test:** Prior to performance verification, the Contractor shall perform a complete pre-test of the installed system, including continuity checks, supervision verification, and operational testing of each device.
- B. **Performance Verification Test:** After successful pre-test, demonstrate to the Owner and the Architect/Engineer that the installed system complies with the Contract Documents. Witness testing shall include, at a minimum:
  - 1. Walk-test of every motion sensor confirming coverage pattern, sensitivity, and absence of coverage into adjacent unintended areas.
  - 2. Operation of every door contact, glass-break sensor, shock sensor, and duress device, confirming correct zone reporting and partition assignment.
  - 3. Verification that each alarm, supervisory, and trouble event is properly annunciated locally and received at the supervising station with the correct event code and zone descriptor.
  - 4. Verification of entry/exit delays, exit error reporting, swinger bypass, cross-zoning, and other CP-01 false-alarm reduction features.
  - 5. Verification of each user code, authority level, and partition assignment.
  - 6. Verification of all programmed schedules, including holiday exceptions.
  - 7. Verification of integration with access control, video surveillance, and other related systems.

8. Battery load test confirming the standby duration calculated under the Submittals Article.
  9. Communication path test on each programmed path, including failover testing.
- C. **Test Report:** Submit a written test report documenting all test results, deficiencies, and corrective actions, signed by the responsible technician and the Contractor's representative.
- D. **Re-Testing:** The Owner reserves the right to require re-testing of any portion of the system found non-compliant. Costs for re-testing shall be borne by the Contractor.

### 3.09 TRAINING

- A. Provide a minimum of eight (8) hours of on-site operator and administrator training, scheduled at times convenient for the Owner.
- B. Training shall use the installed equipment and shall include, at a minimum:
1. Daily operation: arming, disarming, bypassing, silencing, and responding to alarms.
  2. Administrative operation: adding/removing users, modifying authority levels, reviewing event logs, and producing reports.
  3. Maintenance: battery replacement intervals, routine inspections, and troubleshooting.
  4. Integration features with access control, video, and other connected systems.
- C. Provide a follow-up training session within sixty (60) days of Substantial Completion to address questions arising from initial operation.
- D. Provide all training materials, including operator and administrator manuals, in printed and electronic form.

### 3.10 CLOSEOUT

- A. **Operation and Maintenance Manuals:** Furnish a complete O&M manual in accordance with Section 01 78 23, including:
1. Manufacturer technical data sheets for each component.
  2. Replacement parts list with reorder information.
  3. Recommended spare parts, tools, and test equipment.
  4. System functional block diagrams, schematics, and wiring lists.
  5. Terminal identification facilitating installation, operation, and maintenance.
  6. System operating instructions providing a clear and concise description of operation.
  7. Component service manual including testing, troubleshooting, assembly/disassembly, and recommended maintenance intervals.
- B. **Record Drawings:** Submit as-built drawings showing final installed conditions, including all device locations, cable routing, zone assignments, and modifications from the Contract Documents.

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| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
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- C. **System Acceptance:** Demonstrate proper operation of all aspects of the system to the Owner's representative. Final acceptance shall occur only after all punch list items have been corrected and all closeout submittals have been received and accepted.

**END OF SECTION 28 16 00**

**SECTION 28 23 00**

**VIDEO SURVEILLANCE**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. This Section specifies the design, furnishing, installation, configuration, integration, testing, training, and warranty of a networked Internet Protocol (IP) Video Surveillance System (VSS), including:
1. Fixed and pan-tilt-zoom (PTZ) network cameras.
  2. Multi-sensor and multi-directional network cameras.
  3. Specialty cameras (license plate recognition, thermal, panoramic, body-worn integration ports).
  4. Network video recording infrastructure: on-premises server-class Network Video Recorders (NVRs), hybrid cloud-archive appliances, and Video Surveillance as a Service (VSaaS) cloud-recording option.
  5. Video Management System (VMS) software, licensing, and client workstations.
  6. Edge analytics and server-side artificial intelligence (AI) and deep-learning analytics.
  7. Mass storage and storage management.
  8. Operator workstations, monitors, decoders, and video walls.
  9. Camera enclosures, mounts, brackets, poles, and adapters.
  10. Local and remote power, including Power over Ethernet (PoE) injectors and midspans, surge protection, and uninterruptible power supplies (UPS) dedicated to the VSS head-end.
  11. Network infrastructure dedicated to the VSS: managed PoE-capable Ethernet switches, fiber-optic media converters where applicable, and VSS-specific VLAN segmentation.
  12. Structured cabling, jumpers, connectors, and patch panels dedicated to the VSS.
  13. Cybersecurity hardening, identity-management integration, and firmware lifecycle management.
  14. Integration with the Section 28 13 00 Access Control System (ACS) and other associated systems.
  15. System programming, commissioning, owner training, and warranty.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33 – Raceways and Boxes for Electrical Systems.
- C. Section 27 05 26 – Grounding and Bonding for Communications Systems.

- D. Section 27 05 28 – Pathways for Communications Systems.
- E. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems.
- F. Section 27 05 53 – Identification for Communications Systems.
- G. Section 27 11 00 – Communications Equipment Room Fittings.
- H. Section 27 15 00 – Communications Horizontal Cabling.
- I. Section 28 05 00 – Common Work Results for Electronic Safety and Security.
- J. Section 28 13 00 – Access Control.
- K. Section 28 31 00 – Fire Detection and Alarm.
- L. Section 28 46 00 – Electronic Detection and Alarm (where intrusion-detection is provided).

### **1.03 REFERENCE STANDARDS**

- A. The publications listed below form a part of this Section to the extent referenced. Comply with the latest edition in effect at the time of bid unless a specific edition is cited herein.
- B. ANSI/AVIXA, BICSI, and TIA:
  - 1. ANSI/AVIXA 10:2013 – Audiovisual Systems Performance Verification.
  - 2. ANSI/BICSI 007-2020 – Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises (incorporates content formerly in BICSI 005).
  - 3. ANSI/BICSI N1 – Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure.
  - 4. ANSI/BICSI N2 – Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications.
  - 5. ANSI/BICSI N3 – Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure.
  - 6. ANSI/TIA-568.0-E – Generic Telecommunications Cabling for Customer Premises.
  - 7. ANSI/TIA-568.2-D – Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
  - 8. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard.
  - 9. ANSI/TIA-569-E – Telecommunications Pathways and Spaces.
  - 10. ANSI/TIA-606-D – Administration Standard for Telecommunications Infrastructure.
  - 11. ANSI/TIA-607-E – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
  - 12. ANSI/TIA-862-C – Structured Cabling Infrastructure Standard for Intelligent Building Systems.

13. ANSI/TIA-942-C – Telecommunications Infrastructure Standard for Data Centers.
14. ANSI/TIA TSB-184-A – Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling.

C. IEEE:

1. IEEE 802.1Q – Bridges and Bridged Networks (VLAN).
2. IEEE 802.1X – Port-Based Network Access Control.
3. IEEE 802.3 – Ethernet.
4. IEEE 802.3af / 802.3at / 802.3bt – Power over Ethernet (Types 1 through 4).

D. IEC, ISO, and ONVIF:

1. IEC 60529 – Degrees of Protection Provided by Enclosures (IP Code).
2. IEC 62262 – Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts (IK Code).
3. ISO/IEC 27001 – Information Security Management Systems.
4. ONVIF Profile S – Streaming video.
5. ONVIF Profile G – Recording and storage.
6. ONVIF Profile T – Advanced video streaming, including H.265 and analytics.
7. ONVIF Profile M – Metadata and analytics.
8. ONVIF Profile A – Access control configuration (for ACS integration).

E. NFPA and NEC:

1. NFPA 70 – National Electrical Code (current adopted edition). Comply with Articles 725, 770, and 800 / Chapter 8 as restructured by NEC 2026, including new Article 750 where applicable.
2. NFPA 72 – National Fire Alarm and Signaling Code.
3. NFPA 75 – Standard for the Fire Protection of Information Technology Equipment.
4. NFPA 731 – Standard for the Installation of Premises Security Systems.

F. UL and Other Safety Listings:

1. UL 294 – Access Control System Units (where VSS interfaces directly with ACS power or relays).
2. UL 62368-1 – Audio/Video, Information and Communication Technology Equipment – Safety Requirements.
3. UL 2900-1 / UL 2900-2-3 – Software Cybersecurity for Network-Connectable Products, General and Industry Specific (Security and Life Safety).
4. UL 1981 – Central-Station Automation Systems (where central-station monitoring is provided).

G. Federal:

1. NDAA Section 889 (Pub. L. 115-232) – Prohibition on contracting for certain telecommunications and video-surveillance services or equipment.
  2. FAR 52.204-25 – Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.
  3. FIPS PUB 140-3 – Security Requirements for Cryptographic Modules.
  4. NIST SP 800-53 – Security and Privacy Controls for Information Systems and Organizations.
  5. NIST SP 800-171 – Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations.
  6. NIST Cybersecurity Framework (CSF) 2.0.
- H. Applicable building, electrical, life-safety, and accessibility codes and ordinances having jurisdiction at the Project location.

#### 1.04 DEFINITIONS

- A. **AI Analytics:** Edge- or server-resident analytic processes that apply deep-learning or other artificial-intelligence techniques to video and/or metadata for the purpose of detection, classification, attribute extraction, and search.
- B. **Camera-as-a-Service (CaaS) / VSaaS:** A subscription-based service in which video recording, storage, management software, cybersecurity patching, and remote-access infrastructure are hosted by a service provider in the cloud and consumed by the Owner on a per-camera or per-site basis.
- C. **Edge Recording:** Recording of video and metadata to onboard storage media (microSD, SD, or onboard SSD) within the camera or to a local appliance at the edge of the network, with cloud or central server functioning as secondary, archive, or failover target.
- D. **FPS:** Frames Per Second.
- E. **H.264:** ITU-T Recommendation H.264 (also known as MPEG-4 Part 10 / AVC) video compression standard.
- F. **H.265 / HEVC:** ITU-T Recommendation H.265 (High-Efficiency Video Coding) compression standard.
- G. **Head-End:** Centralized server, NVR, storage, switching, and management equipment that supports the VSS.
- H. **IP Rating:** Ingress-protection rating per IEC 60529.
- I. **IK Rating:** Impact-protection rating per IEC 62262.
- J. **LPR / ANPR:** License Plate Recognition / Automatic Number Plate Recognition – edge or server analytic that extracts vehicle license-plate text from video.
- K. **Multi-Sensor Camera:** A single camera housing containing two or more independent image sensors, each with its own lens, providing simultaneous coverage of multiple fields of view from a single mounting point and a single network connection.
- L. **NVR:** Network Video Recorder – a server or appliance that receives, indexes, records, and serves IP video streams.

- M. **ONVIF:** Open Network Video Interface Forum – global standardization initiative governing interfaces between IP-based physical-security products.
- N. **PoE / PoE+ / PoE++:** Power over Ethernet (IEEE 802.3af), Power over Ethernet Plus (IEEE 802.3at), and 4-Pair Power over Ethernet (IEEE 802.3bt Types 3 and 4).
- O. **PTZ:** Pan, Tilt, and Zoom camera.
- P. **SoC:** System-on-Chip – integrated processor used in network cameras and recording devices.
- Q. **VMS:** Video Management System – software platform that manages live viewing, recording, playback, alarms, users, and integrations across the VSS.
- R. **VSS:** Video Surveillance System – this entire Section 28 23 00 work.
- S. **WDR:** Wide Dynamic Range – imaging technology that increases the usable dynamic range of a camera scene.

#### 1.05 SYSTEM DESCRIPTION

- A. **General:** Provide a complete, networked IP video surveillance system that captures, transmits, records, displays, retains, and protects video and associated metadata from interior and exterior areas as indicated on the Drawings. Architecture shall be open, standards-based, NDAA Section 889 compliant, and cybersecure.
- B. **Architecture:** The system shall consist of edge devices (network cameras and encoders), one or more managed PoE switches dedicated to the VSS VLAN, video-recording infrastructure (on-premises servers/NVRs, hybrid cloud-archive appliances, or cloud-only recording where specified), VMS software, operator workstations, and integration interfaces to the Access Control System (Section 28 13 00) and other premises systems.
- C. Three Deployment Models. The system shall be capable of any of the following deployment models. The selected model shall be coordinated with the Owner and documented in the Submittals:
  - 1. **On-Premises VMS:** VMS server(s), NVR(s), and storage installed in the Owner's facility. All recording, retention, and analytics performed locally. Internet connectivity required only for remote viewing, software updates, and cloud backup.
  - 2. **Hybrid (Cloud-Managed, Edge-Recorded):** Recording occurs at the edge (camera SD/SSD or local appliance). Management plane, configuration, user administration, and selected archive video reside in the manufacturer's cloud platform. Suitable for distributed sites with limited IT staff.
  - 3. **VSaaS (Video Surveillance as a Service / Cloud Recording):** Recording, storage, retention, and management are provided as a subscription cloud service. Local appliances function as a bridge / cyber gateway between cameras and the cloud. Bandwidth and retention sized per the Owner's operational requirements.
- D. **Cybersecurity Posture:** All edge devices, recorders, servers, and cloud services shall enforce signed firmware, secure boot, encrypted transport (TLS 1.2 or later), unique device certificates, multi-factor authentication for administrative access, and role-based access control. All equipment shall be NDAA Section 889 compliant.



Cryptographic modules used to protect data in transit and at rest shall be FIPS 140-2 or FIPS 140-3 validated where required by the Owner.

**E. Performance Objectives:** Unless otherwise indicated:

1. Image resolution: minimum 4 MP (2688 x 1520) for fixed cameras in identification and recognition zones; minimum 2 MP (1920 x 1080) for general detection zones.
2. Recorded frame rate: 15 fps minimum for general coverage; 30 fps minimum for entries, transaction points, and LPR coverage; configurable to 30 fps per camera.
3. Recording retention: 30 days minimum continuous recording, expandable to 90 days for designated forensic-priority cameras.
4. Compression: H.265 with bitrate-control technology (smart codec) shall be the default codec; H.264 fallback permitted only for legacy or compatibility-constrained devices.
5. Latency, live view: less than 500 ms from camera image acquisition to operator display on the same VLAN.
6. System availability: 99.5% per month, exclusive of scheduled maintenance windows.

**F. Coordination With Access Control:** Provide bi-directional integration with the ACS specified in Section 28 13 00 such that access-control events automatically call up live and recorded video and create bookmarks at the time of the event; cardholder records and door schedules shall be searchable from the VMS where supported. Integration shall be by the manufacturer's documented method (REST API, SDK, ONVIF Profile A, or native plug-in).

**1.06 ACTION SUBMITTALS**

- A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures and Section 28 05 00 – Common Work Results for Electronic Safety and Security:
1. Product data sheets for each camera model, recorder, server, switch, accessory, mount, enclosure, UPS, and software license proposed for the Project.
  2. Manufacturer's NDAA Section 889 compliance statement for each device, recorder, server, and switch.
  3. Camera schedule cross-referenced to floor plans, including model number, location, mounting height, lens / field-of-view, IP/IK rating, PoE class, and assigned channel.
  4. Field-of-view (FOV) study for each camera location: pixels-per-foot at the design Distance-To-Subject (DTS) for both Detect (20 ppf), Recognize (40 ppf), and Identify (80 ppf) zones, prepared by the Contractor or camera manufacturer using a published FOV calculator.
  5. Rack elevation drawings showing each on-premises NVR, server, UPS, switch, PDU, and cable manager.
  6. Block diagram showing camera-to-switch-to-NVR / cloud connectivity, VLAN assignments, recording paths, and integration to the ACS.

7. Storage calculation worksheet for each NVR or cloud retention bucket, demonstrating compliance with retention requirements based on the as-designed camera schedule, codec, frame rate, and motion percentage.
8. Network bandwidth calculation per VLAN, per uplink, and per WAN circuit for VSaaS / hybrid deployments.
9. Cybersecurity hardening plan, including default-password change procedure, port-restriction plan, certificate-management plan, firmware update plan, and backup/restore plan.
10. Sample of all labels and identification markings in accordance with Section 27 05 53 and ANSI/TIA-606-D.
11. Where a cloud / VSaaS option is selected: service-level agreement (SLA), data-residency statement, encryption-at-rest statement, data-portability statement, and transition / exit plan.

#### **1.07 INFORMATIONAL SUBMITTALS**

A. Submit the following:

1. Qualifications of the Installer and lead technician, including manufacturer certifications for each proposed camera and VMS platform.
2. Installer's company profile and list of three (3) projects of comparable scope and complexity completed in the last five (5) years.
3. Cybersecurity certifications of the proposed platform (e.g., UL 2900-2-3, ISO/IEC 27001 for cloud-hosted services).
4. Manufacturer test reports for each camera model: IP/IK rating, EMC, NDAA compliance, FIPS 140 validation (where claimed).
5. List of cybersecurity vulnerabilities (CVEs) disclosed against proposed firmware versions within the prior 24 months, and the date of resolution for each.

#### **1.08 CLOSEOUT SUBMITTALS**

A. Submit prior to Substantial Completion:

1. As-built drawings reflecting final camera locations, model numbers, IP addresses, MAC addresses, recording groups, and PoE-switch port assignments.
2. Final camera FOV / pixels-per-foot study reflecting actual installed conditions.
3. Test reports for each camera: focus, image quality, recording verification, analytic verification, network reachability, and PoE budget.
4. Network test reports per Section 27 15 00 for each VSS cable.
5. Operations and Maintenance (O&M) manuals (electronic, searchable PDF) including:
  - a. Theory of operation for each subsystem.
  - b. Detailed product data and warranty documents.
  - c. User-level operating procedures.

- d. Administrator-level procedures: user provisioning, role assignment, recording-group editing, schedule editing, firmware-update procedure, backup and restore.
  - e. Cybersecurity reference: account inventory, password-rotation procedure, certificate inventory and rotation procedure, system-event log retrieval, syslog destinations, and incident-response runbook.
  - f. Spare-parts list and recommended on-hand spares.
- 6. Software licenses (perpetual or subscription) registered to the Owner; original license certificates.
  - 7. Training records and attendance sheets.
  - 8. Where a cloud / VSaaS option is selected: cloud-tenant administrator credentials transferred to the Owner; signed data-processing agreement.

#### 1.09 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Firms regularly engaged in the manufacture of network video-surveillance equipment of types and capacities indicated, having a documented history of products having been in satisfactory service for a minimum of five (5) years prior to bid. Manufacturer's products specified shall be NDAA Section 889 compliant, ISO/IEC 27001 certified for any hosted services offered, and shall be supported in the United States.
- B. **Installer Qualifications:** Firm authorized by the basis-of-design manufacturer of the proposed VMS platform as a current certified integrator. Installer's lead technician shall be a manufacturer-certified specialist on the proposed VMS, hold a BICSI Installer 2 (INST2) credential or higher, and have a minimum of three (3) years of documented experience with network video systems of comparable scope.
- C. **Regulatory Compliance:** All cameras, recorders, encoders, switches, software, and cloud services provided under this Section shall be NDAA Section 889 / FAR 52.204-25 compliant. Products manufactured by Hangzhou Hikvision Digital Technology Co., Dahua Technology Co., Huawei Technologies Co., Hytera Communications Corp., ZTE Corp., or any subsidiary or affiliate thereof, including OEM-rebranded variants, shall not be acceptable.
- D. **Privacy and Data-Handling Compliance:** Comply with applicable state and federal privacy law governing video surveillance, biometric data (where face- or LPR-based analytics are deployed), and student or patient information where applicable. Provide privacy-mask capability on every camera and a documented procedure for owner-controlled redaction of exported video.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store products indoors in a clean, dry, temperature-controlled space within manufacturer's published storage range. Do not store outdoors.
- C. Handle products with care to avoid damage, abrasion, and impact. Replace products damaged during handling at no additional cost to the Owner.

### 1.11 PROJECT CONDITIONS

- A. Coordinate work of this Section with other Sections as required to provide a complete and operational system.
- B. Verify field conditions and dimensions prior to installation. Notify the Architect/Engineer in writing of any conditions that would prevent satisfactory installation.
- C. Cameras viewing exterior spaces in cold-climate locations shall be specified with a heater package suitable for sustained operation at the design low temperature.

### 1.12 WARRANTY

- A. **Manufacturer's Warranty:** Cameras and recording appliances shall carry a minimum 5-year manufacturer's warranty against defects in materials and workmanship. PTZ cameras with mechanical drive trains shall carry a minimum 3-year manufacturer's warranty. Network switches and UPS shall carry the manufacturer's standard warranty, minimum 3 years.
- B. **Installation Warranty:** Installer shall warrant labor and workmanship for one (1) year from Date of Substantial Completion, including on-site response for defects within four (4) business hours of notification by the Owner.
- C. **Software / Cloud Subscription:** Where a subscription-based VMS or VSaaS solution is provided, include first-year subscription cost in the bid for all cameras, sites, retention days, and user seats specified. Subsequent renewals shall be the Owner's responsibility unless otherwise specified.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS – BASIS-OF-DESIGN

- A. **Approved Manufacturers:** Provide the equipment and software of one (1) of the following manufacturers. Mixing of camera and VMS manufacturers shall be permitted only where bi-directional certified integration is published and supported by both manufacturers' current release notes. Submit a complete bill of materials and integration certification for review and acceptance.
- B. **Approved Camera and VMS Platforms:**
  - 1. Axis Communications AB – Cameras (Q, P, M, and F series) and AXIS Camera Station Pro VMS (current release; 6.x as of date of issue). Cloud option: AXIS Cloud Connect.
  - 2. Hanwha Vision America – Wisenet cameras (P, X, Q, and T series) and Wisenet WAVE VMS (on-premises) or Wisenet OnCloud (cloud / VSaaS).
  - 3. LenelS2 (Honeywell) – VRx or NetVR VMS, integrated with the LenelS2 OnGuard or NetBox access-control platform; cameras shall be sourced from the LenelS2 Certified Camera List, including Axis and Hanwha. Cloud option: LenelS2 Elements (cloud-native VMS + access control).
- C. **Substitutions:** Substitutions to the manufacturers listed above shall be submitted in accordance with Section 01 25 00 – Substitution Procedures, and shall demonstrate equivalent or superior performance in image quality, cybersecurity posture, NDAA Section 889 compliance, manufacturer support, and integration capability.

## 2.02 NETWORK CAMERAS – GENERAL REQUIREMENTS

A. **Common Requirements:** All network cameras shall comply with the following:

1. NDAA Section 889 compliant; manufacturer-published statement on file.
2. ONVIF Profile S, G, and T conformant; Profile M where on-board analytics are provided.
3. Power: IEEE 802.3af/at/bt Class as required by the device; auxiliary 12 VDC / 24 VAC input only where required by external accessories.
4. Operating temperature: meet or exceed the as-deployed environmental range; exterior cameras minimum -40 deg F to +122 deg F (-40 deg C to +50 deg C).
5. Ingress protection: IP66 minimum for exterior; IP52 minimum for interior.
6. Impact protection: IK10 for cameras installed below 12 ft (3.7 m) AFF in publicly accessible areas; IK08 minimum for all other locations.
7. Codec: H.265, H.264, and MJPEG; manufacturer's bandwidth-reduction technology (smart codec, Zipstream, WiseStream, or equal).
8. Wide Dynamic Range (WDR): 120 dB minimum on cameras viewing scenes with mixed lighting; manufacturer's forensic-grade WDR preferred.
9. Low-light technology: color image to 0.05 lux at f/1.6 or better.
10. Onboard storage: dual microSD/SDHC/SDXC slots, minimum 256 GB capacity each, supporting edge recording and failover.
11. Cybersecurity features: signed firmware, secure boot, TPM 2.0 (FIPS 140-2 Level 2 where claimed), IEEE 802.1X port authentication, HTTPS / TLS 1.2 or later, individual device certificate, and user-account management with strong-password enforcement.
12. Edge analytics: line crossing, intrusion, loitering, object classification (person / vehicle), tamper detection, and audio analytics where audio is provided. AI-based analytics required on identification-zone cameras.
13. Audio (where indicated): bi-directional audio capability with G.711 / G.726 / AAC support and external microphone / speaker input.
14. Cabling and mounting hardware furnished by camera manufacturer (or equal) shall be used where applicable to maintain warranty and weather rating.

## 2.03 FIXED CAMERAS – INTERIOR

A. **Interior Dome – 4 MP (Identification Zones):** Indoor IK10 vandal-resistant mini-dome network camera with edge AI analytics, motorized varifocal lens, dual SD-card slots, PoE Class 4, and TPM module.

1. Basis-of-design products:
  - a. Axis: AXIS P3268-LV, AXIS M4318-LVE, or approved equal.
  - b. Hanwha Vision: PNV-A6081R or PNV-A9081R (P-series AI), or approved equal.
  - c. LenelS2: model from the OEM Camera Catalog including Axis or Hanwha models above.

2. Performance:

- a. Image sensor: 1/1.8" or larger; 4 MP (2688 x 1520) minimum; 8 MP / 4K available for forensic-priority cameras.
- b. Lens: motorized varifocal, 3.4-8.9 mm or wider; remote focus and zoom.
- c. Frame rate: 30 fps minimum at full resolution.
- d. WDR: 120 dB forensic.
- e. Audio: built-in microphone and line-in; speaker line-out.

**2.04 FIXED CAMERAS – EXTERIOR**

- A. **Exterior Dome / Bullet – 4 MP:** Outdoor IP66, IK10 (dome) or IP66 (bullet) network camera with edge AI analytics, motorized varifocal lens, integrated IR illumination, dual SD-card slots, heater, and PoE Class 4 (or higher per IR requirement).

1. Basis-of-design products:

- a. Axis: AXIS P3268-LVE (dome) / AXIS P1468-LE (bullet), or approved equal.
- b. Hanwha Vision: PNO-A6081R / PNO-A9081R (bullet) and PNV-A6081R / PNV-A9081R (vandal dome), or approved equal.
- c. LenelS2: equivalent product from the OEM Camera Catalog.

2. Performance:

- a. Image sensor: 1/1.8" or larger; 4 MP minimum, 8 MP/4K for forensic-priority cameras.
- b. Integrated IR LED: effective range 100 ft (30 m) minimum, adaptive.
- c. WDR: 120 dB forensic; Lightfinder, X-Lighter, or equivalent low-light enhancement.
- d. Operating temperature: -40 deg F to +140 deg F (-40 deg C to +60 deg C).
- e. Surge protection: integrated transient suppression on the Ethernet port and a separately bonded ground lug; comply with NFPA 70 Article 800.

**2.05 MULTI-SENSOR CAMERAS**

- A. **Multi-Directional Multi-Sensor:** Quad-sensor or four-sensor network camera providing four independent 4 MP image streams from a single mounting point and a single network connection. Suitable for intersections, parking-lot quadrants, building corners, and large-area overviews.

1. Basis-of-design products:

- a. Axis: AXIS P3727-PLE or AXIS Q3819-PVE, or approved equal.
- b. Hanwha Vision: PNM-9322VQP or PNM-9085RQZ1, or approved equal.
- c. LenelS2: equivalent product from the OEM Camera Catalog.

2. Performance:

- a. Sensors: four (4) independently adjustable image sensors, each minimum 4 MP.

- b. Aggregate resolution: minimum 16 MP across all sensors.
- c. Combined coverage: up to 360 degrees of selectable field-of-view.
- d. PoE: IEEE 802.3bt Class 6 (Type 3) or higher to accommodate combined sensor and heater load.

**B. Panoramic Single-Sensor (Fisheye):** 360-degree fisheye camera with onboard dewarping for interior corridor, classroom, retail, or open-office overview; minimum 12 MP single sensor.

- 1. Basis-of-design products: AXIS M4327-P, Hanwha PNF-A9311RV, or approved equal LenelS2 catalog equivalent.

## 2.06 PTZ CAMERAS

**A. Standard PTZ:** Pan-tilt-zoom dome network camera with 360-degree continuous rotation, integrated IR or white-light illumination, and on-board AI auto-tracking.

- 1. Basis-of-design products:
  - a. Axis: AXIS Q6135-LE or AXIS Q6225-LE, or approved equal.
  - b. Hanwha Vision: XNP-9250R or XNP-C9303RW, or approved equal.
  - c. LenelS2: equivalent product from the OEM Camera Catalog.
- 2. Performance:
  - a. Resolution: 4 MP minimum at 30 fps.
  - b. Optical zoom: 25x minimum.
  - c. IR or white-light illumination: 750 ft (230 m) range adaptive.
  - d. Preset positions: 256 minimum; configurable tours and guard tours.
  - e. PoE: IEEE 802.3bt Class 6 (Type 3) or higher; high-PoE midspan permitted where the connected switch port is limited.
  - f. Speed: 700 deg/s preset pan minimum; auto-tracking shall maintain target lock with sub-second response to motion within the scene.

## 2.07 SPECIALTY CAMERAS

**A. License Plate Recognition (LPR) Camera:** Dedicated LPR camera with onboard LPR engine, license-included regional database, and event-output to the VMS.

- 1. Basis-of-design products: Hanwha PNO-A9081RLP or PNV-A9081RLP (Wisenet Road AI LPR), Axis P1468-LE with AXIS License Plate Verifier, or approved equal.
- 2. Performance: minimum 4K resolution at 30 fps, dedicated narrow field of view, configurable plate-region database for North America.

**B. Thermal Camera (Where Indicated):** Long-wave-infrared thermal network camera for perimeter detection in zero-light conditions.

- 1. Basis-of-design products: Axis Q1951-E / Q2901-E, Hanwha TNO-3050T / TNO-7180TRP, or approved equal LenelS2-listed thermal product.

## 2.08 NETWORK VIDEO RECORDING – ON-PREMISES OPTION

- A. **Recording Server / NVR:** Server-class rack-mount network video recording appliance with redundant power supplies, hot-swappable hard drives, hardware RAID controller (RAID 5 minimum, RAID 6 for storage greater than 48 TB), iLO/iDRAC-class out-of-band management, and TPM 2.0.
1. Basis-of-design appliances:
    - a. Axis: AXIS Camera Station S22 / S24 / S26 Appliance series.
    - b. Hanwha Vision: Wisenet WAVE WRR-P-S2xxx series (e.g., WRR-P-S205W) or WRR-Q rack-mount.
    - c. LenelS2: NetVR or VRx appliance from the current series price list.
  2. Sizing:
    - a. Sized to the as-designed camera count plus 25 percent spare channel capacity.
    - b. Storage sized to retention requirement per Article 1.05, with capacity calculations submitted per Article 1.06.
    - c. Network ports: minimum two (2) 10 GbE uplinks to the VSS switch; out-of-band management on a separate 1 GbE port.
    - d. Power: redundant 80-PLUS Platinum or Titanium PSUs; total UPS-supported AC load including 25 percent margin.
- B. **Storage Architecture:** Provide on-board RAID storage for primary recording. For systems exceeding 100 cameras or 96 TB of effective capacity, provide a separate iSCSI / SAS attached storage shelf in the same rack.
- C. **Hard Drives:** Manufacturer-qualified, surveillance-grade hard drives (WD Purple Pro, Seagate SkyHawk AI, or manufacturer-equivalent), minimum 8 TB each; minimum five (5) year manufacturer warranty per drive. Provide one (1) on-site hot spare per RAID group.

## 2.09 NETWORK VIDEO RECORDING – HYBRID CLOUD-MANAGED OPTION

- A. **Architecture:** Where the Owner elects the hybrid deployment model per Article 1.05.C.2, provide an edge-recording solution: cameras record continuously to internal SD/SSD storage (256 GB minimum each, dual cards); management plane is the manufacturer's cloud service. Provide a cloud-bridge appliance per site where total camera count exceeds the cloud-direct connectivity limit of the chosen platform.
- B. Basis-of-design hybrid services:
1. Axis Cloud Connect with AXIS Camera Station Edge.
  2. Hanwha Vision OnCloud (cloud-managed, edge-recorded).
  3. LenelS2 Elements (cloud-native access control and video, integrated).

## 2.10 NETWORK VIDEO RECORDING – VSAAS FULL-CLOUD OPTION

- A. **Architecture:** Where the Owner elects the VSaaS deployment model per Article 1.05.C.3, provide cloud-recorded video surveillance: video transported from a cloud-bridge appliance to a hosted, multi-tenant or single-tenant cloud-recording



infrastructure. Local appliance buffers video during WAN outages and uploads upon restoration.

B. Basis-of-design VSaaS services:

1. Axis Cloud Connect with full cloud-recording service tier.
2. Hanwha Vision OnCloud with cloud-recording subscription tier.
3. LenelS2 Elements with cloud-recording subscription.

C. VSaaS Service Requirements:

1. **Encryption:** video and metadata encrypted in transit (TLS 1.2 or later) and at rest (AES-256).
2. **Authentication:** Single Sign-On (SAML 2.0, OIDC, or Microsoft Entra ID integration), multi-factor authentication, role-based access control.
3. **Geographic data residency:** video and metadata shall be stored in U.S. data centers; service provider shall identify the data-center provider (e.g., AWS, Azure, GCP) and the primary and secondary regions.
4. **Cybersecurity certifications:** ISO/IEC 27001 and SOC 2 Type II for the hosted service.
5. **Data portability:** at the Owner's request and at the end of the subscription term, the service provider shall provide a method for bulk export of recorded video in a non-proprietary format (MP4 or MKV with H.264/H.265 elementary streams) on standard media or via secure download. Vendor lock-in by proprietary container format alone shall not be acceptable.
6. **Service Level Agreement:** 99.9 percent service availability per month exclusive of scheduled maintenance; documented support response times.
7. **Camera bandwidth:** provide bandwidth-management features (per-camera streaming bitrate caps, scheduling, and store-and-forward) suitable for the available WAN circuit.
8. **Retention:** minimum 30 days as specified; offered higher-retention tiers shall be available.

## 2.11 VIDEO MANAGEMENT SYSTEM (VMS)

A. **General:** Provide the VMS software corresponding to the selected manufacturer per Article 2.01, in the currently shipping version at time of project award. Manufacturer's standard Owner-facing maintenance / Software Update Plan (SUP) shall be included for the first year.

B. VMS Functional Requirements:

1. Live view of all cameras with operator-configurable layouts; minimum 16 cameras per pane, 64 cameras per screen.
2. Synchronized multi-camera playback of recorded video, with audio.
3. Search by time, camera, event, alarm, motion region, and metadata (object class, color, attribute).

4. Bookmarks (manual and auto-on-event), export to MP4, AVI, or native format with chain-of-custody hash and watermark.
  5. Map / GIS view supporting drag-and-drop placement of camera and door icons, with live status.
  6. Active Directory / LDAP / SAML / OIDC integration for user authentication; multi-factor authentication for administrative accounts.
  7. Role-based permissions: minimum five (5) role tiers (super-admin, admin, operator, view-only, audit-only).
  8. Audit log: complete log of user logons, video views, exports, configuration changes, and analytic events. Audit log shall be exportable to syslog and tamper-evident.
  9. Mobile and web clients: iOS, Android, and HTML5 web clients with the same authentication and role enforcement as the desktop client.
  10. API: REST or SDK for integration; bi-directional integration to the ACS specified in Section 28 13 00.
  11. Health monitoring: per-camera, per-recorder, and per-storage status with alerts on degradation.
  12. Failover / redundancy: N+1 server failover for camera count exceeding 100 cameras; daily configuration backup.
  13. Cybersecurity: signed installers, TLS 1.2 or later for all client-server traffic, automated firmware push to cameras with cryptographic verification.
- C. **VMS License Quantities:** Provide a license per camera in the as-designed camera schedule, plus 25 percent spare channel capacity. Provide at minimum the number of operator-workstation seats indicated on the Drawings or in the Workbook (companion document).

## 2.12 VIDEO ANALYTICS

- A. **Edge Analytics:** Each camera provided under this Section shall include the manufacturer's standard edge-analytic suite, with at minimum: motion / pixel-change detection, tamper detection, line crossing, zone intrusion, loitering, object classification (person, vehicle), and sound classification (where the camera includes a microphone).
- B. **AI / Deep-Learning Analytics:** Identification-zone cameras shall additionally provide: BestShot or equivalent re-identification, vehicle-attribute extraction (color, type), face-attribute extraction (where lawful and authorized by the Owner), and metadata streaming for forensic search in the VMS.
- C. **Disabling Conditions.** The Contractor shall disable face-recognition analytics by default and shall enable face-related features only on written authorization of the Owner. Any use of biometric analytics shall comply with applicable state privacy law.

## 2.13 NETWORK INFRASTRUCTURE FOR VSS

- A. **Managed Ethernet Switch:** Layer 2+ managed Ethernet switch with PoE+ / PoE++ ports sized to the as-designed camera load plus 20 percent spare PoE budget and 25 percent spare port count.

1. Basis-of-design: Cisco Catalyst 9200-L / 9300, Juniper EX2300 / EX3400, Aruba CX 6200 / 6300, Netgear M4250 / M4350, or approved equal that meets the Owner's IT standard.
  2. Required features: 802.1Q VLAN tagging, 802.1X port authentication, port-based MAC limit, IGMP snooping, LACP, jumbo frame, SNMP v3, RADIUS / TACACS+, NTP, syslog.
  3. PoE: per-port budgeting; 802.3bt Type 3 / Type 4 ports allocated to PTZ and multi-sensor cameras.
  4. Uplinks: dual 10 GbE SFP+ to the core / NVR; LACP aggregation.
- B. **VLAN Segmentation:** Provide a dedicated VSS-VLAN routed only to the NVR, VMS server, and operator workstations. Cameras shall not be reachable from end-user networks except via the VMS proxy.
- C. **Cabling:** Category 6A 4-pair UTP or shielded cabling per Section 27 15 00, terminated with manufacturer-rated RJ-45 jacks and supporting IEEE 802.3bt Type 4 (90 W). Plenum-rated CMP / OFNP where required by NEC. Multi-mode (OM4) or single-mode fiber where distances exceed 295 ft (90 m) channel.
- D. **Surge Protection:** Provide UL-listed Ethernet surge protection devices on every cable that leaves the building envelope or crosses between buildings, in accordance with NFPA 70 Article 800 (or Chapter 8 / Article 750 per the adopted NEC). Bond surge protectors to the telecommunications grounding bus per Section 27 05 26.

## 2.14 OPERATOR WORKSTATIONS AND DISPLAYS

- A. **Operator Workstation:** PC workstation with VMS-manufacturer-recommended specification for the as-designed channel count and display configuration, minimum 32 GB RAM, 1 TB NVMe SSD, discrete GPU sufficient to drive the connected displays at 30 fps without frame loss, dual 1 GbE NICs, and a UPS-supported power inlet. Windows 11 Pro 64-bit or current manufacturer-supported equivalent.
- B. **Displays:** Commercial-grade LCD or LED monitors, minimum 27" diagonal, 4K (3840 x 2160) resolution, IPS or VA panel, 24/7 rated for monitoring applications. Mount on swing-arm or VESA wall-mount as indicated.
- C. **Video Wall (Where Indicated):** Provide manufacturer's video-wall decoder or controller (e.g., AXIS T8705, Hanwha SPD-152, LenelS2 Magic Monitor) and associated displays per the Drawings. Coordinate with Section 27 41 16 where applicable.

## 2.15 POWER AND UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. **Dedicated Branch Circuit:** VSS head-end shall be powered from a dedicated 20 A isolated-ground branch circuit (or 30 A where indicated for larger NVR / storage loads), terminated in a NEMA L5-30R or equivalent twist-lock receptacle. Coordinate with Division 26.
- B. **UPS:** Provide a rack-mount lithium-iron-phosphate (LiFePO4) UPS sized to support the head-end (NVR + switch + workstation) for a minimum of 30 minutes at full load and 4 hours for life-safety-related cameras (perimeter and egress paths). Sealed lead-acid (VRLA / SLA) chemistry is not acceptable.

1. Required features: online double-conversion topology, output power factor 1.0, SNMP v3 management card, dry contact and USB notification, hot-swappable batteries, end-of-life self-test, automatic transfer time less than 4 ms.
  2. Basis-of-design: Eaton 9PX Li-ion, CyberPower PRL3000RT2UC, Vertiv Liebert PSI5 (LiFePO4 variant), or approved equal.
- C. **PoE Power Budget:** Size each managed switch PoE budget to support the sum of connected device classes plus 20 percent margin. Where high-PoE (Type 3 / Type 4) cameras exceed switch budget, provide manufacturer-listed midspan PoE injectors.

## 2.16 IDENTIFICATION

- A. Label all cameras, recorders, switches, patch panels, jacks, and cables in accordance with Section 27 05 53 and ANSI/TIA-606-D, using the Owner's labeling scheme. Provide laminated camera-location plan diagrams at each NVR location.

## 2.17 ENCLOSURES, MOUNTS, AND ACCESSORIES

- A. **General:** Provide the manufacturer's mounting brackets, pole adapters, corner mounts, parapet mounts, and recessed-ceiling adapters required for each camera location. Painted finishes shall be color-matched to the adjacent surface where indicated by the Architect.
- B. Outdoor pole-mount cameras shall include a pole-mount adapter and back-box rated for the IP and IK requirements of the exposed environment.
- C. Furnish manufacturer's recommended lightning / surge protection at each pole-mount or building-to-building exposed-cable location.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Verify field conditions are acceptable and that all required pathways (Section 27 05 28), equipment-room provisions (Section 27 11 00), grounding (Section 27 05 26), and electrical service (Division 26) are in place prior to commencing work.
- B. Examine each camera location and verify that the proposed mounting surface is suitable; coordinate with the Architect/Engineer if alternate backing or blocking is required.
- C. Verify network paths and conduit sizes will accommodate Category 6A cabling and PoE bundle de-rating in accordance with ANSI/TIA TSB-184-A.

## 3.02 INSTALLATION – GENERAL

- A. Install in accordance with the manufacturer's published instructions, the listing of the device, and the applicable provisions of NFPA 70, ANSI/BICSI N1, ANSI/BICSI N2, ANSI/BICSI N3, and ANSI/BICSI 007-2020.
- B. Provide cable supports at intervals not exceeding 60 in (1.5 m) per NFPA 70 Article 800 / Chapter 8 (as applicable to the adopted edition).
- C. Maintain bend-radius and pulling-tension limits published by the cable manufacturer.

- D. Plenum cable (CMP / OFNP) where required by NEC; otherwise riser (CMR / OFNR) within building risers; CM general purpose only in unconcealed spaces below 7 ft (2.1 m) AFF.
- E. Bond all metallic raceways, equipment racks, and surge-protection devices to the Telecommunications Grounding Busbar (TGB) or PBB per Section 27 05 26 and ANSI/TIA-607-E.
- F. Maintain TIA-569-E separation between low-voltage cabling and Class 1 power, including parallel-run distances and crossings.

### **3.03 INSTALLATION – CAMERAS**

- A. Install each camera at the location, mounting height, and orientation indicated on the Drawings, adjusting field-of-view to confirm the design pixels-per-foot at the design distance-to-subject. Use a sample target during commissioning to verify.
- B. Tighten mounting hardware to manufacturer's published torque values. Apply manufacturer-recommended thread-lock compound to fasteners exposed to vibration or mechanical impact.
- C. Pole-mount and corner-mount cameras shall be secured with all manufacturer-supplied hardware; pole banding shall be stainless steel rated to the pole diameter.
- D. Outdoor cameras shall be sealed at the cable entry with the manufacturer's gasket or equivalent silicone bead to maintain IP rating.
- E. Bond each metallic camera enclosure and any exposed metal pole or mast to the telecommunications grounding system.

### **3.04 NETWORK AND SYSTEM PROGRAMMING**

- A. Configure each camera with: unique strong password; HTTPS / TLS 1.2 or later; 802.1X authentication where the network supports it; NTP synchronization to the Owner's time source; SNMPv3 (where used) with unique community and authentication credentials; SYSLOG forwarding to the Owner's SIEM (where deployed).
- B. Disable unused services and ports on each device, including but not limited to: Telnet, FTP, UPnP, multicast discovery (Bonjour, mDNS), and HTTP (in favor of HTTPS).
- C. Configure recording groups, retention policies, alarm rules, schedules, user accounts, and role assignments per the Owner's operational requirements and the as-designed camera schedule.
- D. Establish bi-directional integration with the ACS per Section 28 13 00. Verify door-event-to-camera mapping for every controlled door.
- E. Configure all firmware to the most-current manufacturer release as of the date of Substantial Completion. Document firmware versions for each device.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform manufacturer's published commissioning procedure for each device, the VMS, and the head-end servers. Document results in the Closeout Submittal.
- B. **Tests Required for Each Camera:**

1. Visual: confirm mounting, alignment, gasket, and labeling.
2. Image: capture day and night reference images; confirm focus, exposure, and white balance.
3. FOV: verify design pixels-per-foot at design distance using a calibrated test pattern or pylon-target.
4. Recording: verify 24-hour continuous recording with no dropped frames; confirm motion-event recording.
5. Analytics: validate each configured edge analytic with a representative test scenario.
6. Network: confirm 802.1X authentication (where deployed), TLS handshake, and reachability.
7. PoE: confirm switch-port power class and load is within budget.

**C. Tests Required at the Head-End / Cloud:**

1. Storage retention: project storage to design retention and confirm RAID health.
2. Failover: where N+1 redundancy is provided, demonstrate live failover and recovery.
3. UPS load test: full transfer test demonstrating runtime per Article 2.15.B.
4. Cloud / VSaaS: confirm encryption, MFA, and data-residency through the manufacturer's published verification report.

- D. ACS Integration Test:** Trigger a series of access-control events (valid, invalid, forced-door, door-held-open) at a representative sample of doors and confirm correct video call-up and bookmarking in the VMS.

**3.06 COMMISSIONING**

- A. Cooperate with the Commissioning Authority (Cx) and the Owner during functional performance testing. Provide trained technicians for the duration of Cx testing.
- B. Demonstrate end-to-end functionality: live view, recording, search, export, alarm, integration, and remote-access.
- C. Demonstrate cybersecurity posture: certificate validity, password strength, account inventory, audit-log capture, firmware version.
- D. Provide a 30-day burn-in / soak-test period beginning at Substantial Completion. Address any defects identified prior to Final Acceptance.

**3.07 TRAINING**

- A. Provide a minimum of two (2) instructor-led training sessions for the Owner's personnel, conducted at the Project site by manufacturer-certified trainers.
  1. **Operator Training:** eight (8) hours covering daily operation, live view, playback, search, export, and incident response.
  2. **Administrator Training:** sixteen (16) hours covering user provisioning, role configuration, system maintenance, backup / restore, firmware update, cybersecurity hygiene, and report generation.

- B. Video-record each session and provide an electronic copy to the Owner as part of the Closeout Submittal.

### **3.08 CLEANING AND CLOSEOUT**

- A. Clean lenses, domes, and enclosures using manufacturer's recommended cleaning agents prior to Substantial Completion.
- B. Remove from the Project site all packaging materials, scrap, and surplus, and dispose in accordance with Section 01 74 19.
- C. Provide a final walk-through with the Owner; correct deficiencies prior to requesting Final Acceptance.

**END OF SECTION 28 23 00**

**SECTION 28 48 00**

**EMERGENCY RESPONDER COMMUNICATION ENHANCEMENT SYSTEM (ERCES) —  
DESIGN-BUILD**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is performance-based and intended for execution under a Design-Build delivery method. The Design-Builder is responsible for the design, engineering, procurement, installation, commissioning, testing, permitting, and Authority Having Jurisdiction (AHJ) approval of a complete and operational Emergency Responder Communication Enhancement System (ERCES).
- C. Where conflicts exist between this Section and other Contract Documents, the more stringent requirement governs unless specifically modified in writing by the Owner.

**1.02 SUMMARY**

- A. This Section establishes the performance criteria, code compliance obligations, and acceptance requirements for a complete and fully functional Emergency Responder Communication Enhancement System (ERCES), also known as an in-building two-way emergency radio communication enhancement system, in accordance with the 2024 International Fire Code (IFC) Section 510, NFPA 1225 Chapter 18, NFPA 72, and UL 2524.
- B. The ERCES is a life-safety system intended to ensure reliable two-way radio communications for emergency responders (fire, police, and EMS) within the building, by amplifying public-safety radio signals in areas where the existing signal is inadequate.
- C. **Design-Builder Scope of Work:** The Design-Builder shall provide all design, engineering, procurement, project management, installation, commissioning, testing, training, AHJ coordination, permitting, and warranty services necessary to deliver a fully functional, code-compliant, and AHJ-approved ERCES. The Scope of Work includes, but is not limited to:
  - 1. Pre-design site survey, including measurement of existing macro-cell and public-safety RF signal levels at representative locations throughout the building.
  - 2. Coordination with the AHJ and PSN frequency license holder to confirm frequencies, channels, retransmission requirements, and acceptance criteria prior to design.
  - 3. Complete RF design, including link budget, propagation modeling (iBwave or approved equivalent), donor antenna location and orientation, equipment sizing, cable routing, and survivability strategy.



4. Selection and procurement of all UL 2524-listed equipment from a single manufacturer family for active components, with passive components selected to support the design.
  5. Permit drawing preparation, AHJ submittals, and FCC signal-booster registration per 47 CFR 90.219(d).
  6. Furnishing and installation of all equipment, cabling, antennas, grounding, lightning protection, and supporting infrastructure.
  7. Commissioning, factory acceptance testing, and AHJ-witnessed acceptance testing per 2024 IFC Section 510.5.
  8. Documentation closeout, including as-built drawings, O&M manuals, training, and the first annual test.
  9. Warranty service and maintenance per Article 1.10.
  10. Optional Neutral-Host Cellular Distributed Antenna System (DAS) per Article 2.10, where included in the Owner's Project Requirements.
- D. **Owner-Furnished Items:** The following are provided by the Owner or under separate Contract and shall be coordinated with by the Design-Builder:
1. Dedicated 120 V, 20 A branch circuit served from the life-safety / standby-generator system, terminating at the head-end equipment location.
  2. Telecommunications grounding busbar (TGB) at the head-end equipment location, complying with ANSI/TIA-607.
  3. Building penetrations, sleeves, and firestopping for ERCES pathways, where furnished under Division 07. Coordination of pathway locations is the responsibility of the Design-Builder.
  4. Fire Alarm Control Panel (FACP) module space and supervisory addressing for ERCES interface points.
  5. Building access, security clearances, and roof access for survey and installation.
- E. **Owner's Project Requirements (OPR):** The Owner-defined performance requirements and acceptance criteria are summarized in Article 1.07. The Design-Builder shall confirm in writing that the proposed design satisfies each OPR item prior to start of construction.

### 1.03 DESIGN-BUILD DELIVERY

- A. **Design Responsibility:** The Design-Builder bears full and unitary responsibility for the design and performance of the ERCES, including the suitability of materials, methods, and means used to achieve the performance requirements of this Section. The Design-Builder is the engineer of record for the ERCES.
- B. **Stamping and Sealing:** ERCES design documents (drawings, specifications, calculations, and test reports) shall be stamped and sealed by a Professional Engineer licensed in the jurisdiction of the Project, holding a current NICET ERCES Certification (Level III preferred, Level II minimum), or by an engineer otherwise acceptable to the AHJ.
- C. **Design Phases:** The Design-Builder shall execute the design in three phases, each subject to Owner and AHJ review:

1. **Schematic Design (SD):** RF coverage strategy narrative, preliminary equipment selection, single-line concept, and predictive heat maps based on the pre-design survey.
  2. **Design Development (DD):** RF link budget, donor antenna location and orientation, equipment locations, cable pathway routing, survivability strategy, FACP interface point list, and 60% drawings.
  3. **Construction Documents (CD):** 100% drawings, complete bill of materials, ATP, AHJ permit submittal package, and stamped/sealed engineering documents.
- D. **Owner Review:** The Owner reserves the right to review and comment on each design submittal within ten (10) business days of receipt. Owner comments do not relieve the Design-Builder of responsibility for design adequacy or code compliance.
- E. **Changes to Performance Criteria:** Changes to the performance criteria of this Section after Contract execution shall be processed as Owner-directed change orders. Means and methods to satisfy the unchanged performance criteria are the Design-Builder's risk.
- F. **Errors and Omissions:** The Design-Builder is responsible at no additional cost for any work, material, or design correction necessary to achieve the performance criteria of this Section, including correction of design errors discovered during installation or acceptance testing.

#### 1.04 REFERENCE STANDARDS

- A. Comply with the current editions of the following codes, standards, and regulations, as adopted by the jurisdiction. Where multiple editions are referenced, the more stringent governs unless the AHJ directs otherwise:
1. 2024 International Fire Code (IFC), Section 510 – Emergency Responder Communications Enhancement Systems.
  2. 2024 International Building Code (IBC).
  3. NFPA 1225 – Standard for Emergency Services Communications (2022 edition, as amended). Chapter 18 governs in-building ERCES.
  4. NFPA 72 – National Fire Alarm and Signaling Code (2025 edition or current adopted edition). NFPA 1225 Section 18.14 defers ERCES supervision, annunciation, and pathway integrity to NFPA 72 Chapters 10, 14, and 24. NFPA 72-2025 Chapter 11 governs cybersecurity provisions.
  5. NFPA 1 – Fire Code (current adopted edition).
  6. NFPA 70 – National Electrical Code (2023 edition or current adopted edition).
  7. NFPA 101 – Life Safety Code (current adopted edition).
  8. UL 2524 – Standard for In-Building 2-Way Emergency Radio Communication Enhancement Systems. Listing as a complete system is mandatory.
  9. FCC 47 CFR Part 90.219 – Use of Signal Boosters. Class A narrowband signal boosters required for ERCES.
  10. FCC 47 CFR Parts 22, 90, and 101 as applicable.

11. FCC Office of Engineering and Technology (OET) Bulletin 65 – Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
12. TIA TSB-88.1 – Wireless Communications Systems Performance in Noise and Interference-Limited Situations.
13. ANSI/TIA-568 – Commercial Building Telecommunications Cabling Standard.
14. ANSI/TIA-607 – Generic Telecommunications Bonding and Grounding.
15. Americans with Disabilities Act (ADA).
16. Occupational Safety and Health Administration (OSHA) regulations.
17. Local fire code, AHJ-specific ordinances, and AHJ submittal checklists.

#### 1.05 DEFINITIONS

- A. **AHJ:** Authority Having Jurisdiction.
- B. **ATP:** Acceptance Test Plan.
- C. **BDA:** Bi-Directional Amplifier (signal booster).
- D. **BoD:** Basis of Design.
- E. **DAQ:** Delivered Audio Quality, per TIA TSB-88.
- F. **DAS:** Distributed Antenna System.
- G. **Design-Builder:** The single entity in Contract with the Owner for both design and construction of the ERCES, and the engineer of record for the system.
- H. **ERCES:** Emergency Responder Communication Enhancement System, per 2024 IFC Section 510 and NFPA 1225.
- I. **FACP:** Fire Alarm Control Panel.
- J. **MNO:** Mobile Network Operator (commercial wireless carrier).
- K. **NICET:** National Institute for Certification in Engineering Technologies.
- L. **NMS:** Network Management System.
- M. **OPR:** Owner's Project Requirements.
- N. **PIM:** Passive Intermodulation.
- O. **PSN:** Public Safety Network.
- P. **RoF:** Radio-over-Fiber.
- Q. **WSP:** Wireless Service Provider.

#### 1.06 DESIGN-BUILDER QUALIFICATIONS

- A. The Design-Builder shall be a single legal entity holding a Contract with the Owner. The Design-Builder may execute design and construction with in-house staff or subcontract portions of the work, but retains full responsibility for performance of the ERCES.
- B. Firm Qualifications:

1. Minimum five (5) years of demonstrated experience as the Design-Builder of in-building public-safety RF systems, including at least three (3) Projects of comparable size and complexity completed and accepted by the AHJ within the past 36 months. Provide reference contact information for each.
2. Authorized and certified value-added reseller for the proposed active equipment manufacturer, listed on that manufacturer's published authorized reseller roster.
3. Design-Build firm shall maintain professional liability (errors and omissions) insurance with coverage of not less than the amount required in Division 01, including coverage for design services.
4. Office or licensed local affiliate within 100 miles of the Project site, or guaranteed on-site response within 24 hours of notification.

C. Personnel Qualifications:

1. **Engineer of Record:** A Professional Engineer licensed in the jurisdiction of the Project, holding a current NICET ERCES Certification (Level III preferred, Level II minimum), or otherwise acceptable to the AHJ. The Engineer of Record shall stamp and seal the design documents.
2. **Design Lead:** NICET ERCES Level II minimum, with documented experience in iBwave or approved equivalent RF design software.
3. **Acceptance-Test Personnel:** Current FCC General Radio Operator's License (GROL) and manufacturer certification on the installed equipment.
4. **Installation Technicians:** Manufacturer factory-certified for the specific product line being installed.

D. **Spare Parts:** The Design-Builder or its systems-integration partner shall maintain in regional stock for next-business-day deployment a quantity of major spare components equivalent to:

1. One (1) BDA of the type installed.
2. One (1) fiber-optic master unit of the type installed (where active fiber distribution is used).
3. Two (2) fiber-optic remote units of the type installed (where active fiber distribution is used).

## 1.07 PERFORMANCE REQUIREMENTS

A. The Design-Builder shall design and deliver the ERCES to satisfy the following performance requirements. Failure to demonstrate any requirement during acceptance testing shall require the Design-Builder to remediate at no additional cost to the Owner.

B. Coverage:

1. **Coverage Area:** The entire building shall be covered, including all general and critical areas, unless the AHJ has authorized exclusion of specific areas in writing.
2. **Critical Areas:** Critical areas, as designated by the fire code official, shall include at minimum: fire command centers, fire pump rooms, interior exit stairways, exit

passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and any additional areas designated by the AHJ.

3. **Coverage Acceptance Criteria:** Signal-strength measurements shall meet minimum requirements in 95 percent of all general areas and 99 percent of critical areas on each floor, per 2024 IFC Section 510.4.1.

C. Signal Strength and Audio Quality:

1. **Downlink Minimum:** Signal strength into the building shall be sufficient to provide a minimum DAQ of 3.0, typically -95 dBm at the portable radio throughout the coverage area, per 2024 IFC Section 510.4.1.2. Design target shall be DAQ 3.4 or better.
2. **Uplink Minimum:** Signal strength of -95 dBm received at the AHJ radio system from the coverage area, or an equivalent BER or SINR for the technology in use.
3. **Donor Antenna Isolation:** Not less than 20 dB above system gain under all operating conditions, per NFPA 1225.

D. Frequency Support:

1. The system shall support all frequencies designated by the AHJ for first-responder use within the coverage area. The Design-Builder shall confirm the frequency plan in writing with the AHJ during the Schematic Design phase.
2. Anticipated frequencies for design include: 700 MHz and 800 MHz Public Safety bands (P25 Phase 1 and 2, analog and digital simultaneously); UHF LMR 380-512 MHz and 769-806 MHz; VHF 150-174 MHz; and LTE Band 14 (FirstNet) where designated by the AHJ.
3. The system shall support simultaneous operation of analog and digital modes within each band where required by the AHJ.

E. Reliability and Survivability:

1. **Secondary Power:** The ERCES shall operate for a minimum of 24 hours at 100 percent system capacity from secondary power upon loss of primary power, per NFPA 1225 Section 18.11 and 2024 IFC Section 510.4.2.3.
2. **Survivability:** All main risers and trunk pathways shall provide Survivability Level 2 or Level 3 per NFPA 1225 Chapter 18 and NFPA 72-2025 Chapter 10. Survivability strategy shall be one or more of: 2-hour fire-rated cable; routing through 2-hour fire-rated enclosure(s) or shaft(s); looped 1-hour fire-rated design capable of transmitting and receiving during a single open or single ground fault; or AHJ-approved performance alternative.
3. **Mean Time Between Failures (MTBF):** The total system MTBF shall be not less than 50,000 hours.
4. Equipment shall be operable across an interior temperature range of -10 to +120 degrees F (-23 to +49 degrees C) at up to 85 percent humidity non-condensing. Rooftop equipment shall be rated for full rooftop temperature extremes including solar gain.

F. RF Performance:

1. **Reject Filtering:** Minimum downlink adjacent-band rejection of 35 dB or greater at 865 MHz and 870 MHz.
  2. **Band Migration:** Re-tunable digital filters or replaceable filter modules shall be provided to accommodate NPSPAC and other band changes. Non-adjustable, non-replaceable RF input and output filters are not acceptable.
  3. **Output Level Control:** Automatic output leveling with a minimum dynamic range of 60 dB to maintain FCC out-of-band and spurious-emission compliance.
  4. **Operating Mode:** Normally powered on; continuously passes frequencies within the public-safety and first-responder bands. Circuits that intentionally disable the signal booster under abnormal conditions shall not be implemented as the standard operating mode.
  5. **Passive Intermodulation (PIM):** All passive components and cable assemblies shall achieve PIM performance of -150 dBc or better, measured per IEC 62037.
- G. Listing and Certification:
1. All ERCES equipment, including the BDA, fiber master unit (where used), fiber remote units (where used), battery system, FACP interface, and supervisory components, shall be listed to UL 2524 as a complete system. Unlisted equipment is not acceptable, regardless of individual component performance or the existence of alternative listings.
  2. All RF amplification, filtering, and distribution equipment shall carry FCC type certification (47 CFR 90.219 Class A narrowband for public-safety frequencies) prior to installation.
- H. **Expansion Capacity:** The installed system shall support, without replacing infrastructure, the addition of:
1. At least one (1) additional public-safety frequency band beyond those in the initial frequency plan.
  2. At least 25 percent additional channel capacity within the initial frequency plan.
  3. At least 25 percent additional remote-unit / antenna nodes.
- I. **Optional Cellular Coverage:** Where the Owner's Project Requirements include neutral-host cellular coverage, performance criteria are stated in Article 2.10.

## 1.08 DESIGN SUBMITTALS

- A. **Pre-Award Submittals:** With the Design-Build proposal, submit:
1. Design-Builder qualifications and personnel certifications per Article 1.06.
  2. Concept narrative describing the proposed approach, anticipated equipment manufacturer (subject to confirmation during design), and basis of pricing.
  3. Project schedule showing design phases, AHJ submittal milestones, installation, commissioning, and acceptance testing.
  4. Statement of any exceptions taken to the performance requirements of Article 1.07, with justification. Exceptions accepted by the Owner shall be documented in the Contract.

**B. Schematic Design (SD) Submittal:** Within thirty (30) days of Notice to Proceed (NTP):

1. RF coverage strategy narrative, including donor antenna concept and active-vs-passive distribution strategy.
2. Predictive RF heat maps based on the pre-design survey, using iBwave or approved equivalent.
3. Anticipated equipment list, identifying make and model for each major component.
4. AHJ frequency-plan confirmation letter.
5. Single-line concept diagram showing head-end, distribution, and remote locations.
6. Risk register identifying significant design and constructibility risks and proposed mitigation.

**C. Design Development (DD) Submittal:**

1. 60% drawings, including donor antenna location and mounting, head-end equipment location, distribution backbone routing, remote unit locations, and antenna placement floor plans.
2. RF link budget, downlink and uplink, for worst-case coverage points.
3. Updated predictive RF heat maps reflecting the DD design.
4. Survivability strategy with pathway selection and fire-rating documentation.
5. Battery sizing calculation per NFPA 1225 Section 18.11.
6. FACP interface design and supervisory monitoring point list, coordinated with the Fire Alarm subcontractor.
7. Updated equipment list with confirmed UL 2524 system listing documentation.

**D. Construction Documents (CD) / 100% Submittal:**

1. Complete drawings, stamped and sealed by the Engineer of Record.
2. Final equipment list and bill of materials.
3. Final RF link budget and predictive heat maps.
4. Acceptance Test Plan (ATP) accepted in writing by the Owner and AHJ. ATP shall include test methodology, equipment, pass/fail criteria, sample data sheets, and AHJ witness coordination.
5. FCC signal-booster registration per 47 CFR 90.219(d), filed prior to energization.
6. AHJ permit drawings and supporting documentation per the AHJ submittal checklist.
7. Maintenance service contract for the warranty period and renewal options.
8. Code compliance matrix demonstrating how each provision of 2024 IFC Section 510, NFPA 1225 Chapter 18, NFPA 72, and UL 2524 is satisfied.

**E. Construction Phase Submittals:**

1. Product data sheets and manufacturer's installation instructions for each component.
  2. Cut sheets and current calibration certificates for all test instruments.
  3. Manufacturer's training certificates for the assigned acceptance-test personnel.
- F. Closeout Submittals:
1. As-built drawings (DWG and PDF formats).
  2. Accepted ATP report with all coverage, signal strength, DAQ, and FACP test data.
  3. Cable test reports for all coaxial segments (Return Loss, Distance-to-Fault, PIM).
  4. OTDR test reports for all fiber runs.
  5. Operation and Maintenance (O&M) manuals.
  6. UL 2524 system listing documentation and FCC signal-booster registration confirmation.
  7. AHJ acceptance certificate.
  8. Manufacturer and Design-Builder warranty documents.
  9. Native iBwave design files.
  10. Training records and recordings.

#### **1.09 COORDINATION**

- A. The Design-Builder shall coordinate the Work of this Section with the Owner, Owner's IT / Network integrator, Construction Manager (CM), Architect, Fire Alarm Contractor, Elevator Contractor, AHJ, the PSN frequency license holder(s), and (if applicable) participating Wireless Service Providers.
- B. The Design-Builder shall conduct, at minimum, the following coordination meetings and shall record and distribute meeting minutes:
1. Project kickoff meeting within ten (10) days of NTP.
  2. AHJ pre-design coordination meeting prior to Schematic Design.
  3. Design review meetings at SD, DD, and CD milestones.
  4. Pre-installation coordination meeting with the General Contractor / CM and affected trades.
  5. Pre-commissioning coordination meeting with the Owner, AHJ, and Fire Alarm Contractor.
  6. Acceptance test coordination meeting at least two (2) weeks prior to AHJ-witnessed testing.
- C. Amplification systems capable of operating on frequencies licensed to any public-safety agency by the FCC shall not be installed without prior coordination and written approval of the fire code official per 2024 IFC Section 510.4.2.1.



- D. The Design-Builder shall confirm a schedule time frame within which all equipment will be installed, all documentation will be delivered, and AHJ permit and testing time frames will be met.

## 1.10 WARRANTY AND SERVICE

- A. **Design-Builder Warranty:** The Design-Builder shall warrant the design, installation, and performance of the ERCES, as approved by the AHJ, for a period of one (1) year minimum from the date of Substantial Completion. Warranty service shall include all parts, labor, travel, and trip charges.
- B. **Manufacturer Warranty:** The Design-Builder shall pass through to the Owner all manufacturer warranties applicable to the installed equipment, including, at minimum:
1. Active components (BDA, fiber master unit, fiber remote units, battery system): one (1) year minimum from date of Substantial Completion.
  2. Splitters, couplers, and coverage antennas: five (5) years minimum from date of Substantial Completion.
  3. Coaxial cable and connectors: ten (10) years minimum from date of Substantial Completion.
  4. Fiber-optic cable: twenty (20) years minimum from date of Substantial Completion.
- C. **First Annual Test:** The Design-Builder shall perform the first annual inspection and test required by NFPA 1225 Section 18.17 and 2024 IFC Section 510.6 within the warranty period at no additional cost to the Owner.
- D. **Service Response:** The Design-Builder shall respond on-site to a service request within forty-eight (48) hours for normal service, and within eight (8) hours for emergency service. Emergency service is defined as loss of the BDA, loss of coverage on any floor, or any condition that prevents the ERCES from performing its life-safety function.
- E. **Loaner Equipment:** If equipment cannot be repaired within twenty-four (24) hours of the service visit, the Design-Builder shall provide loaner equipment of equivalent or superior performance at no charge until permanent repairs are completed.
- F. **Extended Warranty:** The Design-Builder shall provide an add-alternate price for extension of the full parts-and-labor warranty to five (5) years.

## PART 2 - PRODUCTS

### 2.01 GENERAL PRODUCT REQUIREMENTS

- A. **Performance-Based Selection:** All products incorporated into the Work shall be selected by the Design-Builder to satisfy the performance criteria of Article 1.07 and the requirements of this Part. Specific manufacturer or model designations are not provided. The Design-Builder shall confirm in writing that selected products satisfy each applicable requirement of this Section.
- B. **UL 2524 Listing:** All ERCES equipment, including the BDA, fiber master unit (where used), fiber remote units (where used), battery system, FACP interface, and supervisory components, shall be listed to UL 2524 as a complete system.

Equipment listed only as individual components is not acceptable. Substitutions during construction shall not affect the UL 2524 system listing.

- C. **Single-Source Responsibility:** All active ERCES equipment shall be supplied by a single manufacturer, ensuring system compatibility, common Network Management System (NMS), unified UL 2524 system listing, and consolidated warranty support. Mixed-manufacturer active equipment is not acceptable.
- D. **FCC Certification:** All RF amplification, filtering, and distribution equipment shall carry FCC type certification (47 CFR 90.219 Class A narrowband for public-safety frequencies) prior to installation.
- E. **Compatibility:** Equipment shall not interfere with existing communication systems utilized by public-safety and first-responder agencies.
- F. **Modularity:** Active equipment shall be of modular design with digital filtering and software-configurable passbands to support future expansion per Article 1.07.H.
- G. **Power:** All active equipment shall operate from 120 VAC, 60 Hz from a dedicated 20-amp branch circuit, with secondary power supplied per Article 2.04.
- H. **Materials:** All materials furnished under this Contract shall be new, of the highest quality, and shall be of a regularly manufactured production line currently in production at the time of installation. Custom or one-off equipment is not acceptable.
- I. **Operating Environment:** All active equipment shall operate within the manufacturer's published environmental specifications when installed in the locations selected by the Design-Builder. Locations selected by the Design-Builder shall not subject the equipment to environmental conditions outside the manufacturer's published limits.

## 2.02 ACCEPTABLE MANUFACTURERS

- A. **Active ERCES Equipment:** The Design-Builder shall select active equipment from one of the following manufacturers, or an Owner-approved equivalent:
  - 1. Westell – EOS Enterprise platform.
  - 2. CommScope – ION-E or Era platform.
  - 3. Corning – Everon platform.
  - 4. SOLiD Technologies – ALLIANCE platform.
  - 5. Honeywell – Fire-Lite or Gamewell-FCI ERCES offerings.
  - 6. JMA Wireless.
  - 7. Bird Technologies (TXRX Systems).
  - 8. Comba Telecom.
- B. **Substitutions:** Substitution of an active-equipment manufacturer not listed above shall be requested in writing during the Schematic Design phase, supported by complete UL 2524 system listing documentation, and is subject to Owner approval. Substitutions during construction are not permitted.
- C. **Cable and Passive Components:** The Design-Builder shall select cable and passive components from manufacturers of established reputation and demonstrated

performance, including but not limited to CommScope, Times Microwave, RFS (Radio Frequency Systems), Tessco, or approved equivalent.

- D. All manufacturers proposed shall have a documented service and support presence in the region of the Project.

### 2.03 BI-DIRECTIONAL AMPLIFIER (BDA)

- A. The BDA shall be a UL 2524-listed multicarrier signal booster, FCC certified Class A narrowband per 47 CFR 90.219, with the capability to support all frequencies in the AHJ-approved frequency plan.
- B. Performance Requirements:
1. Modular construction with digital filtering and software-configurable passbands.
  2. Sufficient gain, output power, and dynamic range to satisfy the link budget and coverage requirements of Article 1.07.
  3. Automatic gain control and automatic output leveling per Article 1.07.F.
  4. Noise figure consistent with the link budget; the Design-Builder shall confirm system noise figure does not degrade uplink coverage below the requirements of Article 1.07.
  5. Adjacent-band rejection per Article 1.07.F.
- C. **Enclosure:** NEMA 4 minimum, or NEMA 4X in corrosive environments. The enclosure shall dissipate internal heat without venting to the outside atmosphere. Operating temperature range shall include the actual installation environment with appropriate margin.
- D. **Monitoring:** SNMP-based supervision with dry-contact outputs for FACP interface, capable of annunciating each supervisory signal listed in Article 3.05.
- E. **Power:** 100-240 VAC, 50/60 Hz, with secondary power per Article 2.04.

### 2.04 POWER SUPPLIES AND BATTERY BACKUP

- A. **Primary Power:** Dedicated 20-amp branch circuit complying with NFPA 72 Section 4.4.1.4. Where available, served from the life-safety / standby-generator system.
- B. **Secondary Power:** A battery system capable of operating the ERCES for a minimum of 24 hours at 100 percent system operation, per NFPA 1225 Section 18.11 and 2024 IFC Section 510.4.2.3. The Design-Builder shall size the battery system based on documented manufacturer load data and submit the calculation as part of the Design Development submittal.
- C. **Charging:** The battery system shall automatically charge in the presence of external power input. Battery condition shall be supervised, with low-battery and charger-failure conditions annunciating to the FACP.
- D. **Enclosure:** NEMA 4 or NEMA 4X. Battery enclosure ventilation shall comply with battery manufacturer requirements.
- E. **Cybersecurity:** Where the battery system is network-connected, it shall comply with the cybersecurity provisions of NFPA 72-2025 Chapter 11.

### 2.05 DISTRIBUTION SYSTEM

- A. The Design-Builder shall select the distribution architecture (passive coaxial, active fiber, or hybrid) appropriate to the building size, geometry, and link budget.
- B. Where active fiber distribution is used:
  - 1. Fiber master unit and fiber remote units shall be UL 2524-listed as part of the complete ERCES system.
  - 2. Single-mode fiber, OS2 grade, with SC-APC connectors.
  - 3. The fiber master unit shall provide automatic gain control for optical-loss compensation, auto-mapping of remote units, and remote supervision via the NMS.
  - 4. Fiber remote units shall be enclosed in NEMA 4-rated red enclosures for ERCES applications, sized to dissipate internal heat in the installation environment.
- C. Coaxial cable and passive components shall meet the PIM performance requirement of Article 1.07.F.5 at all operating frequencies.

## **2.06 ANTENNAS**

- A. Donor Antenna(s):
  - 1. Selected by the Design-Builder for compatibility with the AHJ-approved frequency plan, sufficient gain to provide the required donor link budget, and adequate front-to-back ratio to satisfy the donor isolation requirement of Article 1.07.C.3.
  - 2. Mounted, grounded, and lightning-protected per manufacturer's instructions and the requirements of Article 3.02.
  - 3. Wind loading rated for the actual site wind exposure category per ASCE 7.
- B. Coverage Antennas:
  - 1. Multi-band omnidirectional or directional antennas selected to satisfy the coverage requirements of Article 1.07.B.
  - 2. Low-PIM construction meeting the PIM performance requirement of Article 1.07.F.5.
  - 3. Plenum-rated jacket on integral coaxial pigtails where installed in plenum spaces.
  - 4. Aesthetic finishes (white or black ABS, paintable) shall be coordinated with the Architect.
- C. Surge Protection:
  - 1. Coaxial surge arrestors shall be installed at all building-penetration points for donor antenna feeds, sized for the system frequency and power.
  - 2. Surge arrestors shall be DC-blocked and grounded per Article 3.02.

## **2.07 CABLE, CONNECTORS, AND PASSIVE COMPONENTS**

- A. Coaxial Cable:
  - 1. Low-PIM, 50-ohm impedance, with frequency response covering all operating bands.

2. Plenum-rated jacket where installed in plenum spaces; outdoor-rated jacket where installed outdoors.
  3. Fire retardancy: NFPA 262 / CMP for plenum cable.
  4. PIM performance shall meet the requirement of Article 1.07.F.5.
- B. Fiber-Optic Cable:
1. Single-mode (OS2) for active distribution, terminated in SC-APC connectors at both ends.
  2. Plenum-rated jacket where installed in plenum spaces; OSP-rated where installed outdoors.
- C. **Connectors and Passive Components:** Selected to maintain PIM performance, return loss, and impedance matching across all operating frequencies. All connectors shall be installed using manufacturer-specified tools and torque values.

## 2.08 FIRE ALARM INTERFACE

- A. The ERCES shall provide a UL 2524-listed interface module to the Fire Alarm Control Panel (FACP), capable of annunciating the supervisory signals listed in Article 3.05.
- B. Interface signals shall be coordinated with the Fire Alarm subcontractor and the FACP supervisory addressing scheme during the Design Development phase.

## 2.09 NETWORK MANAGEMENT SYSTEM (NMS)

- A. The Design-Builder shall provide a Network Management System (NMS) capable of alarm, status monitoring, configuration, and control of all active ERCES components, with a Web-based GUI per active device and SNMP compatibility for integration with third-party managers.
- B. **Cybersecurity:** The NMS and all network-connected ERCES devices shall comply with NFPA 72-2025 Chapter 11, including secure authentication, role-based access control, password policy, access logging, encrypted remote connections (TLS or equivalent), and a documented patch management process.

## 2.10 CELLULAR COVERAGE SYSTEM (OPTIONAL – NEUTRAL-HOST DAS)

- A. This Article applies only where commercial wireless (cellular) in-building coverage is included in the Owner's Project Requirements, in addition to the ERCES. The cellular DAS is not governed by NFPA 1225 or 2024 IFC Section 510 and is not required to be UL 2524 listed. Where ERCES and cellular coverage coexist, passive cable and antenna infrastructure may be shared where design and carrier approval permit. Where cellular coverage is not included in the OPR, this Article does not apply.
- B. **General:** The Design-Builder shall provide a Neutral-Host active hybrid DAS to reinforce commercial Wireless Service Provider (WSP) signals within the building. The cellular system shall be electrically and logically independent of the ERCES head end.
- C. Performance Requirements – Cellular:
1. Support for multiple Mobile Network Operators (MNOs) simultaneously, with independent gain optimization per MNO and per band.

2. Minimum downlink RSRP of -85 dBm (LTE / 5G NR) throughout the designated cellular coverage area, unless more stringent WSP requirements apply.
  3. Uplink noise ingress in compliance with each WSP's published uplink noise contribution limit at the donor.
  4. Per-carrier KPI thresholds (RSRP, RSRQ, SINR, PCI dominance) verified with each WSP and documented in the ATP.
  5. Dynamic adjustment of uplink and downlink independently per band per MNO, including continuous adaptation to changing outdoor macro parameters.
  6. Advanced echo cancellation to maintain cellular quality of service.
  7. Active distribution. In-line amplifiers are not acceptable.
- D. Acceptable Manufacturers – Cellular:
1. Nextivity – SHIELD or Q4000c platforms.
  2. CommScope – OneCell or ERA platforms.
  3. SOLiD – ALLIANCE platform.
  4. Corning – Everon platform.
  5. JMA Wireless.
  6. Owner-approved equivalent.
- E. WSP Coordination:
1. The cellular system shall not be energized without prior WSP acceptance and a retransmission agreement with each participating carrier.
  2. The Design-Builder is responsible for obtaining all WSP approvals and ensuring the RF design adapts to each carrier's requirements throughout the Project. Costs and schedule risks associated with WSP approval are the Design-Builder's responsibility.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION AND PRE-INSTALLATION SURVEY**

- A. The Design-Builder shall conduct a comprehensive on-site survey prior to start of design, including:
1. Location-specific RF measurements of existing public-safety signal levels at a minimum of twenty (20) representative locations per floor.
  2. Location-specific RF measurements of existing commercial cellular signal levels (where cellular coverage is included in the OPR), per WSP and per band.
  3. Confirmation of equipment-room availability, power, telecommunications grounding, HVAC, and pathway feasibility for the proposed ERCES head-end and remote locations.
  4. Verification of structural feasibility for donor antenna mounting, including roof access, structural attachment, and lightning protection coordination.

5. Identification of any building conditions that would prevent achievement of the performance requirements of Article 1.07. Issues shall be documented in writing to the Owner during the Schematic Design phase.
- B. By starting design and submitting the Schematic Design package, the Design-Builder confirms that the existing conditions are suitable for the work of this Section, subject only to the issues documented in writing per Paragraph A.5 above.

### 3.02 INSTALLATION

- A. Install the ERCES in accordance with NFPA 70 (NEC), NFPA 72, NFPA 1225, 2024 IFC Section 510, UL 2524, the manufacturer's published instructions, the approved Construction Documents, and the UL 2524 system listing.
- B. Provide FCC signal-booster registration per 47 CFR 90.219(d) prior to energization.
- C. Install all equipment, cabling, antennas, grounding, and lightning protection per the approved Construction Documents and manufacturer's instructions. Where the Construction Documents conflict with the manufacturer's instructions, notify the Owner and AHJ for resolution prior to installation.
- D. Mount equipment securely and independently of other building systems, with seismic bracing where required by local code.
- E. **Cable Routing:** Cable pathways shall be designed and installed to provide the survivability required by Article 1.07.E.2, to maintain manufacturer-required clearances from other building systems, and to allow future maintenance and expansion access.
- F. **Coordination with Other Trades:** Field coordinate the installation of head-end equipment, remote units, and cable pathways to ensure compatibility with structural, mechanical, electrical, plumbing, fire protection, and architectural finishes.
- G. **Penetrations and Firestopping:** All penetrations of fire-rated assemblies shall be firestopped per Section 07 84 00. Firestopping is included in the Work of this Section unless specifically furnished under another Contract.

### 3.03 GROUNDING AND BONDING

- A. Ground all donor antennas, cable shields, and active equipment to eliminate shock hazards and to minimize ground loops, common-mode returns, noise pickup, cross-talk, and other RF impairments.
- B. Bond all rack-mounted equipment to the Common Bonding Network within the equipment rack or cabinet using an equipment bonding jumper kit and minimum #6 AWG insulated copper bonding conductor with a green jacket (or green with yellow stripe) and compression-style lugs.
- C. Provide a separate grounding conductor from each donor antenna and lightning-protection device to the Telecommunications Grounding Busbar (TGB), per manufacturer recommendations.
- D. Grounding and bonding shall comply with ANSI/TIA-607, NFPA 70 Article 250, and the equipment manufacturer's instructions.

### 3.04 LABELING AND IDENTIFICATION

- A. Label all devices, cables, splitters, couplers, and active equipment. Labeling shall be machine-made; hand labeling is not acceptable.
- B. Minimum device label text height: 0.25 inch.
- C. Show all labels on the as-built drawings. Labeling scheme shall be coordinated with and acceptable to the Owner.
- D. **Label Scheme** ("XXXX" is a sequential 4-digit number starting at 0001):
  - 1. Cable: ERCES-C-XXXX.
  - 2. Antenna: ERCES-A-XXXX.
  - 3. Couplers and Taps: ERCES-S-XXXX.
  - 4. Active Equipment: ERCES-E-XXXX.
  - 5. Cellular-dedicated components (if provided): substitute "CELL-" in place of "ERCES-".

### 3.05 FIRE ALARM INTEGRATION AND SYSTEM MONITORING

- A. The ERCES shall interface with the FACP to annunciate, at a minimum, the following supervisory signals, per NFPA 1225 Section 18.14.1.1 and NFPA 72 Chapter 10:
  - 1. Antenna malfunction.
  - 2. Signal booster (BDA) failure.
  - 3. Active RF-emitting device failure (oscillation).
  - 4. Loss of normal AC power.
  - 5. Low battery condition.
  - 6. Charger failure.
  - 7. Communication link failure.
- B. Monitoring of the integrity of power sources and pathways shall comply with NFPA 72 Chapter 10.
- C. Provide a sign at the FACP with the name and telephone number of the local Fire Department, indicating that the Fire Department shall be notified of any ERCES failure extending past the 2-hour time limit.
- D. Remote access to the ERCES shall comply with NFPA 72-2025 Chapter 11 cybersecurity provisions.

### 3.06 FIELD QUALITY CONTROL – ACCEPTANCE TESTING

- A. Acceptance testing shall be performed by personnel meeting the requirements of Article 1.06.C.3, in the presence of the fire code official, in accordance with the AHJ-accepted ATP, 2024 IFC Section 510.5, NFPA 1225 Chapter 18, and NFPA 72.
- B. Notify the Owner, CM, and AHJ in writing at least two (2) weeks prior to the start of testing, and provide three (3) copies of the AHJ-accepted ATP.
- C. Final testing shall not be performed until the building is fully enclosed (roof, doors, windows, interior walls, and ceilings in place).



- D. **Pre-Test Requirements:** All licenses (including FCC signal-booster registration), system documentation, and test plans shall be current. Record all equipment settings before test and after any adjustments. Test equipment shall be allowed to stabilize in the test environment for a minimum of thirty (30) minutes prior to calibration.
- E. RF Signal-Strength and DAQ Test:
1. Tests shall be conducted using a calibrated portable radio of the latest brand and model used by the public agency, talking through the agency's radio communication system.
  2. Take DAQ readings simultaneously with RF signal-strength measurements. Minimum acceptable DAQ is 3.0 per 2024 IFC Section 510.4.1.2.
  3. Hold the antenna in a vertical position at three (3) to four (4) feet above the floor to simulate portable radios worn on the belt or turnout coat pocket.
  4. Measure and record gain values of all amplifiers.
  5. Use a spectrum analyzer to verify that no spurious oscillations are generated by the signal boosters.
- F. **20-Grid Test (Primary, per 2024 IFC Section 510.5.3):**
1. Divide each floor into a minimum of twenty (20) approximately equal test areas.
  2. Select a spot approximately at the center of each test area. Key the radio to verify two-way communication to and from the outside through the public-agency radio system. The selected spot represents the entire test area; prospecting for a better spot is not permitted.
  3. A maximum of two (2) non-adjacent test areas per floor shall be allowed to fail the 20-grid test.
- G. 40-Grid Retest:
1. If three (3) or more (or greater than 5 percent) test areas fail the 20-area test, divide the floor into forty (40) equal test areas.
  2. In the 40-area test, a maximum of four (4) non-adjacent areas may fail.
  3. If the system fails the 40-area test, the Design-Builder shall alter the system to meet the 95 percent / 99 percent coverage requirement at no additional cost to the Owner.
- H. Cable Testing:
1. Submit test results for all coaxial segments, including Return Loss (RL), Distance-to-Fault (DTF), and Passive Intermodulation (PIM).
  2. Submit OTDR test results for all fiber runs.
- I. **FACP Interface Testing:** Test all supervisory signals listed in Article 3.05 for correct annunciation at the FACP. Document in the ATP report.
- J. Documentation of Results:
1. Present results as building floor plans with each floor overlaid with the test grid. Show on each grid cell the measured uplink signal, downlink signal, and DAQ.

2. Indicate weather conditions at the time of testing (temperature, humidity, precipitation).
  3. Save spectrum-analyzer screenshots for every designated grid space with frequency span plus or minus 20 MHz relative to the center frequency.
- K. Certificate of Compliance and AHJ Acceptance:
1. Provide a Certificate of Compliance signed by the Engineer of Record upon completion of site installation, certifying compliance with the Contract Documents, NFPA 1225, 2024 IFC Section 510, and UL 2524.
  2. Report all test results in writing to the AHJ. Successful test completion is required prior to issuance of the Certificate of Occupancy.
  3. Repeat testing whenever a design change is made to the system that changes technical performance or coverage. Repeat testing is the responsibility of the Design-Builder where the change is required to satisfy the performance criteria of Article 1.07.
- L. Deficiencies discovered with equipment provided under this Section, including equipment dead on arrival or failing during burn-in, shall be repaired or replaced at no cost to the Owner.

### 3.07 TRAINING

- A. The Design-Builder shall provide two (2) training sessions, each a minimum of four (4) hours, coordinated in advance with the Owner:
1. **Session 1 – System Operation and Testing:** accommodating up to four (4) attendees.
  2. **Session 2 – System Maintenance and Configuration:** accommodating up to four (4) attendees.
- B. Training shall be conducted by qualified personnel fully conversant in the equipment, materials, software, and overall operation of the installed system, utilizing the equipment provided at the Project site.
- C. Training shall be based on hands-on instruction to the greatest extent possible and shall include written handouts covering operation, routine maintenance, troubleshooting, NMS use, and annual-test procedures.
- D. Complete all training prior to Final Acceptance. Training shall be recorded and delivered to the Owner in digital format for future use.

### 3.08 ANNUAL INSPECTION AND TESTING

- A. The Design-Builder shall perform the first annual inspection and test within the warranty period at no additional cost to the Owner, per Article 1.10.C, NFPA 1225 Section 18.17, and 2024 IFC Section 510.6.
- B. Annual testing shall include:
1. The in-building 20-grid and 40-grid coverage tests per Article 3.06.
  2. Signal-booster gain verification against the value recorded at initial acceptance.

3. Load test of backup batteries and power supplies for one (1) hour minimum. If the battery shows symptoms of failure during the one-hour test, extend the test in one-hour increments until integrity is determined.
  4. Verification that all other active components operate within manufacturer's specifications.
  5. Verification of FACP supervisory signal annunciation per Article 3.05.
  6. Written test report submitted to the fire code official.
- C. The Design-Builder shall provide pricing for an annual maintenance and testing contract for years two (2) through five (5), as an add-alternate.

### **3.09 PROJECT RECORD DOCUMENTS**

- A. Submit in accordance with Section 27 05 00 for the complete system. Record drawings shall indicate all components of the installed systems, including routing of conduit, raceways, and cable.
- B. Drawings shall be coordinated with and referenced to the O&M manuals and related wiring diagrams. Floor plan drawings shall be at 1/8" = 1'-0" scale in AutoCAD format. Provide the Owner with a digital copy containing all final AutoCAD (DWG) drawing files of the entire system and the floor plans, plus PDF export.
- C. As-built drawings shall include donor antennas, grounding and lightning-protection details; cable routing, splitters, couplers, and coverage-antenna locations; active-component locations, layout, and configuration; FACP interface wiring; and a single-line block diagram of the as-installed system.
- D. Include the following in O&M manuals:
  1. Component operation manuals, including technical data sheets.
  2. Information for reordering replacement parts, with a replacement parts list.
  3. Recommended parts, tools, and instruments for testing and maintenance.
  4. Wiring diagrams and details, including system functional block diagrams, system schematics, and system wiring lists, with terminals identified to facilitate installation, operation, and maintenance.
  5. System operating instructions, providing a clear and concise description of operation with all information required to properly operate the equipment and system.
  6. Component service manual, including information for testing, repair, troubleshooting, assembly, disassembly, and required / recommended maintenance intervals.
  7. UL 2524 system listing documentation.
  8. FCC signal-booster registration confirmation.
  9. Accepted ATP reports and AHJ acceptance certificate.
  10. Manufacturer and Design-Builder warranty documents.
  11. Design narrative and stamped/sealed Construction Documents from the Engineer of Record.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

**END OF SECTION 28 48 00**

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
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## SECTION 311000 - SITE CLEARING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Protecting existing trees, shrubs, groundcovers, plants, and grass, to remain.
  - 2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on drawings.
  - 3. Clearing and grubbing.
  - 4. Removing above- and below-grade site improvements.
  - 5. Disconnecting, capping or sealing, and removing site utilities.
  - 6. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
  - 1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

#### 1.3 DEFINITIONS

- A. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

#### 1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

## **PART 2 - PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
  - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### **3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and in accordance with sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within fenced area.
  - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
  - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

### 3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
  - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
  - 4. Use only hand methods for grubbing within tree protection zone.
  - 5. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

### 3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

### 3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

**END OF SECTION 311000**



## SECTION 312000 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
  - 2. Excavating and backfilling for buildings and structures.
  - 3. Drainage course for slabs-on-grade.
  - 4. Subbase course for concrete walks and pavements.
- B. Related Sections include the following:
  - 1. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
  - 2. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
  - 3. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

#### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.

- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Geotextile.
  - 2. Controlled low-strength material, including design mixture.

#### 1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Geotechnical Testing Agency Qualifications: Owner will employ and pay a qualified, independent geotechnical testing laboratory to perform soil testing and inspection services during earthwork operations. Contractor shall be responsible for scheduling and coordination of these services.
- C. Preexcavation Conference: Before commencing earthwork, meet with representatives of governing authorities, Owner, Architect, Structural Engineer, consultants, Geotechnical Testing Agency and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each attendee.

#### 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated.
  - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
  - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

## **PART 2 - PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. General: Provide off-site borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.
- B. Satisfactory Soils: On site soils satisfactory to testing agency, containing less than 25% pulverized shale fragments, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, organics, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Silt, highly organic soils, wood, roots, trash, debris, and other soils and materials not acceptable to the testing agency.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

### **2.2 GEOTEXTILES**

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; as noted on drawings.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; as noted on the drawings.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect and maintain erosion and sedimentation controls during earthwork operations.
- C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

#### **3.2 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated utility trenches as temporary drainage ditches.
  - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

#### **3.3 EXPLOSIVES**

- A. Explosives: Do not use explosives.

#### **3.4 EXCAVATION FOR STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.6 EXCAVATION FOR UTILITY TRENCHES

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utilities follow below.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: 12 inches each side of pipe or conduit.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
  - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

### 3.7 SUBGRADE INSPECTION

- A. Notify testing agency when excavations have reached required subgrade.
- B. If testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Construction Manager, without additional compensation.

### 3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Geotechnical Engineer.
  - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Construction Manager.

### 3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring and bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.11 UTILITY TRENCH BACKFILL

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utility backfill, follow below.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- D. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.
- E. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- F. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit in non-paved areas.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit in paved areas.
- H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

- I. Place and compact final backfill of satisfactory soil to final subgrade elevation in non-paved areas.
- J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation in paved areas.

### 3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations in accordance with sections 3.13 and 3.14 and as follows:
  - 1. Under grass and planted areas, use satisfactory soil material or engineered fill.
  - 2. Under walks and pavements, use satisfactory soil material (excluding topsoil) or engineered fill.
  - 3. Under steps and ramps, use satisfactory soil material (excluding topsoil) or engineered fill.
  - 4. Under building slabs, use satisfactory soil material (excluding topsoil) or engineered fill.
  - 5. Under footings and foundations, use satisfactory (excluding topsoil) soil material or engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  - 1. Under structures, building slabs, steps, and pavements, including 10 feet beyond all such areas, compact each layer of backfill or fill soil material at 100 percent maximum dry density.

2. Under walkways, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent maximum dry density.
4. For utility trenches, compact each layer of initial and final backfill soil material at 100 percent maximum dry density.

### 3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Lawn or Unpaved Areas: Plus or minus 1 inch.
  2. Walks: Plus or minus 1/2 inch.
  3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

### 3.16 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
  1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
  1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

### 3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:



1. Where specified install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  2. Shape subbase and base course to required crown elevations and cross-slope grades.
  3. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry density.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry density.

### 3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  2. Place drainage course 6 inches or less in compacted thickness in a single layer.
  3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

### 3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

### 3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

1. Scarify or remove and replace soil material to depth as directed by Construction Manager; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus soil material offsite to a legal disposal site off Owner's property.
  1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Excavated pavements shall be considered waste material and shall not be incorporated into fills.

**END OF SECTION 312000**

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| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Hot-mix asphalt patching.
  2. Hot-mix asphalt paving.
  3. Hot-mix asphalt paving overlay.
  4. Asphalt surface treatments.
  5. Pavement-marking paint.
  6. Wheel Stops.
- B. Related Sections:
  1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
  2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
  3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
  4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

#### 1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

#### 1.4 SUBMITTALS

- A. Material Certificates: For each paving material, from manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Ohio Department of Transportation for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard DOT specifications do not apply to this section.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
    - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    - b. Review condition of subgrade and preparatory work.
    - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
    - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Prime Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
  - 2. Tack Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
  - 3. Asphalt Base Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
  - 4. Asphalt Surface Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, and 55 deg F for water-based materials, and not exceeding 95 deg F.

## **PART 2 - PRODUCTS**

### **2.1 AGGREGATES**

- A. General: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

### **2.2 ASPHALT MATERIALS**

- A. Asphalt Binder: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- B. Asphalt Cement: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- C. Prime Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications.
- D. Tack Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- E. Water: Potable.

### **2.3 AUXILIARY MATERIALS**

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Paving Geotextile: As specified on plans.
- C. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.
- D. Pavement-Marking Paint: ODOT Item 642.
  - 1. Color: White, Yellow, & Blue.
- E. Wheel Stops: Precast, air-entrained concrete, 3500-psi minimum compressive strength, see drawings for dimensions. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
  - 1. Dowels: 2 - Galvanized steel, minimum 1/2-inch diameter.

### **2.4 MIXES**

- A. Hot-Mix Asphalt: Use plant-mixed, hot-laid asphalt aggregate mixtures complying with the Ohio Department of Transportation Construction and Materials Specifications as indicated on the plans.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Proof rolling to be performed in presence of Architect or Construction Manager.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of asphalt.

#### **3.2 PATCHING**

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove all soft or unsatisfactory material. Recompact subgrade and any existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting against new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

#### **3.3 REPAIRS**

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
  - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/2 inch.
  - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
  - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
  1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
  1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
  1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.5 PAVING GEOTEXTILE INSTALLATION

- A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
  1. Protect paving geotextile from traffic and other damage and place next portion of the pavement section the same day.

### 3.6 HOT-MIX ASPHALT PLACING

- A. Asphalt shall be placed in accordance with the Ohio Department of Transportation Construction and Material Specifications and as indicated on the plans.
- B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  2. Place hot-mix asphalt surface course in single lift.

3. Spread mix at minimum temperatures as per the Ohio Department of Transportation Construction and Material Specifications.
  4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- C. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints Per ODOT standards.
  5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction within temperature specifications as set in the Ohio Department of Transportation Construction and Materials Specifications.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.



- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch (total of all combined base courses).
  - 2. Surface Course: Plus 1/4 inch, no minus.
  - 3. Total Thickness: Where total thickness is of asphalt material is 3" or less, total pavement thickness is to be plus or minus 1/4 inch.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age per manufacturers recommendations before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply per ODOT 642 Specifications to a minimum wet film thickness of 20 mils.

3.11 WHEEL STOPS

- A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels a minimum of 7 inches into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner is to engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow milled materials to accumulate on-site.

**END OF SECTION 321216**

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Driveways and roadways.
  - 2. Parking lots.
  - 3. Curbs and gutters.
  - 4. Walkways.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
  - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

#### 1.4 SUBMITTALS

- A. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
  - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials.
  - 2. Admixtures.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

3. Curing compounds.
4. Applied finish materials.

D. Jointing Plan

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications:
  1. Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
  2. Comply with ACI 330, "Guide for Design and Construction of Concrete Parking Lot" unless modified by requirements in the Contract Documents.
  3. Comply with ACI 325, "Design of Jointed Concrete Pavements for Streets and Local Roads" unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete producer.
    - d. Concrete pavement subcontractor.

## 1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

### **2.2 FORMS**

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

### **2.3 STEEL REINFORCEMENT**

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- C. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

### **2.4 CONCRETE MATERIALS**

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: ASTM C 150, Type I., gray. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10

years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material when steel reinforcement is called out in exterior installations.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. Dry, delivered pre-wetted and soaked.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM 1752 Vinyl full depth, with joint sealant.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
  1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28 Days): 4,500 psi, unless otherwise indicated on the drawings.
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.

3. Slump Limit: 4 inches, or up to 5 inches with the use of a water-reducing chemical admixture.
  - C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
    1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
  - D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
  - E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
    1. Use water-reducing admixture in concrete, as required, for placement and workability.
    2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements and as follows:
    1. Fly Ash or Pozzolan: 25 percent.
- 2.8 CONCRETE MIXING
- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
    1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades
  1. Proof rolling to be performed in presence of Architect or Construction Manager.
  2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### 3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain 2" minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, or through locations of intended contraction or isolation joints, unless otherwise indicated.
  - 2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.
- C. Isolation (expansion) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.



1. Locate expansion joints at intervals of not more than 30 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
6. Apply joint sealant / caulk.
7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For thickness 5 inches or less construct contraction joints for a depth equal to at least one-third of the concrete thickness, for thickness greater than 5 inches construct contraction joints for a depth equal to at least one-quarter of the concrete thickness, as follows or match jointing of existing adjacent concrete pavement:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: (*Not permitted on sidewalks*). Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- D. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- E. Comply with ACI 301 and ASTM C94, requirements for measuring, mixing, transporting, and placing concrete.

- F. A one time add of water to concrete during delivery or at Project site is permitted but the water to cementitious material ratio must not be violated.
- G. Do not add water to fresh concrete after testing.
- H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.
- L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature,

provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

### 3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated prior to placement and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall

within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.9 TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unlevel straightedge not to exceed 1/4 inch.
4. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
5. Joint Spacing: 3 inches.
6. Contraction Joint Depth: Plus 1/4 inch, no minus.
7. Joint Width: Plus 1/8 inch, no minus.

### 3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
  - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
  - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project

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|----------------------------------------------------------------------|--|-------------------------------------|

identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

### END OF SECTION 321313

## SECTION 323113 - CHAIN LINK FENCES AND GATES

### 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. Chain-Link Fences
  - 2. Gates
- B. Related Sections include the following:
  - 1. Division 31 Section "Earth Moving" for site excavation, fill, and backfill where chain-link fences and gates are located.

#### 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
  - 1. Fence and gate posts, rails, and fittings.
  - 2. Chain-link fabric, reinforcements, and attachments.
  - 3. Gates and hardware.
  - 4. Gate operators, including operating instructions.
  - 5. Accessories: Privacy slats.
  - 6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. UL Standard: Provide gate operators that comply with UL 325.
- C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Insert height, limited to 12 feet (3.6 m). Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
1. Steel Wire Fabric: Polymer-coated wire with a diameter of 0.148 inch (3.76 mm).
    - a. Mesh Size: 2 inches (50 mm).
    - b. Polymer Coating: ASTM F 668, Class 2b over metallic-coated steel wire.
      - 1) Color: Black, complying with ASTM F 934.
    - c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
  2. Selvage: Knuckled at both selvages.

### 2.2 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:
1. Group: IA, round steel pipe, Schedule 40 IC, round steel pipe, yield strength 50,000 psi (345 MPa).
  2. Fence Height: As indicated on drawings.
  3. Strength Requirement: Heavy industrial according to ASTM F 1043.
  4. Post Diameter and Thickness: According to ASTM F 1083.
  5. Post Size and Thickness: According to ASTM F 1083.
    - a. Top Rail: 1.66 inches.
    - b. Steel Line Post:
      - 1) Height up to and including 6 feet – 1.900 inches
      - 2) Height over 6 feet – 2.375 inches
    - c. Steel End, Corner and Pull Post:
      - 1) Height up to and including 6 feet – 2.375 inches
      - 2) Height over 6 feet – 2.875 inches
    - d. Swing Gate Post for fabric height up to and including 6 feet:: According to ASTM F 900 and as follows:
      - 1) Gate leaf width up to and including 4 feet: 2.375 inches OD pipe, 3.11-lb/ft weight
      - 2) Gate leaf width over 4 feet to 10 feet: 2.875 inches OD pipe, 4.64-lb/ft weight.
    - e. Swing Gate Post for fabric height over 6 feet:: According to ASTM F 900 and as follows:

- 1) Gate leaf width up to and including 6 feet: 2.875 inches OD pipe, 4.64-lb/ft weight
- 2) Gate leaf width over 4 feet to 10 feet: 4.000 inches OD pipe, 8.65-lb/ft weight.

6. Coating for Steel Framing:

a. Metallic Coating:

- 1) Type I Steel Pipe: Type A, consisting of not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.
- 2) Type II Steel Pipe: Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, of 30 plus or minimum 15 micrograms, and a clear, verifiable polymer film of 0.5 plus 0.2 mils. Type B inside with a minimum of 0.9 oz of zinc per sq.ft.

b. Polymer coating over metallic coating.

2.3 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along bottom of fence fabric.

B. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

1. Metallic Coating: Type II, zinc coated (galvanized), with the following minimum coating weight:
  - a. Class 1: Not less than 0.8 oz./sq. ft. (244 g/sq. m) of uncoated wire surface.
  - b. Matching chain-link fabric coating weight.

2.4 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for single and double swing gate types.

1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:

1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
2. Leaf Width: As indicated on drawings.
3. Frame Members:
  - a. Tubular Steel: 1.66 inches (42 mm) round for gate heights up to and including 6 feet; 1.90 inches (48 mm) round for gate heights over 6 feet.



C. Frame Corner Construction:

1. Welded and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

D. Hardware: Provide galvanized and coated hardware matching the fence specs as necessary and as follows:

1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
2. Latch: Forked type or plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.
3. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
4. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

2.5 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
  - a. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; 0.148-inch- (3.76-mm-) diameter, mill-finished wire.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

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|----------------------------------------------------------------------|--|-------------------------------------|

2. Match Fence materials.

## 2.6 PRIVACY SLATS

- A. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips, and fins for increased privacy factor.
- B. Color: Black.

## 2.7 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.
  1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

## 2.8 POLYMER FINISHES

- A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide fence components with polymer coating.
- B. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 2b.
- C. Metallic-Coated Steel Framing and Fittings: Comply with ASTM F 626 and ASTM F 1043 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.
  1. Polymer Coating: Not less than 10-mil- (0.254-mm-) thick PVC finish.
- D. Color: Match chain-link fabric, complying with ASTM F 934.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
  1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

### 3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil.
  - 1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
  - 2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than the post bottom, with bottom of posts set not less than 36 inches below finish grade surface.
- B. Post Setting: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- D. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
  - 1. Locate horizontal braces at midheight of fabric 6 feet (1.83 m) or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric.
  - 1. Top Tension Wire: Install tension wire through post cap loops.
  - 2. Bottom Tension Wire: Install tension wire within 6 inches (150 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.

- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Bottom Rails: Install, spanning between posts.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  - 1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Privacy Slats: Install slats in vertical direction, securely locked in place.

### 3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.6 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

### END OF SECTION 323113

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## SECTION 331100 - WATER DISTRIBUTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section includes water-distribution piping and related components outside of the building for domestic, fire, and combined water service mains.

#### 1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PP: Polypropylene plastic.
- C. PVC: Polyvinyl chloride plastic.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. All work must be done in compliance with the local water jurisdiction having authority, the local building department, the governing fire department, and all applicable state and national codes. If local codes conflict with project specifications or project plans the contractor should contact the Construction Manager.
- B. Minimum working pressures: The following are minimum pressure requirements for piping and specialties:
  - 1. Domestic Water Service: 200 psi

2. Fire Protection Water Service: 250 psi

C. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

D. Piping materials shall bear label, stamp, or other markings of specified testing agency.

E. 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.

F. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

G. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

H. NSF Compliance:

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

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| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

## 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of water-distribution service without Construction Manager's permission.

## 1.8 COORDINATION

- A. Coordinate connection to water main with utility company.
- B. Coordinate water main installation with other utility work.

## PART 2 - PRODUCTS

### 2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: Class 52 minimum, 250 psi minimum pressure rating, AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated. The interior of the pipe shall be cement-mortar lined and seal coated in accordance with AWWA C104. The exterior of all pipe shall receive wither coal tar or asphalt base coating a minimum of 1 mil thick.
  - 1. Mechanical-Joint, Ductile-Iron Fittings: 250 psi minimum pressure rating, AWWA C110, ductile-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile-iron glands, rubber gaskets, and Core 10 Alloy Steel only bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: Class 52 minimum, 250 psi minimum pressure rating, AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. The interior of the pipe shall be cement-mortar lined and seal coated in accordance with AWWA C104. The exterior of all pipe shall receive wither coal tar or asphalt base coating a minimum of 1 mil thick.
  - 1. Push-on-Joint, Ductile-Iron Fittings: 250 psi minimum pressure rating, AWWA C110, ductile-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.

### 2.2 GATE VALVES

- A. AWWA, Gate Valves:
  - 1. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
    - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

- 1) Standard: AWWA C509.
- 2) Minimum Pressure Rating: 250 psig.
- 3) End Connections: Push on or mechanical joint.
- 4) Interior Coating: Complying with AWWA C550.

## 2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

### A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.
  - a. Standard: MSS SP-60.
  - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
  - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

### B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

### C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

## 2.4 CHECK VALVES

### A. AWWA Check Valves:

1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
  - a. Standard: AWWA C508.
  - b. Pressure Rating: 250 psig.

## 2.5 DETECTOR CHECK VALVES

### A. Detector Check Valves:

1. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
  - a. Standards: UL 312 and FMG approved.
  - b. Pressure Rating: 250 psig.



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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- c. Bypass Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
  - 2. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
    - a. Standards: UL 312 and FMG approved.
    - b. Pressure Rating: 250 psig.

## 2.6 WATER METERS

- A. Water meters are to be per the requirements of the authority having jurisdiction.

## 2.7 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies:
  - 1. As required per the jurisdiction having authority.
- B. Double-Check, Detector-Assembly Backflow Preventers:
  - 1. As required per the jurisdiction having authority.

## 2.8 WATER METER BOXES

- A. As required per the jurisdiction having authority.
- B. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

## 2.9 CONCRETE VAULTS

- A. As required per the jurisdiction having authority.
- B. Description: Precast, reinforced-concrete vault.
  - 1. Drain: Provide a gravity drain line from the pit to a suitable open daylight drainage point or storm sewer; or provide a sump pump and appurtenances with associated piping to suitable outlet point.

## 2.10 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
  - 1. As required per the jurisdiction having authority.

2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant barrel shall have safety breakage feature above the ground line. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure so that the valve remains closed should the barrel be broken off.
  - a. Standard: AWWA C502.
  - b. Pressure Rating: Minimum 250 psig.
  - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
  - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
  - e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.

## 2.11 FIRE DEPARTMENT CONNECTIONS

### A. Fire Department Connections:

1. As required per the jurisdiction having authority.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

#### A. General:

1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

#### B. Excavation For Utility Trenches:

1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

#### C. Utility Trench Backfill:

1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.

3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
  - a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
    - 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    - 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
  - b. Type C and D. Backfill Type C and D conduits as follows:
    - 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    - 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.

11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

### 3.2 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
  1. Make connections larger than NPS 2 with tapping machine in accordance with the jurisdiction having authority.
  2. Make connections NPS 2 and smaller with drilling machine in accordance with the jurisdiction having authority.
- B. Comply with NFPA 24 for fire-service-main piping installation.
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- D. Bury piping with depth of cover over top at least 48 inches below finish grade.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
  1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

### 3.3 ANCHORAGE INSTALLATION

- A. Anchorage, General: Only the following may be used for anchorages and restrained-joint types:
  1. Concrete thrust blocks.
  2. Locking mechanical joints.
  3. Set-screw mechanical retainer glands.
  4. Bolted flanged joints.
  5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.4 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

### 3.5 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

### 3.6 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

### 3.7 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

### 3.8 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top 1 inch above surface.

### 3.9 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.10 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints and thrust blocks, and support in upright position.
- B. AWWA Fire Hydrants: Comply with AWWA M17.

3.11 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.

3.12 CONNECTIONS

- A. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve, or service clamp and corporation valve.
- B. Connect water-distribution piping to interior domestic water and fire-suppression piping if in place. Coordinate connection with plumber.
- C. Connect drainage piping from concrete vault drains to storm-drainage system swale or pipe.

3.13 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
  - 2. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the contractors expense.
- C. Prepare reports of testing activities.

3.14 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
- b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

**END OF SECTION 331100**

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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

## **SECTION 333100 – SANITARY SEWERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
  - 1. Cleanouts.
  - 2. Precast concrete manholes.

#### **1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PP: Polypropylene plastic.
- C. PVC: Polyvinyl chloride plastic.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Nonpressure, Piping Pressure Rating: at least equal to system test pressure.

#### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Pipe.
  - 2. Cleanouts.
- B. Shop Drawings: For the following:
  - 1. Manholes: Include plans, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, and locations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings (as necessary): Show system piping in elevation view. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch



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|----------------------------------------------------------------------|--|-------------------------------------|
| Warren County Career Center<br>Medical Academy Addition<br>263306.00 |  | Bid / Permit Documents<br>9/15/2026 |
|----------------------------------------------------------------------|--|-------------------------------------|

equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and locations of other utilities crossing system piping.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

#### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Construction Manager 's permission.

### PART 2 - PRODUCTS

#### 2.1 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
  - 1. NPS 3 to NPS 6: SDR 35.
  - 2. NPS 8 to NPS 12: SDR 42.
  - 3. Gaskets: ASTM F 477, elastomeric seals.

#### 2.2 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with integral bell-and-spigot rubber gasketed joints per ASTM D 3212.
- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with integral bell-and-spigot rubber gasketed joints per ASTM D 3212.

#### 2.3 CLEANOUTS

- A. PVC with cast iron adaptor: Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Include cast iron adaptor and threaded brass closure plug.

## 2.4 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: Precast manhole section joints shall be formed entirely of concrete employing a round, wedge shaped profile gasket, and when assembled shall be self centering and make a uniform watertight joint conforming to ASTM C 443. The joint shall also be sealed with a bituminous mastic joint sealing compound.
7. Resilient Pipe Connectors: Sewer pipe to manhole connections on all sanitary sewers shall be flexible and watertight. Sewer pipe shall be sealed in the manhole section pipe openings with a resilient connector meeting the requirements of ASTM C 923. The connection may be any of the following types:
  - a. Rubber sleeve with stainless steel banding
  - b. Rubber gasket compression

Resilient connector shall be cast integrally into the wall of the manhole section at the time of manufacture, or, shall be installed by mechanical means in openings cut into manhole wall per ASTM C 923.

8. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; Ductile Iron; or Cast Aluminum. Steps shall be wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Steps shall be equally spaced. Whenever possible steps shall not be placed directly above manhole flow channel. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
10. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil minimum thickness applied to interior surfaces.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER." Manhole Frames and Covers shall be heavy duty.
  - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

## 2.5 CONCRETE

- A. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: minimum fall of 0.10 foot across manhole.
  2. Benches: Concrete, sloped to drain into channel.
- B. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.6 MISCELLANEOUS MATERIALS

- A. Paint: SSPC-Paint 16.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. General:
1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
  2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.
- B. Excavation For Utility Trenches:
1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
  2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
  3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
  4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.
- C. Utility Trench Backfill:
1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
  2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.

3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
  - a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
    - 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    - 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
  - b. Type C and D. Backfill Type C and D conduits as follows:
    - 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    - 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.

11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, contact Construction Manager.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:
  1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
  2. Install piping with 36-inch minimum cover unless otherwise indicated.
  3. Install ABS sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
  4. Install PVC sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Preparatory to making pipe joints, all joint surfaces shall be cleaned of all dirt, dust, and foreign matter and shall be dry, smooth, and free of imperfections before placing joining materials. Gaskets, lubricants, primers, adhesives, or other joining materials shall be used as recommended by the pipe or joint manufacturer's specifications. Generally, lubricants and primers and adhesives shall be placed on both the bell and spigot portions of the joint. The pipe shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness required. In the event that pipe previously laid is disturbed due to any cause, it shall be removed and relaid.
- B. Joints that show leakage will not be accepted. If after backfilling and inspection, any joints are found to be allowing groundwater to enter the sewer, such joints shall be sealed by the contractor at no cost to the owner.

- C. No fittings (except service wyes and repair couplings) shall be allowed in gravity sewers. Open ends of wyes shall be plugged or sealed until service laterals are installed.
- D. Join gravity-flow, nonpressure, drainage piping according to the following:
  - 1. Join ABS sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
  - 2. Join PVC sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
  - 3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

### 3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

### 3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use medium-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use heavy-duty, top-loading classification cleanouts in paved foot-traffic, vehicle-traffic, roads, and service areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in asphalt or concrete pavement with tops flush with pavement surface.

### 3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye

fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
  3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to **[grease]** **[oil]** **[sediment]** interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

### 3.8 PAINTING

- A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:
1. Precast Concrete Manholes: All interior.

### 3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate report for each system inspection.
  2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.

- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice. If authorities having jurisdiction do not have published procedures, or if sewer does not fall under a jurisdiction, perform tests as follows:
  4. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
  5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- C. Manholes: Perform hydraulic test according to ASTM C 969.
- D. Leaks and loss in test pressure constitute defects that must be repaired.
- E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.10 CLEANING

- A. Clean interior of piping of dirt and superfluous material.

### END OF SECTION 333100



## **SECTION 334100 - STORM DRAINAGE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
  - 1. Cleanouts.
  - 2. Drains, Catch Basins, Inlets, & Headwalls.
  - 3. Precast concrete & Cast-in-place concrete manholes.

#### **1.3 DEFINITIONS**

- A. PE: Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.
- C. ODOT: Ohio Department of Transportation

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

#### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Pipe.
  - 2. Cleanouts.
  - 3. Trench Drains.
- B. Shop Drawings: For the following:
  - 1. Manholes: Include plans, sections, details, and frames and covers.
  - 2. Catch Basins, Headwalls and Stormwater Inlets. Include plans, sections, details, and frames, covers, and grates.
  - 3. Stormwater Detention Structures: Include plans, sections, details, frames, grates, and covers.

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- C. Coordination Drawings: Show pipe sizes, and locations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings (as necessary): Show system piping in elevation view. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and locations of other utilities crossing system piping.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins, headwalls, and stormwater inlets according to manufacturer's written rigging instructions.

#### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Construction Manager 's permission.

### PART 2 - PRODUCTS

#### 2.1 GENERAL:

- A. Public Roadway Culverts: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type A Conduits.
- B. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
- C. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.
- D. Private Drive Pipes and Bikeways: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.

2.2 ALUMINIZED CORRUGATED METAL PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.3 PE PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.4 PVC PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.
- B. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.5 REINFORCED CONCRETE PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.6 DUCTILE IRON PIPE

- A. Per ODOT 748.01 conforming to ANSI/AWWA C151/A21.51, service and extra-heavy classes, for gasketed joints.
- B. Gaskets: ANSI/AWWA C111/A21.11, rubber, compression type, thickness to match class of pipe.

2.7 CLEANOUTS

- A. PVC with cast iron adaptor: Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Include cast iron adaptor and threaded brass closure plug.

2.8 DRAINS

- A. Yard Drains: As noted on the Drawings.
- B. Trench Drains: As noted on the Drawings.

## 2.9 MANHOLES

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
1. Diameter: 48 inches minimum, unless otherwise indicated on the drawings.
  2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  3. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
  4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; Ductile Iron; or Cast Aluminum. Steps shall be wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Steps shall be equally spaced. Whenever possible steps shall not be placed directly above manhole flow channel. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
  5. Manhole Frames and Covers: Include lettering cast into cover, using wording equivalent to "STORM SEWER."
    - a. Frames and Covers must be heavy duty

## 2.10 CONCRETE

- A. General: Cast-in-place concrete according to the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings

## 2.11 CATCH BASINS

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
1. See drawings for schedule of specific types of catch basins
  2. Frames and Grates:
    - a. Are to be heavy duty.
    - b. Are to be ADA compliant.
    - c. Are to be Bicycle safe.

## 2.12 STORMWATER DETENTION STRUCTURES

- A. As indicated on the Drawings and Per the jurisdiction having authority.

## 2.13 PIPE INLETS AND OUTLETS

- A. Headwalls: Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Rock Channel Protection (Riprap): Per the latest version of the ODOT Construction and Material Specifications and as indicated on the Drawings.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

A. General:

1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

B. Excavation For Utility Trenches:

1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:

1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
  - a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
    - 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction

- equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
- 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
- b. Type C and D. Backfill Type C and D conduits as follows:
- 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
  - 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
  9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 312000.
  10. Coordinate backfilling with utilities testing.
  11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
  12. Place and compact final backfill of satisfactory soil material to final subgrade.

### 3.2 PIPING INSTALLATION

- A. All installation shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, contact architect.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
  - 2. Install piping with 12 inches minimum cover, unless otherwise indicated on the drawings. Notify architect if less than 12 inches of cover will exist.
  - 3. During construction protect installed piping from damage. Maintain manufacturers recommended minimum cover.

### 3.3 PIPE JOINT CONSTRUCTION

- A. All joint construction shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.
- B. Join dissimilar pipe materials with pressure-type couplings, or concrete collar.

### 3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use medium-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use heavy-duty, top-loading classification cleanouts in paved foot-traffic, vehicle-traffic, roads, and service areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in asphalt or concrete pavement with tops flush with pavement surface.

### 3.5 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
  - 1. Use medium-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
  - 2. Use heavy-duty, top-loading classification drains in paved foot-traffic, vehicle-traffic, roads, and service areas.
- B. Install per manufacturer's written recommendations.

### 3.6 MANHOLE INSTALLATION

- A. General: Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.

- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

### 3.7 CATCH BASIN INSTALLATION

- A. General: Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Set frames and grates to elevations indicated.

### 3.8 STORMWATER INLET AND OUTLET INSTALLATION

- A. General: Installation of Headwalls and Rock Channel Protection shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.

### 3.9 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

### 3.10 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

### 3.11 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
  - 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 3. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.



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- C. Replace defective piping using new materials, and repeat testing until defect is within allowances specified.

### 3.12 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

**END OF SECTION 334100**