

# PROJECT MANUAL – VOL 2 CONSTRUCTION DOCUMENTS

## LITTLE ROCK EYE CLINIC – WEST LITTLE ROCK, ARKANSAS

July 8, 2026



Architect  
WER Architects

Civil Consultants  
Joe White & Associates, Inc.

Structural Consultants  
Live Oak Engineering

Mechanical/Electrical/Plumbing/Fire Protection  
Insight Engineering

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ARCHITECTS

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## TABLE OF CONTENTS

# **VOLUME I**

### **DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS**

|         |                                       |
|---------|---------------------------------------|
| 00 0105 | CERTIFICATIONS PAGE                   |
| 00 0110 | TABLE OF CONTENTS                     |
| 00 2100 | INSTRUCTIONS TO BIDDERS               |
| 00 2113 | SUPPLEMENTARY INSTRUCTIONS TO BIDDERS |
| 00 3100 | AVAILABLE PROJECT INFORMATION         |
| 00 5200 | AGREEMENT FORM                        |
| 00 6000 | PERFORMANCE BOND AND PAYMENT BOND     |
| 00 6200 | CONSENT OF SURETY                     |
| 00 6300 | RELEASE OF CLAIMS                     |
| 00 6325 | SUBSTITUTION REQUEST FORM             |
| 00 7200 | GENERAL CONDITIONS                    |
| 00 7300 | SUPPLEMENTARY CONDITIONS              |

### **DIVISION 01 -- GENERAL REQUIREMENTS**

|         |                                                |
|---------|------------------------------------------------|
| 01 1000 | SUMMARY                                        |
| 01 2000 | PRICE AND PAYMENT PROCEDURES                   |
| 01 2100 | ALLOWANCES                                     |
| 01 2200 | UNIT PRICES                                    |
| 01 2300 | ALTERNATES                                     |
| 01 2500 | SUBSTITUTION PROCEDURES                        |
| 01 3000 | ADMINISTRATIVE REQUIREMENTS                    |
| 01 3216 | CONSTRUCTION PROGRESS SCHEDULE                 |
| 01 3340 | DELEGATED DESIGN DEFERRED SUBMITTAL PROCEDURES |
| 01 5000 | TEMPORARY FACILITIES AND CONTROLS              |
| 01 6000 | PRODUCT REQUIREMENTS                           |
| 01 7000 | EXECUTION AND CLOSEOUT REQUIREMENTS            |
| 01 7800 | CLOSEOUT SUBMITTALS                            |

### **DIVISION 02 -- EXISTING CONDITIONS**

|         |                  |
|---------|------------------|
| 02 2000 | SITE PREPARATION |
|---------|------------------|

### **DIVISION 03 -- CONCRETE**

|         |                         |
|---------|-------------------------|
| 03 3000 | CAST-IN-PLACE CONCRETE  |
| 03 3511 | CONCRETE FLOOR FINISHES |

### **DIVISION 04 -- MASONRY**

|         |                                |
|---------|--------------------------------|
| 04 0511 | MASONRY MORTARING AND GROUTING |
| 04 2000 | UNIT MASONRY                   |
| 04 2200 | CONCRETE UNIT MASONRY          |
| 04 7200 | CAST STONE MASONRY             |
| 04 7300 | MANUFACTURED STONE MASONRY     |

## **DIVISION 05 -- METALS**

|         |                           |
|---------|---------------------------|
| 05 1200 | STRUCTURAL STEEL FRAMING  |
| 05 2100 | STEEL JOIST FRAMING       |
| 05 3100 | STEEL DECKING             |
| 05 4000 | COLD FORMED METAL FRAMING |
| 05 5000 | METAL FABRICATIONS        |
| 05 5133 | METAL LADDERS             |
| 05 7000 | DECORATIVE METAL          |

## **DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES**

|         |                             |
|---------|-----------------------------|
| 06 1000 | ROUGH CARPENTRY             |
| 06 4100 | ARCHITECTURAL WOOD MILLWORK |

## **DIVISION 07 -- THERMAL AND MOISTURE PROTECTION**

|            |                                      |
|------------|--------------------------------------|
| 07 1113    | BITUMINOUS DAMPPROOFING              |
| 07 2100    | THERMAL INSULATION                   |
| 07 2119    | FOAMED-IN-PLACE INSULATION           |
| 07 2500    | WEATHER BARRIERS                     |
| 07 4213    | METAL WALL PANELS                    |
| 07 4213.23 | METAL COMPOSITE MATERIAL WALL PANELS |
| 07 4619    | STEEL SIDING                         |
| 07 5400    | THERMOPLASTIC MEMBRANE ROOFING       |
| 07 6200    | SHEET METAL FLASHING AND TRIM        |
| 07 7100    | ROOF SPECIALTIES                     |
| 07 7200    | ROOF ACCESSORIES                     |
| 07 8400    | FIRESTOPPING                         |
| 07 9200    | JOINT SEALANTS                       |

## **DIVISION 08 -- OPENINGS**

|         |                               |
|---------|-------------------------------|
| 08 1113 | HOLLOW METAL DOORS AND FRAMES |
| 08 1416 | FLUSH WOOD DOORS              |
| 08 3100 | ACCESS DOORS AND PANELS       |
| 08 4313 | ALUMINUM-FRAMED STOREFRONTS   |
| 08 4413 | GLAZED ALUMINUM CURTAIN WALLS |
| 08 7100 | DOOR HARDWARE                 |
| 08 7113 | AUTOMATIC DOOR OPERATORS      |
| 08 8000 | GLAZING                       |

## **DIVISION 09 -- FINISHES**

|         |                                              |
|---------|----------------------------------------------|
| 09 0561 | COMMON WORK RESULTS FOR FLOORING PREPARATION |
| 09 2116 | GYPSUM BOARD ASSEMBLIES                      |
| 09 3000 | TILING                                       |
| 09 5100 | ACOUSTICAL CEILINGS                          |
| 09 5423 | LINEAR METAL CEILINGS                        |
| 09 6500 | RESILIENT FLOORING                           |
| 09 6816 | CARPETING                                    |
| 09 7200 | WALL COVERINGS                               |
| 09 9113 | EXTERIOR PAINTING                            |
| 09 9123 | INTERIOR PAINTING                            |
| 09 9723 | CONCRETE AND MASONRY COATING                 |

## **DIVISION 10 -- SPECIALTIES**

|            |                                         |
|------------|-----------------------------------------|
| 10 1400    | SIGNAGE                                 |
| 10 1419    | DIMENSIONAL LETTER SIGNAGE              |
| 10 2601    | WALL AND CORNER GUARDS                  |
| 10 2800    | TOILET, BATH, AND LAUNDRY ACCESSORIES   |
| 10 4400    | FIRE PROTECTION SPECIALTIES             |
| 10 7316.13 | METAL CANOPIES                          |
| 10 8213    | EXTERIOR GRILLES, DIVIDERS, AND SCREENS |

## **DIVISION 11 -- EQUIPMENT**

NOT USED

## **DIVISION 12 -- FURNISHINGS**

|         |               |
|---------|---------------|
| 12 2400 | WINDOW SHADES |
|---------|---------------|

## **DIVISION 13 – 14**

NOT USED

# **VOLUME II**

## **DIVISION 21 – FIRE SUPPRESSION**

|         |                                                                          |
|---------|--------------------------------------------------------------------------|
| 21 0000 | SUPPLEMENTARY FIRE SUPPRESSION GENERAL CONDITIONS                        |
| 21 0500 | COMMON WORK RESULTS FOR FIRE SUPPRESSION                                 |
| 21 0523 | GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING              |
| 21 0548 | VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT |
| 21 0553 | IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT                 |
| 21 1100 | FACILITYFIRE-SUPPRESSION WATER-SERVICE PIPING                            |
| 21 1200 | FIRE SUPPRESSION STANDPIPES                                              |
| 21 1300 | FIRE-SUPPRESSION SPRINKLER SYSTEMS                                       |

## **DIVISION 22 – PLUMBING**

|         |                                                        |
|---------|--------------------------------------------------------|
| 22 0000 | SUPPLEMENTARY PLUMBING GENERAL CONDITIONS              |
| 22 0513 | COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT       |
| 22 0516 | EXPANSION FITTINGS AND LOOP FOR PLUMBING PIPING        |
| 22 0517 | SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING           |
| 22 0519 | METERS AND GAUGES FOR PLUMBING PIPING                  |
| 22 0523 | GENERAL-DUTY VALVES FOR PLUMBING PIPING                |
| 22 0529 | HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT |
| 22 0553 | IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT       |
| 22 0719 | PLUMBING PIPING INSULATION                             |
| 22 1005 | PLUMBING PIPING                                        |
| 22 1006 | PLUMBING PIPING SPECIALTIES                            |
| 22 3000 | PLUMBING EQUIPMENT                                     |
| 22 4000 | PLUMBING FIXTURES                                      |

## **DIVISION 23 – HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)**

|            |                                                    |
|------------|----------------------------------------------------|
| 23 0000    | SUPPLEMENTARY HVAC GENERAL CONDITIONS              |
| 23 0529    | HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT |
| 23 0548    | VIBRATION AND SEISMIC CONTROLS FOR HVAC            |
| 23 0553    | IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT       |
| 23 0593    | TESTING, ADJUSTING, AND BALANCING FOR HVAC         |
| 23 0713    | DUCT INSULATION                                    |
| 23 0934    | VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC      |
| 23 2300    | REFRIGERANT PIPING                                 |
| 23 3100    | HVAC DUCTS AND CASINGS                             |
| 23 3300    | AIR DUCT ACCESSORIES                               |
| 23 3423    | HVAC POWER VENTILATORS                             |
| 23 3600    | AIR TERMINAL UNITS                                 |
| 23 3700    | AIR OUTLETS AND INLETS                             |
| 23 7416    | PACKAGED ROOFTOP AIR-CONDITIONING UNITS            |
| 23 8126.13 | SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS       |

## **DIVISION 26 – ELECTRICAL**

|            |                                                    |
|------------|----------------------------------------------------|
| 26 0000    | SUPPLEMENTARY ELECTRICAL GENERAL CONDITIONS        |
| 26 0519    | LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES |
| 26 0526    | GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS       |
| 26 0529    | HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS        |
| 26 0533.13 | CONDUIT FOR ELECTRICAL SYSTEMS                     |
| 26 0533.16 | BOXES FOR ELECTRICAL SYSTEMS                       |
| 26 0536    | CABLE TRAYS FOR ELECTRICAL SYSTEMS                 |
| 26 0553    | IDENTIFICATION FOR ELECTRICAL SYSTEMS              |
| 26 0583    | WIRING CONNECTIONS                                 |
| 26 0923    | LIGHTING CONTROL DEVICES                           |
| 26 2100    | LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE            |
| 26 2416    | PANELBOARDS                                        |
| 26 2726    | WIRING DEVICES                                     |
| 26 2816.16 | ENCLOSED SWITCHES                                  |
| 26 4113    | LIGHTNING PROTECTION FOR STRUCTURES                |
| 26 5100    | INTERIOR LIGHTING                                  |
| 26 5600    | EXTERIOR LIGHTING                                  |

## **DIVISION 27 – COMMUNICATIONS**

|         |                                                |
|---------|------------------------------------------------|
| 27 0529 | HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS |
| 27 1000 | STRUCTURED CABLING                             |

## **DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

|         |                          |
|---------|--------------------------|
| 28 4600 | FIRE DETECTION AND ALARM |
|---------|--------------------------|

## **DIVISION 29 – 30**

NOT USED

## **DIVISION 31 – EARTHWORK**

|         |            |
|---------|------------|
| 31 0000 | EARTHWORK  |
| 31 2200 | GRADING    |
| 31 2316 | EXCAVATION |

|         |                              |
|---------|------------------------------|
| 31 2317 | TRENCHING FOR UTILITIES      |
| 31 2323 | FILL AND BACKFILL            |
| 31 2500 | EROSION AND SEDIMENT CONTROL |
| 31 3116 | TERMITE CONTROL              |

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

|         |                                  |
|---------|----------------------------------|
| 32 1123 | AGGREGATE BASE COURSE            |
| 32 1216 | BITUMINOUS CONCRETE PAVING       |
| 32 1313 | PORTLAND CEMENT CONCRETE PAVING  |
| 32 3119 | DECORATIVE METAL FENCE AND GATES |

**DIVISION 33 – SITE UTILITIES**

|         |                                  |
|---------|----------------------------------|
| 33 1116 | WATER DISTRIBUTION SYSTEM        |
| 33 3113 | SANITARY SEWER COLLECTION SYSTEM |
| 33 4100 | STORM DRAINAGE SYSTEM            |

**END OF SECTION**

**SECTION 210000**  
**SUPPLEMENTARY FIRE SUPPRESSION GENERAL CONDITIONS**

**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 supplementary general requirements for the following:
  - 1. Codes and Standards
  - 2. Conflicting Requirements
  - 3. Specifications and Drawing Conventions
  - 4. Work Restrictions
  - 5. Fees, Permits, and Inspection
  - 6. Submittals
  - 7. Products
  - 8. Warranties
  - 9. Delegated Design
  - 10. Coordination Drawings
  - 11. Operation and Maintenance Manuals
  - 12. Record Drawings
  - 13. Owner Training

**1.03 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
  - 1. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- I. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- J. Basis-of-Design Product: A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
  - K. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
  - L. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
  - M. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
  - N. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
  - O. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

#### **1.04 SYSTEM: AN ORGANIZED COLLECTION OF PARTS, EQUIPMENT, OR SUBSYSTEMS UNITED BY REGULAR INTERACTION.**

- A. Subsystem: A portion of a system with characteristics similar to a system.
- B. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- C. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

#### **1.05 ABBREVIATIONS AND ACRONYMS**

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|      |                                                      |                |
|------|------------------------------------------------------|----------------|
| ABMA | American Bearing Manufacturers Association           | (202) 367-1155 |
|      | <a href="http://www.abma-dc.org">www.abma-dc.org</a> |                |
| AGA  | American Gas Association                             | (202) 824-7000 |
|      | <a href="http://www.aga.org">www.aga.org</a>         |                |
| AIA  | American Institute of Architects (The)               | (800) 242-3837 |



|      |                                                                               |                 |
|------|-------------------------------------------------------------------------------|-----------------|
|      | www.aia.org                                                                   | (202) 626-7300  |
| ANSI | American National Standards Institute                                         | (202) 293-8020  |
|      | www.ansi.org                                                                  |                 |
| ASCE | American Society of Civil Engineers                                           | (800) 548-2723  |
|      | www.asce.org                                                                  | (703) 295-6300  |
| ASME | ASME International                                                            | (800) 843-2763  |
|      | (American Society of Mechanical Engineers International)                      | (973) 882-1170  |
|      | www.asme.org                                                                  |                 |
| ASTM | ASTM International                                                            | (610) 832-9500  |
|      | (American Society for Testing and Materials International)                    |                 |
|      | www.astm.org                                                                  |                 |
| AWS  | American Welding Society                                                      | (800) 443-9353  |
|      | www.aws.org                                                                   | (305) 443-9353  |
| CGA  | Compressed Gas Association                                                    | (703) 788-2700  |
|      | www.cganet.com                                                                |                 |
| CSI  | Construction Specifications Institute (The)                                   | (800) 689-2900  |
|      | www.csinet.org                                                                | (703) 684-0300  |
| EJMA | Expansion Joint Manufacturers Association, Inc.                               | (914) 332-0040  |
|      | www.ejma.org                                                                  |                 |
| ISO  | International Organization for Standardization                                | 41 22 749 01 11 |
|      | www.iso.ch                                                                    |                 |
| MSS  | Manufacturers Standardization Society of The Valve and Fittings Industry Inc. | (703) 281-6613  |
|      | www.mss-hq.com                                                                |                 |

|      |                                                  |                |
|------|--------------------------------------------------|----------------|
| NEMA | National Electrical<br>Manufacturers Association | (703) 841-3200 |
|      | www.nema.org                                     |                |
| NFPA | NFPA                                             | (800) 344-3555 |
|      | (National Fire Protection<br>Association)        | (617) 770-3000 |
|      | www.nfpa.org                                     |                |
| STI  | Steel Tank Institute                             | (847) 438-8265 |
|      | www.steeltank.com                                |                |
| UL   | Underwriters Laboratories<br>Inc.                | (877) 854-3577 |
|      | www.ul.com                                       | (847) 272-8800 |
|      |                                                  |                |
|      |                                                  |                |

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|     |                            |                |
|-----|----------------------------|----------------|
| ICC | International Code Council | (888) 422-7233 |
|     | www.iccsafe.org            |                |
|     |                            |                |

- C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|       |                                              |                |
|-------|----------------------------------------------|----------------|
| ADAAG | Americans with Disabilities Act<br>(ADA)     | (800) 872-2253 |
| CFR   | Code of Federal Regulations                  | (866) 512-1800 |
|       | Available from Government<br>Printing Office | (202) 512-1800 |
|       | www.gpoaccess.gov/cfr/index.html             |                |
| UFAS  | Uniform Federal Accessibility<br>Standards   | (800) 872-2253 |
|       | Available from Access Board                  | (202) 272-0080 |
|       | www.access-board.gov                         |                |

## 1.06 CODES AND STANDARDS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.

- B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.
  - 1. Building Codes for Arkansas
    - a. International Building Code 2012
    - b. Arkansas Fire Prevention Code 2021
    - c. National Electrical Code 2020
    - d. Arkansas Fuel Gas Code 2018
    - e. Arkansas Energy Code 2014 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    - f. Arkansas State Plumbing Code 2018
    - g. International Mechanical Code 2021
    - h. Accessibility Code ICC/ANSI A117.1 2003

#### **1.07 CONFLICTING REQUIREMENTS**

- A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

#### **1.08 SPECIFICATION AND DRAWING CONVENTIONS**

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

#### **1.09 FEES, PERMITS, AND INSPECTIONS**

- A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.
- B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

#### **1.10 SUBMITTAL SCHEDULE**

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  - 3. Format: Arrange the following information in a tabular format:
    - a. Specification Section number and title.
    - b. Submittal category: Action; informational.
    - c. Name of subcontractor.
    - d. Description of the Work covered.
    - e. Scheduled date for Engineer's final release or approval.

#### **1.11 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Submit submittals to Architect.
  - 2. Engineer will return annotated file.
- B. Digital Data Files:
  - 1. Electronic digital data files of the Project drawings may be provided by Architect for Contractor's use in preparing submittals.
  - 2. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.

- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
  4. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Engineer.
    - e. Name of Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Names of subcontractor, manufacturer, and supplier.
    - h. Category and type of submittal.
    - i. Submittal purpose and description.
    - j. Specification Section number and title.
    - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - l. Drawing number and detail references, as appropriate.
    - m. Location(s) where product is to be installed, as appropriate.
    - n. Related physical samples submitted directly.
    - o. Indication of full or partial submittal.
    - p. Transmittal number.
    - q. Submittal and transmittal distribution record.
    - r. Other necessary identification.
    - s. Remarks.
  5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
    - a. Project name.
    - b. Number and title of appropriate Specification Section.
    - c. Manufacturer name.
    - d. Product name.
- F. Options: Identify options requiring selection by Engineer.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
- K. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

#### **1.12 CLOSEOUT SUBMITTALS**

- A. Closeout submittals shall include, but not limited to, the following:
  - 1. Operation and Maintenance Materials
  - 2. Record Drawings
  - 3. Demonstration and Training Materials
  - 4. Final Approved Submittals

#### **1.13 MAINTENANCE MATERIAL SUBMITTALS**

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
  - 2. In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the "Closeout Documents". Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return two copies. The two paper copies will be provided to the Owner as part of the "Closeout Documents"
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.
  - 1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

#### **1.14 QUALITY ASSURANCE**

- A. Products:

1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

#### **1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- B. Storage:
  1. Store products to allow for inspection and measurement of quantity or counting of units.
  2. Store materials in a manner that will not endanger Project structure.
  3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.
  4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  6. Protect stored products from damage and liquids from freezing.

#### **1.16 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submit warranties in accordance with "Closeout Procedures."

#### **1.17 FIELD CONDITIONS**

- A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

#### **1.18 WARRANTY**

- A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the plumbing, air conditioning, ventilating, heating and control systems under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

## **PART 2 - PRODUCTS**

### **2.01 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Submit electronic submittals to Architect.
    - a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  - 2. Manufacturer and product name, and model number if applicable.
  - 3. Number and name of room or space.
  - 4. Location within room or space.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100.



- F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000.
- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700.
- H. Maintenance Data: Comply with requirements specified in Section 01 7823.
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- R. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- S. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

## **2.02 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Where two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 5. Where products are accompanied by the term "as selected," Engineer will make selection.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  - 7. Products containing asbestos shall not be used.
  - 8. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
  - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
  - 4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
  - 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer" or similar phrase, select a product that complies with requirements. Engineer will

select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

### **2.03 COMPARABLE PRODUCTS**

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  - 5. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

### **2.04 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
  - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Supplement plan drawings with section drawings where required to adequately represent the Work.
  - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to

- accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  6. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
  7. Fire-Protection System: Show the following:
    - a. Locations of standpipes, main piping, branch lines, pipe drops, and sprinkler heads.
  8. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: DXF operating in Microsoft Windows operating system.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.
  3. BIM File Incorporation: Provide coordination drawing files into Building Information Model established for Project.
    - a. Provide three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Engineer.

## **2.05 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  1. List of documents.
  2. List of systems.
  3. List of equipment.
  4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the

Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## **2.06 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## **2.07 OPERATION MANUALS**

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor has delegated design responsibility.
  - 3. Operating standards.
  - 4. Operating procedures.
  - 5. Operating logs.
  - 6. Wiring diagrams.
  - 7. Control diagrams.
  - 8. Piped system diagrams.

9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## **2.08 PRODUCT MAINTENANCE MANUALS**

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

- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## **2.09 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## **2.10 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.

- c. Record data as soon as possible after obtaining it.
  - d. Record and check the markup before enclosing concealed installations.
  - e. Cross-reference record prints to corresponding archive photographic documentation.
- 2. Content: Types of items requiring marking include, but are not limited to, the following:
  - a. Dimensional changes to Drawings.
  - b. Revisions to details shown on Drawings.
  - c. Depths of foundations below first floor.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Change Order or Change Directive.
  - k. Details not on the original Contract Drawings.
  - l. Field records for variable and concealed conditions.
  - m. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
  - 1. Format: Annotated PDF electronic file.
  - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  - 3. Refer instances of uncertainty to Engineer for resolution.
  - 4. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 01 3300 for requirements related to use of Engineer's digital data files.
    - b. Engineer will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  - 2. Format: Annotated PDF electronic file.
  - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  - 4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Engineer.
    - e. Name of Contractor.

### **PART 3 - EXECUTION**



### **3.01 CONTRACTOR'S SUBMITTAL REVIEW**

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### **3.02 ENGINEER'S SUBMITTAL ACTION**

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

### **3.03 DISPOSAL OF WASTE**

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Disposal: Remove waste materials from Owner's property and legally dispose of them

### **3.04 OPERATION AND MAINTENANCE MANUAL PREPARATION**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  1. Do not use original project record documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared record Drawings in "Project Record Documents."
- F. Comply with "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

### **3.05 RECORD DRAWING RECORDING AND MAINTENANCE**

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

### **3.06 COORDINATION OF WORK**

- A. The Contractor shall compare the fire suppression Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the fire suppression work. The fire suppressions work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the fire suppression work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of pipes and equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe prior to fabrication.
  1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
  2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all drains, etc., as required to effect these offsets, transitions and changes in direction.
  3. Installation and Arrangement: The Contractor shall install all fire suppression work to permit removal (without damage to other parts) of belt guards, sheaves and drives, and all

other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.

4. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves and dampers. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.
- E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, supports, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.
- F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection
- G. Inaccessible Equipment
  1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
  2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
- H. Electrical Coordination
  1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
  2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
  3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division 21 and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
  4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, thermostats and similar items required for the proper operation of the HVAC equipment.
- I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints. Provide 18 gauge (minimum) galvanized, 4 inch (minimum) deep drain pans under piping and ductwork located or passing

over electrical equipment. Pipe 1" drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold 4 inches of water without collapse.

- J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Pump shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

### **3.07 PAINTING**

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
  - 1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  - 2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
  - 3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  - 4. Do not paint piping specialties with factory-applied finish.
  - 5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
  - 6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

**END OF SECTION 210000**

**SECTION 210500  
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Above ground piping.
- B. Escutcheons.
- C. Mechanical couplings.
- D. Pipe hangers and supports.

**1.02 RELATED REQUIREMENTS**

- A. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- B. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- F. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- I. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- K. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- L. AWWA C606 - Grooved and Shouldered Joints; 2015.
- M. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL (DIR) - Online Certifications Directory; Current Edition.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.

- F. Project Record Documents: Record actual locations of components and tag numbering.
- G. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

#### **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 work of the type specified in this section.
  - 1. Minimum three years experience.
  - 2. Approved by manufacturer.
- C. Comply with FM (AG) and UL (DIR) requirements.
- D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- E. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

#### **1.07 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.

### **PART 2 PRODUCTS**

#### **2.01 FIRE PROTECTION SYSTEMS**

- A. Sprinkler Systems: Comply with NFPA 13.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

#### **2.02 ABOVE GROUND PIPING**

- A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, ASTM A135/A135M Schedule 10, or ASTM A795 Schedule 40, black.
  - 1. Steel Fittings: ASME B16.5 steel flanges and fittings.
  - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
  - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
  - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
  - 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

#### **2.03 ESCUTCHEONS**

- A. Material:
  - 1. Metals and Finish: Comply with ASME A112.18.1.
- B. Construction:

1. One-piece for mounting on chrome-plated tubing, pipe, or \_\_\_\_\_ and one-piece, split-pattern, or \_\_\_\_\_ type elsewhere.
2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

## **2.04 PIPE HANGERS AND SUPPORTS**

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  1. Rings used as support shall be Heavy Duty and capable of supporting the total load of the pipe being supported. Tolco 200H or approved equal.
- C. Wall support: Welded knee-brace and U-Bolt or strut and clamp.
- D. Vertical Support: Steel riser clamp.
- E. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- F. Seismic Hangers and Couplings (Where required):
  1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
  2. Provide resettable and reusable, break away couplings.
  3. Provide tether cables to avoid excessive seismic joint movement.
  4. Coupling to be manufactured from non-corrosive materials.

## **2.05 MECHANICAL COUPLINGS**

- A. Rigid Mechanical Couplings for Grooved Joints:
  1. Dimensions and Testing: Comply with AWWA C606.
  2. Minimum Working Pressure: 300 psig.
  3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
  4. Housing Coating: Factory applied orange enamel or \_\_\_\_\_.
  5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### **3.02 INSTALLATION**

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
  1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  2. Place hangers within 12 inches of each horizontal elbow.
  3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

- 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- I. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.
- J. Provide sleeves when penetrating footings, floors, walls, partitions, and \_\_\_\_\_. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- K. Escutcheons:
  - 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
  - 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
  - 3. Attach plates at the underside only of suspended ceilings.
  - 4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- M. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

### **3.03 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION 210500**



**SECTION 210523**  
**GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.

**1.02 REFERENCE STANDARDS**

- A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2025.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Installer, Maintenance Contractor, and \_\_\_\_\_ Qualifications:
  - 1. Company specializing in performing the work of this section with minimum five years documented experience.
  - 2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
  - 3. Complies with manufacturer's certification requirements.
  - 4. Complies with manufacturer's insurance requirements.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Set valves open to minimize exposure of functional surfaces.

- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors and maintain at higher than ambient dew point temperature.
    - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
  - 1. Do not use operating handles or stems as lifting or rigging points.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
  - 1. Automated Sprinkler Systems:
    - a. Indicator posts.
- C. Comply with NFPA 13, NFPA 13R, and \_\_\_\_ for valves.
- D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.

### **3.02 INSTALLATION**

- A. Comply with specific valve installation requirements and application in the following Sections:
- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
  - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- E. Valves in horizontal piping installed with stem at or above the pipe center.
- F. Position valves to allow full stem movement.
- G. Install valve tags. Comply with Section 210553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

**END OF SECTION 210523**

## **SECTION 210548**

### **VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration isolators.
- D. External seismic snubber assemblies.
- E. Seismic restraint systems

##### **1.02 DEFINITIONS**

- A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

##### **1.03 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. FM 1950 - Examination Standard for Seismic Sway Braces for Pipe, Tubing and Conduit; 2023.
- F. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

#### **1.05 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Seismic Controls:
  1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  2. Identify mounting conditions required for equipment seismic qualification.
  3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  4. Indicate proposed arrangement of distributed system trapeze support groupings.
  5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  6. Indicate locations of seismic separations where applicable.
  7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- E. Seismic Design Data:
  1. Compile information on project-specific characteristics of actual installed fire suppression components necessary for determining seismic design forces required to design appropriate seismic controls.
  2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- F. Certification for seismically qualified equipment; identify basis for certification.
- G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Evidence of qualifications for seismic controls designer.
- J. Evidence of qualifications for manufacturer.
- K. Manufacturer's detailed field testing and inspection procedures.
- L. Field quality control test reports.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
  1. Designer may be employed by the manufacturer of the seismic restraint products.

- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 - PRODUCTS**

### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing fire suppression equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- D. Piping Isolation:
  - 1. Use flexible piping connections to vibration-isolated equipment.

### **2.02 SEISMIC CONTROL REQUIREMENTS**

- A. Design and provide fire suppression component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor fire suppression components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record or as indicated on the drawings.
- C. Component Importance Factor (Ip): Fire suppression components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
  - 1. Provide special certification for fire suppression equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Premanufactured Modular Fire Suppression Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- F. Seismic Restraints:
  - 1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  - 2. Seismic Restraint Exemptions, All Seismic Design Categories:
    - a. Fire Suppression Piping Exemptions, All Seismic Design Categories:
      - 1) Lateral sway bracing for piping individually supported within 6 inches of the structure measured between the top of pipe and the point of attachment to the structure, where all conditions for exception specified in NFPA 13 are met.

- 2) Lateral sway bracing for branch lines smaller than 2-1/2 inches in diameter, where branch line restraint is provided in accordance with NFPA 13.
3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
  - a. ASHRAE (HVACA).
  - b. FEMA 412.
  - c. FEMA 413.
  - d. FEMA 414.
  - e. FEMA E-74.
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
  - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
  - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
  - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
  - a. Arrange restraint elements to avoid obstruction of sprinklers in accordance with NFPA 13.
  - b. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
  - c. Use only cable restraints to restrain vibration-isolated fire suppression components.
  - d. Use only one restraint system type for a given fire suppression component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
  - e. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain fire suppression component in all lateral directions; consider bracket geometry in anchor load calculations.
  - f. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported fire suppression component weight.
  - g. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported fire suppression component weight.
  - h. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
  - i. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
  - j. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- G. Seismic Attachments:
  1. Comply with support and attachment requirements of NFPA 13.
  2. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
  3. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic Vibration And Seismic Controls For Fire Suppression Piping And Equipment

applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.

4. Do not use power-actuated fasteners.
  5. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps, but not for sway bracing attachments as prohibited by NFPA 13.
  6. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  7. Concrete Housekeeping Pads:
    - a. Increase size of pad as required to comply with anchor requirements.
    - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- H. Seismic Interactions:
1. Include provisions to prevent seismic impact between fire suppression components and other structural or nonstructural components.
  2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
  3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- I. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections, in accordance with NFPA 13, to accommodate:
    - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
    - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    - c. Design displacements at seismic separations.
    - d. Anticipated drifts between floors.
  2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

## **2.03 VIBRATION ISOLATORS**

- A. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- B. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.

2. Restrained Spring Isolators, Seismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
  - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

#### **2.04 EXTERNAL SEISMIC SNUBBER ASSEMBLIES**

- A. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- B. Seismic Snubbing Elements:
  1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
  2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

#### **2.05 SEISMIC RESTRAINT SYSTEMS**

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.
- C. Cable Restraints:
  1. Comply with ASCE 19.
  2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  4. Use protective thimbles for cable loops where potential for cable damage exists.



- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
  - 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
  - 3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
  - 4. Verification of required clearances between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

#### **3.03 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
  - 1. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.

- c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  - 2. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  - 3. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  - 4. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  - 5. Adjust isolators to be free of isolation short circuits during normal operation.
  - 6. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
- 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
  - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  - 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
  - 4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
  - 5. Concrete Housekeeping Pads:
    - a. Size in accordance with seismic design to meet anchor requirements.
    - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
  - 6. Seismic Restraint Systems:
    - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    - b. Install restraints within permissible angles in accordance with seismic design.
    - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspect vibration isolation and/or seismic control components for damage and defects.
- B. Vibration Isolation Systems:
  - 1. Verify isolator static deflections.
  - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- C. Seismic Controls:
  - 1. Verify snubbing element air gaps.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 210548**

**SECTION 210553**  
**IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Pipe markers.
- C. Ceiling tacks.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Control Panels: Nameplates.
- B. Instrumentation: Nameplates.
- C. Major Control Components: Nameplates.
- D. Piping: Tags.
- E. Pumps: Nameplates.
- F. Small-sized Equipment: Nameplates.
- G. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

**2.02 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch.
  - 3. Background Color: Black.
  - 4. Thickness: 1/8 inch.
  - 5. Plastic: Comply with ASTM D709.
- B. Metal rectangular nameplates to be used on valves. Indicate "NORMALLY OPEN" or "NORMALLY CLOSED" in all valves.

**2.03 PIPE MARKERS**

- A. Color: Comply with ASME A13.1.

- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- E. Lettering to be "FIRE PROTECTION WATER" or submit other text as appropriate.
- F. Color code as follows:
  - 1. Fire Quenching Fluids: Red with white letters.

#### **2.04 CEILING TACKS**

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
  - 1. Sprinkler Valves: \_\_\_\_\_.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

#### **3.02 INSTALLATION**

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install plastic pipe markers in accordance with manufacturer's instructions.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- E. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION 210553**

**SECTION 211100**  
**FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water pipe.
- B. Valves.
- C. Fire department connections.
- D. Private fire hydrants.
- E. Bedding and cover materials.
- F. Polyethylene jacketing (encasement).
- G. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 211300 - Fire-Suppression Sprinkler Systems.

**1.03 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
- D. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- G. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- H. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe; 2022.
- I. ASTM B63 - Standard Test Method for Resistivity of Metallically Conducting Resistance and Contact Materials; 2007 (Reapproved 2026).
- J. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2026a.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- M. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings; 2022.
- N. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- O. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- P. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- Q. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- R. AWWA C502 - Dry-Barrel Fire Hydrants; 2024.
- S. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2024.
- T. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.
- U. AWWA M11 - Steel Pipe - A Guide for Design and Installation; 2017, with Addendum (2019).

- V. FM (AG) - FM Approval Guide; Current Edition.
- W. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- X. UL (DIR) - Online Certifications Directory; Current Edition.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### **1.05 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Data:
  - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
  - 2. Provide manufacturer's catalog information.
  - 3. Indicate valve data and ratings.
  - 4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:
  - 1. Record actual locations of piping mains, valves, connections, fire hydrants, free-standing fire department connections, underground manholes and vaults, valve boxes, thrust restraints, and invert elevations.
  - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- F. Maintenance Data: Include installation instructions, spare parts lists, and exploded assembly views.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Division 01 for additional requirements.

#### **1.06 QUALITY ASSURANCE**

- A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- E. Provide grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- F. Date stamp castings used for coupling housings, fittings, and valve bodies for quality assurance and traceability.
- G. Welder Qualifications:
  - 1. Certify in accordance with ASME BPVC-IX.
  - 2. Provide certificate of compliance from local Authority Having Jurisdiction, indicating approval of welders.

- H. Valves: Bearing product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.08 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

#### **1.09 WARRANTY**

- A. Correct defective Work within a five year period after Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 WATER PIPE**

- A. Ductile Iron Pipe: Listed, AWWA C104/A21.4:
  - 1. Fittings: Ductile iron, standard thickness.
  - 2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with rods.
  - 3. Jackets: AWWA C105/A21.5 polyethylene jacket.

#### **2.02 VALVES**

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Detector Check with Water Meter:
- C. Detector Check Valve, Flanged End:
  - 1. 4 inch NPS up to and including 10 inch NPS:
    - a. Construction:
      - 1) Body: Constructed of 300 series stainless steel or ASTM A536 ductile iron to AWWA C550, as applicable.
      - 2) Coating: Fusion bonded epoxy in accordance with AWWA C550.
      - 3) Spring and Linkage: Stainless steel.
      - 4) Removable Clapper Seat Ring: Bronze.
      - 5) Seat: ASTM B63 bronze.
      - 6) Maximum Working Pressure: 175 psi.
- D. Double Check Detector Valve Assembly, Flanged End:
  - 1. 2-1/2 NPS up to and including 10 NPS:
    - a. Construction:
      - 1) Two independently operating, spring-loaded, check valves.
      - 2) Two OSY resilient seated gate valves.
      - 3) Bypass Assembly:
        - (a) Bypass Line: Hydraulically sized to accurately measure low flow.
        - (b) Double check including shut-off valves, and required cocks.
      - 4) Cam-Check:
        - (a) Internally loaded, providing positive, drip-tight closure against reverse flow.
        - (b) Stainless steel cam arm and spring, rubber-faced disc, and replaceable, thermoplastic seat.
      - 5) Valve Cover:
        - (a) Provides access to all internal parts.
        - (b) Held in place through the use of a single grooved style two-bolt coupling.



### **2.03 FIRE DEPARTMENT CONNECTIONS:**

- A. Free-Standing Inlet:
  - 1. Construction:
    - a. Type: Exposed, projected wall mount..
    - b. Inlets: Two way, 2-1/2 inch female inlets, thread size compatible with fire department hardware.
    - c. Rated Working Pressure: 175 psi.
    - d. Double clapper-valves, rocker-lug caps and chain, and cast-in function-identifying lettering.
    - e. Finish: Polished brass.
    - f. Label: Sprinkler - Fire Department Connection.

### **2.04 PRIVATE FIRE HYDRANTS**

- A. Dry-Barrel:
  - 1. Construction:
    - a. Rated Working Pressure: 250 psi.
    - b. Compression type, opening against system pressure and closing with system pressure.
    - c. Traffic breakaway type.
  - 2. Hydrant Cap and Stuffing Box: One piece design with water-tight cavity, sealed from contact with water.
  - 3. Operating Nut: One-Piece, bronze construction with protective weather seal, shield, or \_\_\_\_\_.
  - 4. Nozzles: Tamper resistant, 1/4 turn type with O-ring seals including retaining/locking screws, other suitable nozzle lock, or \_\_\_\_\_ to prevent inadvertent removal.
  - 5. Main Valve: Provide reinforced, synthetic rubber, completely encapsulated with EPDM, or \_\_\_\_\_.
  - 6. Seat: Provide O-rings to seal drain-way and barrel from water leakage into shoe.
  - 7. Drains to momentarily flush outward when opened to remove debris and complete draining upon closing of the main valve.

### **2.05 POLYETHYLENE JACKETING (ENCASEMENT)**

- A. Comply with AWWA C105/A21.5, ASTM A674, or \_\_\_\_\_.
- B. Jackets: Double layer, half lapped, 10 mil polyethylene tape.
- C. Type: Provide tubular based on the application.
- D. Color: Manufacturer's standard color.

### **2.06 ACCESSORIES**

- A. Concrete for Thrust Restraints: Concrete type specified in Section 033000.
- B. Tracer Wire:
  - 1. Provide magnetic, detectable conductor with clear plastic covering and imprinted with "Water Service" in large letters.
  - 2. Conductor to be of sufficient length to be continuous over each separate run of nonmetallic pipe.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

### **3.02 PREPARATION**

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

- C. Prepare pipe connections to equipment with flanges or unions.

### **3.03 TRENCHING**

- A. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide \_\_\_\_ sq feet thrust restraint bearing on subsoil.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.04 INSTALLATION**

- A. General Requirements:
  - 1. Location of Water Lines:
  - 2. Sleeving:
    - a. Sleeve water piping where piping is required to be installed within 3 feet of existing structures.
    - b. Provide ductile iron, Schedule 40 steel, or \_\_\_\_\_ sleeves.
    - c. Fill annular space between pipe and sleeves with mastic.
    - d. Install water pipe and sleeve without damaging structures or causing settlement or movement of foundations or footings.
  - 3. Pipe Laying and Jointing:
    - a. Remove fins and burrs from pipe and fittings.
    - b. Prior to placing in position, clean pipe, fittings, valves, and accessories, and maintain in clean condition.
    - c. Provide proper facilities for lowering pipe sections into trenches.
    - d. Dropping or dumping of piping, fittings, valves, or any other water line material into trenches is not permitted.
    - e. Cut pipe in a neat, workmanlike manner accurately to length established at the site and work into place without forcing or springing.
    - f. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
    - g. Wedging or blocking between bells and spigots will not be permitted.
    - h. Install bell-and-spigot pipe with the bell end pointing in the direction of laying.
    - i. Grade the pipeline in straight lines avoiding the formation of dips and low points.
    - j. Support piping at proper elevation and grade.
    - k. Secure firm, uniform support.
    - l. Wood support blocking will not be permitted.
    - m. Install pipe so that the full length of each pipe section and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
    - n. Provide proper provisions for expansion and contraction of pipelines.
    - o. Keep trenches free of water until joints have been properly made.
    - p. Close open ends of piping temporarily with wood blocks or bulkheads at the end of each workday.
    - q. Do not install pipe during unacceptable trench conditions or inclement weather.
    - r. Minimum Depth of Pipe Cover: Not less than 2-1/2 feet.
  - 4. Tracer Wire:
    - a. Install continuous length of tracer wire for the full length of each run of nonmetallic pipe.
    - b. Attach wire to top of pipe securely to prevent displacement during installation.
  - 5. Connections to Existing Water Lines:
    - a. Ensure minimal interruption of service on the existing line.
    - b. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.
  - 6. Penetrations:

- a. Provide ductile-iron, Schedule 40 steel, or \_\_\_\_\_ for pipes passing through walls of valve pits and structures.
  - b. Fill annular space between sleeves and walls with rich cement mortar.
  - c. Fill annular space between pipe and sleeves with mastic.
- B. Special Requirements:
  - 1. Ductile Iron Piping:
    - a. Unless otherwise specified, install pipe and fittings in accordance with paragraph "General Requirements".
    - b. Jointing:
    - c. Allowable Deflection:
      - 1) Maximum Allowable Deflection: As stated in AWWA C600.
      - 2) If the alignment requires deflection in excess of the above limitations, furnish special blends, a sufficient number of shorter pipe lengths, or \_\_\_\_\_ to provide angular deflections within the limit set forth.
    - d. Pipe Anchorage:
      - 1) Provide concrete thrust blocks (reaction backing), for pipe anchorage except where metal harness is indicated.
      - 2) Thrust blocks to comply with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks to be as indicated.
      - 3) Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
      - 4) Provide metal harness in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as indicated in NFPA 13, except as otherwise indicated.
    - e. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.
- C. Valves:
  - 1. Set valves on solid bearing.
  - 2. Center and plumb valve box over valve.
  - 3. Set box cover flush with finished grade.
- D. Fire Hydrants:
  - 1. Install in accordance with NFPA 13, the Local Authority Having Jurisdiction, the local water utility, and \_\_\_\_\_.
  - 2. Set fire hydrant plumb and brace at grades and locations in upright position and as indicated.
  - 3. Provide thrust blocks on all hydrant tees.
    - a. Provide thrust block behind hydrant shoe if hydrant lateral is not restrained.
    - b. Avoid covering drain ports, bolts, or fittings when placing concrete thrust block.
  - 4. Install each fire hydrant with separate gate valve in supply pipe.
  - 5. Installation of hydrants requiring changes in bury depth due to unforeseen obstructions requires the approval of the Architect in writing prior to installation.
  - 6. Coating Requirements:
    - a. Provide a color chip code sample in accordance with applicable NFPA standards for the hydrant bonnet indicating available flow at 20 psi according to the following:
      - 1) Supply Water Line Flow Characteristics/Bonnet Color:
  - 7. Remove and dispose of unsuitable materials and debris in accordance with local or state requirements.

**END OF SECTION 211100**

**SECTION 211200  
FIRE-SUPPRESSION STANDPIPES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire hose cabinets.
- B. Valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 014100 - Regulatory Requirements.
- B. Section 210500 - Common Work Results for Fire Suppression: Fire protection piping.
- C. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- D. Section 210553 - Identification for Fire Suppression Piping and Equipment.
- E. Section 211300 - Fire-Suppression Sprinkler Systems.

**1.03 REFERENCE STANDARDS**

- A. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.
- B. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- C. UL (DIR) - Online Certifications Directory; Current Edition.
- D. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

**1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.
- B. Shop Drawings: Indicate supports, components, accessories, and sizes.
- C. Project Record Documents: Record actual locations of components.
- D. Operation Data: Include appropriate manufacturer's data.
- E. Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Hoses: One.

**1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with NFPA 14. Maintain one copy on site.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum \_\_\_\_ years documented experience and approved by manufacturer.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store products in shipping packaging until installation.

**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.

**PART 2 PRODUCTS**

**2.01 VALVES**

- A. General Duty Valves: Refer to Section 210523.
- B. Specialty Valves:
  - 1. Hose Connection Valve:
    - a. Angle type; brass finish; 2-1/2 NPS, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.
- C. Hose Connection Valve Cabinets:
  - 1. Style: Recessed mounted. 1-3/4" trim.
  - 2. Tub: 16 gage, 0.0598 inch thick steel, prepared for pipe and accessory rough-in.
  - 3. Door: 12 gage, 0.1046 inch thick steel, flush, glazed with 1/4 inch (6.35 mm) thick wired glass full panel; hinged, positive latch device.
  - 4. Finish: Aluminum, clear anodized..

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 14.
- C. Connect standpipe system to water source ahead of domestic water connection.
- D. Flush entire system of foreign matter.

### **3.02 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing (Field Acceptance Test) in accordance with Section 014000.
- B. Test entire system in accordance with NFPA 14.
- C. Test shall be witnessed by Fire Marshal.

**END OF SECTION 211200**

**SECTION 211300  
FIRE-SUPPRESSION SPRINKLER SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. Dry-pipe sprinkler system.
- C. System design, installation, and certification.
- D. Fire department connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 210548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- D. Section 210553 - Identification for Fire Suppression Piping and Equipment.

**1.03 REFERENCE STANDARDS**

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- H. UL (DIR) - Online Certifications Directory; Current Edition.
- I. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week before starting work of this section.

**1.05 SUBMITTALS**

- A. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Shop Drawings:
  - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
  - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
  - 3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.
- C. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- D. Designer's Qualification Statement.
- E. Manufacturer's Qualification Statement.

- F. Installer's Qualification Statement.
- G. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
  - 2. Sprinkler Wrenches: For each sprinkler type.
- I. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

## **1.06 QUALITY ASSURANCE**

- A. Maintain one copy of referenced design and installation standard on site.
- B. Comply with FM (AG) requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years documented experience..
- F. Equipment and Components: Provide products that bear FM (AG) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

## **PART 2 PRODUCTS**

### **2.01 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: construction drawings..
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Provide fire department connections where indicated.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- F. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
  - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
  - 6. Other Types: As required.

### **2.02 SPRINKLERS**

- A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Pendant type with guard.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Brass.

4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
  1. Response Type: Quick.
  2. Coverage Type: Standard.
  3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Concealed pendant type with matching push on escutcheon plate.
  1. Response Type: Quick.
  2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Flexible Drop System: Stainless steel, multiple use, open gate type.
  1. Application: Use to properly locate sprinkler heads.
  2. Include all supports and bracing.
  3. Provide braided type tube as required for the application.
  4. Manufacturers:
    - a. Victaulic Company; Vic-Flex: [www.victaulic.com](http://www.victaulic.com)

### **2.03 PIPING SPECIALTIES**

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
- B. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
- C. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
- D. Test Connections:
  1. Inspector's Test Connection for Preaction Systems:
    - a. Provide test connections approximately 6 ft above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.
    - b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
    - c. Supply discharge orifice with same size as corresponding sprinkler orifice.
    - d. Limit vertical height of exterior wall penetration to 2 ft above finished grade.
- E. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- G. Fire Department Connections:
  1. Type: Free standing made of corrosion resistant metal complying with UL 405.
    - a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
    - b. Signage: Raised or engraved lettering 1 inch minimum indicating system type.

### **2.04 AIR COMPRESSOR**

- A. Compressor: Single-unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.
- B. Electrical Characteristics:
  1. 120 volts, single phase, 60 Hz.

## **PART 3 EXECUTION**



### **3.01 INSTALLATION**

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- D. Place pipe runs to minimize obstruction to other work.
- E. Place piping in concealed spaces above finished ceilings.
- F. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- G. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- H. Flush entire piping system of foreign matter.
- I. Hydrostatically test entire system.
- J. Require test be witnessed by Fire Marshal.

### **3.02 INTERFACE WITH OTHER PRODUCTS**

- A. Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION 211300**

**SECTION 220000**  
**SUPPLEMENTARY PLUMBING GENERAL CONDITIONS**

**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 supplementary general requirements for the following :
  - 1. Codes and Standards
  - 2. Conflicting Requirements
  - 3. Specifications and Drawing Conventions
  - 4. Fees, Permits, and Inspection
  - 5. Submittals
  - 6. Closeout Submittals
  - 7. Quality Assurance
  - 8. Product Delivery, Storage, and Handling
  - 9. Product Warranties
  - 10. Product Selection Procedures
  - 11. Delegated Design
  - 12. Coordination Drawings
  - 13. Emergency, Operation, and Maintenance Manuals
  - 14. Construction Waste
  - 15. General Coordination for Plumbing Work
  - 16. Cutting and Patching
  - 17. Painting

**1.03 DEFINITIONS**

- A. "Action Submittals": Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Basis-of-Design Product": A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
- D. "Construction Waste": Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- E. "Cutting": Removal of in-place construction necessary to permit installation or performance of other work.
- F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- G. "Disposal": Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- H. "File Transfer Protocol (FTP)": Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet

protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

- I. "Furnish": To supply, deliver, unload, and inspect for damage.
- J. "General": Basic Contract definitions are included in the Conditions of the Contract.
- K. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- L. "Informational Submittals": Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- M. "Install": To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- N. "Patching": Fitting and repair work required to restore construction to original conditions after installation of other work.
- O. "Portable Document Format (PDF)": An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- P. "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. Product may be new, never before used, or re-used materials or equipment.
- Q. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- R. "Provide": Furnish and install, complete and ready for the intended use.
- S. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- T. "Salvage": Recovery of demolition and construction waste and subsequent sale or reuse in another facility.
- U. "Salvage and Reuse": Recovery of demolition and construction waste and subsequent incorporation into the Work.
- V. "System": An organized collection of parts, equipment, or subsystems united by regular interaction.
- W. "Subsystem": A portion of a system with characteristics similar to a system.

#### 1.04 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|      |                                              |                |
|------|----------------------------------------------|----------------|
| AGA  | American Gas Association                     | (202) 824-7000 |
|      | <a href="http://www.aga.org">www.aga.org</a> |                |
| AIA  | American Institute of Architects (The)       | (800) 242-3837 |
|      | <a href="http://www.aia.org">www.aia.org</a> | (202) 626-7300 |
| ANSI | American National Standards Institute        | (202) 293-8020 |

|         |                                                                           |                |
|---------|---------------------------------------------------------------------------|----------------|
|         | www.ansi.org                                                              |                |
| ASCE    | American Society of Civil Engineers                                       | (800) 548-2723 |
|         | www.asce.org                                                              | (703) 295-6300 |
| ASHRAE  | American Society of Heating, Refrigerating and Air-Conditioning Engineers | (800) 527-4723 |
|         | www.ashrae.org                                                            | (404) 636-8400 |
| ASME    | ASME International                                                        | (800) 843-2763 |
|         | (American Society of Mechanical Engineers International)                  | (973) 882-1170 |
|         | www.asme.org                                                              |                |
| ASTM    | ASTM International                                                        | (610) 832-9500 |
|         | (American Society for Testing and Materials International)                |                |
|         | www.astm.org                                                              |                |
| AWS     | American Welding Society                                                  | (800) 443-9353 |
|         | www.aws.org                                                               | (305) 443-9353 |
| CGA     | Compressed Gas Association                                                | (703) 788-2700 |
|         | www.cganet.com                                                            |                |
| CIMA    | Cellulose Insulation Manufacturers Association                            | (888) 881-2462 |
|         | www.cellulose.org                                                         | (937) 222-2462 |
| CSI     | Construction Specifications Institute (The)                               | (800) 689-2900 |
|         | www.csinet.org                                                            | (703) 684-0300 |
| EJMA    | Expansion Joint Manufacturers Association, Inc.                           | (914) 332-0040 |
|         | www.ejma.org                                                              |                |
| HI      | Hydronics Institute                                                       | (908) 464-8200 |
|         | www.gamanet.org                                                           |                |
| HI/GAMA | Hydronics Institute/Gas Appliance Manufacturers Association               | (908) 464-8200 |
|         | Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI) |                |
|         | www.ahrinet.org                                                           |                |
| IGMA    | Insulating Glass Manufacturers Alliance                                   | (613) 233-1510 |
|         | www.igmaonline.org                                                        |                |
| ISA     | Instrumentation, Systems, and Automation Society, The                     | (919) 549-8411 |
|         | www.isa.org                                                               |                |

|       |                                                                                                 |                                  |
|-------|-------------------------------------------------------------------------------------------------|----------------------------------|
| ISO   | International Organization for Standardization<br>www.iso.ch                                    | 41 22 749 01 11                  |
| MSS   | Manufacturers Standardization Society of The Valve and Fittings Industry Inc.<br>www.mss-hq.com | (703) 281-6613                   |
| NEBB  | National Environmental Balancing Bureau<br>www.nebb.org                                         | (301) 977-3698                   |
| NEMA  | National Electrical Manufacturers Association<br>www.nema.org                                   | (703) 841-3200                   |
| NFPA  | NFPA<br>(National Fire Protection Association)<br>www.nfpa.org                                  | (800) 344-3555<br>(617) 770-3000 |
| STI   | Steel Tank Institute<br>www.steeltank.com                                                       | (847) 438-8265                   |
| TEMA  | Tubular Exchanger Manufacturers Association<br>www.tema.org                                     | (914) 332-0040                   |
| UL    | Underwriters Laboratories Inc.<br>www.ul.com                                                    | (877) 854-3577<br>(847) 272-8800 |
| USGBC | U.S. Green Building Council<br>www.usgbc.org                                                    | (800) 795-1747                   |

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|     |                                               |                |
|-----|-----------------------------------------------|----------------|
| ICC | International Code Council<br>www.iccsafe.org | (888) 422-7233 |
|-----|-----------------------------------------------|----------------|

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|     |                                                |                |
|-----|------------------------------------------------|----------------|
| DOE | Department of Energy<br>www.energy.gov         | (202) 586-9220 |
| EPA | Environmental Protection Agency<br>www.epa.gov | (202) 272-0167 |

|      |                                                                                                        |                                  |
|------|--------------------------------------------------------------------------------------------------------|----------------------------------|
| FCC  | Federal Communications Commission<br><a href="http://www.fcc.gov">www.fcc.gov</a>                      | (888) 225-5322                   |
| OSHA | Occupational Safety & Health Administration<br><a href="http://www.osha.gov">www.osha.gov</a>          | (800) 321-6742<br>(202) 693-1999 |
| PHS  | Office of Public Health and Science<br><a href="http://www.hhs.gov/ophs/">http://www.hhs.gov/ophs/</a> | (202) 690-7694                   |
| USP  | U.S. Pharmacopeia<br><a href="http://www.usp.org">www.usp.org</a>                                      | (800) 227-8772                   |
| USPS | Postal Service<br><a href="http://www.usps.com">www.usps.com</a>                                       | (202) 268-2000                   |

- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|       |                                                                                                                                                                    |                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| ADAAG | Americans with Disabilities Act (ADA)                                                                                                                              | (800) 872-2253                   |
| CFR   | Code of Federal Regulations<br>Available from Government Printing Office<br><a href="http://www.gpoaccess.gov/cfr/index.html">www.gpoaccess.gov/cfr/index.html</a> | (866) 512-1800<br>(202) 512-1800 |

### 1.05 CODES AND STANDARDS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.
- B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.
1. Building Codes for Arkansas
    - a. International Building Code 2006
    - b. Arkansas Fire Prevention Code 2007
    - c. National Electrical Code 2017
    - d. Arkansas Fuel Gas Code 2018 (International Fuel Gas Code 2018)
    - e. Arkansas Energy Code 2011 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    - f. Arkansas State Plumbing Code 2018
    - g. Arkansas Mechanical Code 2010
    - h. Accessibility Code ICC/ANSI A117.1 2003

### 1.06 CONFLICTING REQUIREMENTS

- A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the

minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

### **1.07 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
  - 4. The Plumbing Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over Plumbing Drawings. Because of the small scale of the Plumbing Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

### **1.08 FEES, PERMITS, AND INSPECTIONS**

- A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.
- B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

### **1.09 SUBMITTALS**

- A. Submittal Schedule
  - 1. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
    - a. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
    - b. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

- c. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - 1) Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  - d. Format: Arrange the following information in a tabular format:
    - 1) Scheduled date for first submittal.
    - 2) Specification Section number and title.
    - 3) Submittal category: Action; informational.
    - 4) Name of subcontractor.
    - 5) Description of the Work covered.
    - 6) Scheduled date for Engineer's final release or approval.
- B. Submittal Administrative Requirements
  - 1. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
    - a. Submit submittals to Engineer through the Architect.
    - b. Engineer, through Architect, will return annotated file.
  - 2. Digital Data Files:
    - a. Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
    - b. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
    - c. Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings, or Revit model.
  - 3. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
    - a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
    - b. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
    - c. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
    - d. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      - 1) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
  - 4. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
    - a. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
    - b. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
    - c. Resubmittal Review: Allow 14 days for review of each resubmittal.
  - 5. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:



- a. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
- b. Name file with submittal number or other unique identifier, including revision identifier.
  - 1) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
- c. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
- d. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
  - 1) Project name.
  - 2) Name and address of Architect.
  - 3) Name and address of Engineer.
  - 4) Name of Contractor.
  - 5) Name of firm or entity that prepared submittal.
  - 6) Names of subcontractor, manufacturer, and supplier.
  - 7) Category and type of submittal.
  - 8) Submittal purpose and description.
  - 9) Specification Section number and title.
  - 10) Specification paragraph number or drawing designation and generic name for each of multiple items.
  - 11) Drawing number and detail references, as appropriate.
  - 12) Location(s) where product is to be installed, as appropriate.
  - 13) Related physical samples submitted directly.
  - 14) Indication of full or partial submittal.
  - 15) Transmittal number.
  - 16) Submittal and transmittal distribution record.
  - 17) Other necessary identification.
  - 18) Remarks.
- e. Metadata: Include the following information as keywords in the electronic submittal file metadata:
  - 1) Project name.
  - 2) Number and title of appropriate Specification Section.
  - 3) Manufacturer name.
  - 4) Product name.
6. Options: Identify options requiring selection by Engineer.
7. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
8. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - a. Note date and content of previous submittal.
  - b. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - c. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
9. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
10. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

11. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - a. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - b. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor through Architect of approval or rejection of proposed comparable product request within 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - 1) Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

#### **1.10 CLOSEOUT SUBMITTALS**

- A. Closeout submittals shall include, but not limited to, the following:
  1. Operation and Maintenance Materials
  2. Final Approved Submittals
- B. Operation and Maintenance Materials Submittals
  1. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
    - a. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
    - b. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
  2. Format: Submit operations and maintenance manuals in the following format:
    - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
      - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      - 2) Enable inserted reviewer comments on draft submittals.
    - b. In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the "Closeout Documents". Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer, through Architect, will return two copies. The two paper copies will be provided to the Owner as part of the "Closeout Documents"
  3. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.
    - a. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.
- C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.

- f. Application of testing agency labels and seals.
  - g. Notation of coordination requirements.
  - h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
  - a. Wiring diagrams showing factory-installed wiring.
  - b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
- F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."
- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."
- H. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on

evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- Q. Pre-construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

#### **1.11 QUALITY ASSURANCE**

- A. Products:
  - 1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
    - a. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    - b. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

#### **1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage..
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

### **1.13 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submit warranties in accordance with "Closeout Procedures."

### **1.14 FIELD CONDITIONS**

- A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

### **1.15 WARRANTY**

- A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the plumbing under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

## **PART 2 PRODUCTS**

### **2.01 DELEGATED-DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 2 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## **2.02 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  5. Where products are accompanied by the term "as selected," Architect will make selection.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  7. Products containing asbestos shall not be used.
- B. Product Selection Procedures:
  1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
  5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Selection Procedure: Where Specifications include the phrase "as selected by Architect" or similar phrase, select a product that complies with requirements. Architect will select option from manufacturer's product line that includes both standard and premium items.
- D. Comparable Products
  - 1. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
    - a. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
    - b. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - c. Evidence that proposed product provides specified warranty.
    - d. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
    - e. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

## **2.03 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed valves and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
  - 1. Floor Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, low voltage, and electrical work. Supplement plan drawings with section drawings where required to adequately represent the work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, plumbing, fire protection, low voltage, and electrical equipment, and related work.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, low voltage, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  6. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
  7. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: DXF operating in Microsoft Windows operating system.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.

#### **2.04 EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

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



- F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- G. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- H. Operation Manual
  - 1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
    - a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
    - b. Performance and design criteria if Contractor has delegated design responsibility.
    - c. Operating standards.
    - d. Operating procedures.
    - e. Operating logs.
    - f. Wiring diagrams.
    - g. Control diagrams.
    - h. Piped system diagrams.
    - i. Precautions against improper use.
    - j. License requirements including inspection and renewal dates.
  - 2. Descriptions: Include the following:
    - a. Product name and model number. Use designations for products indicated on Contract Documents.
    - b. Manufacturer's name.
    - c. Equipment identification with serial number of each component.
    - d. Equipment function.
    - e. Operating characteristics.
    - f. Limiting conditions.
    - g. Performance curves.
    - h. Engineering data and tests.
    - i. Complete nomenclature and number of replacement parts.
  - 3. Operating Procedures: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Instructions on stopping.
    - f. Normal shutdown instructions.
    - g. Seasonal and weekend operating instructions.
    - h. Required sequences for electric or electronic systems.
    - i. Special operating instructions and procedures.
  - 4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- I. Maintenance Manuals

1. Content: Organize manual into a separate section for each product, system, subsystem, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
2. Source Information: List each product, system, or subsystem included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
3. Product Information: Include the following, as applicable:
  - a. Product name and model number.
  - b. Manufacturer's name.
  - c. Color, pattern, and texture.
  - d. Material and chemical composition.
  - e. Reordering information for specially manufactured products.
  - f. Standard maintenance instructions and bulletins.
  - g. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - h. Identification and nomenclature of parts and components.
  - i. List of items recommended to be stocked as spare parts.
4. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Schedule for routine cleaning and maintenance.
  - e. Repair instructions.
  - f. Test and inspection instructions.
  - g. Troubleshooting guide.
  - h. Precautions against improper maintenance.
  - i. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - j. Aligning, adjusting, and checking instructions.
  - k. Demonstration and training video recording, if available.
5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - a. Include procedures to follow and required notifications for warranty claims.
7. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
8. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
9. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
10. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - a. Include procedures to follow and required notifications for warranty claims.

## **PART 3 EXECUTION**

### **3.01 CONTRACTOR'S SUBMITTAL REVIEW**

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### **3.02 ENGINEER'S SUBMITTAL ACTION**

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the Architect to forward to the appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

### **3.03 CONSTRUCTION WASTE**

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Disposal: Remove waste materials from Owner's property and legally dispose of them

### **3.04 GENERAL COORDINATION FOR PLUMBING WORK**

- A. The Contractor shall compare the Plumbing Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the Plumbing Work. The Plumbing Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the Plumbing Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them

shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.

- D. Locations of pipes, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.
  - 1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
  - 2. Offsets, transitions and changes in direction in pipes shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.
  - 3. Installation and Arrangement: The Contractor shall install all Plumbing Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
  - 4. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.
- E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.
- F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection
- G. Inaccessible Equipment
  - 1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
  - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
- H. Electrical Coordination
  - 1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
  - 2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.

3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, and similar items required for the proper operation of the Plumbing equipment.
- I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints.

### **3.05 CUTTING AND PATCHING**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
  2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.
  3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  5. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.06 PAINTING**

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
  1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
  3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  4. Do not paint piping specialties with factory-applied finish.
  5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
  6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

**END OF SECTION 220000**

**SECTION 220513  
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General construction and requirements.
- B. Applications.

**1.02 RELATED REQUIREMENTS**

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. NEMA MG 00001 - Motors and Generators; 2024.
- B. NFPA 70 - National Electrical 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. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Provide certificate of compliance indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

**PART 2 PRODUCTS**

**2.01 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Electrical Service: Refer to Section 260583 for required electrical characteristics.
- B. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 104 degrees F environment.

3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- D. Wiring Terminations:
  1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

## **2.02 APPLICATIONS**

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

**END OF SECTION 220513**



**SECTION 220516  
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

**1.02 RELATED REQUIREMENTS**

- A. Section 221005 - Plumbing Piping.

**1.03 REFERENCE STANDARDS**

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- C. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- D. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2025.
- E. EJMA (STDS) - EJMA Standards; Eleventh Edition.
- F. FM (AG) - FM Approval Guide; Current Edition.
- G. ITS (DIR) - Directory of Listed Products; current edition.
- H. UL (DIR) - Online Certifications Directory; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Indicate selection calculations.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- E. Maintenance Data: Include adjustment instructions.
- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Packing for Packed Expansion Joints: One set for each joint.

**PART 2 PRODUCTS**

**2.01 REGULATORY REQUIREMENTS**

- A. Comply with UL (DIR) requirements.

**2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING**

- A. Manufacturers:
  - 1. Mercer Rubber Company; \_\_\_\_\_: [www.mercer-rubber.com/#sle](http://www.mercer-rubber.com/#sle).
  - 2. The Metraflex Company; \_\_\_\_\_: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).

3. Substitutions: See Section 016000 - Product Requirements.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

### **2.03 EXPANSION JOINTS AND LOOPS - COPPER HOSE AND BRAID**

- A. Manufacturers:
  1. The Metraflex Company; Metraloop: [www.metroflex.com/#sle](http://www.metroflex.com/#sle).
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.
- C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- D. Flexible Connectors: Welded, braided type with wetted components of \_\_\_\_\_copper, sized to match piping.
  1. Maximum Allowable Working Pressure: 200 \_\_\_\_\_ psig at 250 degrees F \_\_\_\_\_ degrees F.
  2. Accommodate the Following:
    - a. Axial Deflection in Compression and Expansion: 4 inch.
    - b. Lateral Movement: 4 inch.
    - c. Angular Rotation: 15 degrees.
    - d. Force developed by 1.5 times specified maximum allowable operating pressure.
  3. End Connections: Same as specified for pipe jointing.
  4. Provide necessary accessories including, but not limited to, swivel joints.

### **2.04 EXPANSION JOINTS AND LOOPS - CARBON STEEL HOSE AND BRAID**

- A. Manufacturers:
  1. The Metraflex Company; Metraloop-Gas: [www.metroflex.com/#sle](http://www.metroflex.com/#sle).
  2. Substitutions: See Section 016000-Product Requirements.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.
- C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- D. Flexible Connectors: Welded, braided typewith components of stainless steel with components of carbon steel, sized to match piping.
  1. Maximum Allowable Working Pressure: 150 psig..
  2. Accommodate the Following:
    - a. Axial Deflection in Compression and Expansion: inch.
    - b. Lateral Movement: 4inch.
    - c. Angular Rotation: 15 degrees.
    - d. Force developed by 1.5 times specified maximum allowable operating pressure.End Connections: Same as specified for pipe jointing.
  3. End Connections: Flanged ductile iron; complying with ASME B16.1 Class 125.End Connections: Threaded; complying with ASME B16.11.
  4. Provide necessary accessories including, but not limited to, swivel joints.

### **2.05**

### **2.06 ACCESSORIES**

- A. Note to Specifier: The stainless steel material option above is an accessory not relating to the material of the other products below.
- B. Pipe Alignment Guides:
  - 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

**END OF SECTION 220516**

**SECTION 220517**  
**SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.
- D. Section 220523 - General-Duty Valves for Plumbing Piping.
- E. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.
- F. Section 220716 - Plumbing Equipment Insulation.
- G. Section 220719 - Plumbing Piping Insulation.

**1.03 REFERENCE STANDARDS**

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Valve Stem Packings: Two for each type and size of valve.

**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 work of the type specified this section.
  - 1. Minimum three years experience.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 PIPE SLEEVES**

- A. Vertical Piping:
  - 1. Sleeve Length: 1 inch above finished floor.

2. Provide sealant for watertight joint.
  3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
1. Zinc coated or cast iron pipe.
  2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
  2. Connect sleeve with floor plate except in mechanical rooms.
- E. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- F. Clearances:
1. Provide allowance for insulated piping.
  2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
  3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

## **2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS**

- A. Manufacturers:
1. Advance Products & Systems, LLC; Innerlynx: [www.apsonline.com/#sle](http://www.apsonline.com/#sle).
  2. Flexicraft Industries; PipeSeal: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  3. Garlock; Link-Seal: [www.garlock.com](http://www.garlock.com).
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Modular/Mechanical Seal:
1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
  2. Provide watertight seal between pipe and wall/casing opening.
  3. Elastomer element size and material in accordance with manufacturer's recommendations.
  4. Glass reinforced plastic pressure end plates.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

### **3.02 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
1. Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, partitions, and \_\_\_\_\_. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
  2. Aboveground Piping:
    - a. Pack solid using mineral fiber complying with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
  4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### **3.03 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION 220517**

**SECTION 220519  
METERS AND GAUGES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure gauges.

**1.02 RELATED REQUIREMENTS**

- A. Section 230923 - Direct-Digital Control System for HVAC.

**1.03 REFERENCE STANDARDS**

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements. for additional provisions.

**1.05 FIELD CONDITIONS**

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**PART 2 PRODUCTS**

**2.01 PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc; \_\_\_\_\_: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 2. Moeller Instrument Company, Inc; \_\_\_\_\_: [www.moellerinstrument.com/#sle](http://www.moellerinstrument.com/#sle).
  - 3. Omega Engineering, Inc; \_\_\_\_\_: [www.omega.com/#sle](http://www.omega.com/#sle).
  - 4. \_\_\_\_\_.
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - 1. Case: Steel with brass bourdon tube.
  - 2. Size: 4-1/2 inch diameter.
  - 3. Mid-Scale Accuracy: One percent.
  - 4. Scale: Psi.

**2.02 PRESSURE GAUGE TAPPINGS**

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

**2.03 STEM TYPE THERMOMETERS**

- A. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with

positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F.

#### **2.04 THERMOMETER SUPPORTS**

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

#### **2.05 TEST PLUGS**

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

#### **2.06 STATIC PRESSURE GAUGES**

- A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- C. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 230943.
- D. Coil and conceal excess capillary on remote element instruments.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- H. Locate test plugs where indicated.

#### **3.02 SCHEDULES**

**END OF SECTION 220519**



**SECTION 220523**  
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Applications.
- B. General requirements.
- C. Ball valves.
- D. Butterfly valves.
- E. Check valves.
- F. Plug valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels.
- C. Section 220553 - Identification for Plumbing Piping and Equipment.
- D. Section 220719 - Plumbing Piping Insulation.
- E. Section 221005 - Plumbing Piping.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. TFE: Tetrafluoroethylene.

**1.04 REFERENCE STANDARDS**

- A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
- H. ASME B31.9 - Building Services Piping; 2017.
- I. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

- M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).
- O. AWWA C606 - Grooved and Shouldered Joints; 2015.
- P. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).
- Q. MSS SP-67 - Butterfly Valves; 2017.
- R. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.
- S. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- T. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- U. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- V. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- W. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.
- X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- Y. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2018.
- Z. NSF 61 - Drinking Water System Components - Health Effects; 2019.
- AA. NSF 372 - Drinking Water System Components - Lead Content; 2016.

#### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
  - 5. Secure check valves in either the closed position or open position.
  - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.

- a. Provide temporary inlet and outlet caps.
  - b. Maintain caps in place until installation.
- 2. Store valves in shipping containers and maintain in place until installation.
  - a. Store valves indoors in dry environment.
  - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

#### **1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:**

- A. Avoid the use of operating handles or stems as rigging or lifting points.

### **PART 2 PRODUCTS**

#### **2.01 APPLICATIONS**

- A. See drawings for specific valve locations.
- B. Provide the following valves for the applications if not indicated on drawings:
  - 1. Shutoff: Ball, butterfly, gate or plug.
  - 2. Dead-End: Single-flange butterfly (lug) type.
  - 3. Throttling: Provide ball or butterfly.
  - 4. Swing Check (Pump Outlet):
    - a. 2 NPS and Smaller: Bronze swing check valves with bronze disc.
    - b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
- C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
  - 1. Copper Tube:
    - a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
    - b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
- E. Domestic, Hot and Cold Water Valves:
  - 1. 2 NPS and Smaller:
    - a. Bronze, Lead-Free \_\_\_\_\_: Provide with threaded ends.
    - b. Ball: Two piece, full port, \_\_\_\_\_ with stainless-steel trim.
    - c. Bronze Swing Check: Class 125, bronze disc.
  - 2. 2-1/2 NPS and Larger:
    - a. Iron, 2-1/2 NPS to 4 NPS: Provide with flanged ends.
    - b. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
    - c. Iron Swing Check: Class 125, metal seats.

#### **2.02 GENERAL REQUIREMENTS**

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  - 1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
  - 2. Handwheel: Valves other than quarter-turn types.
  - 3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
  - 4. Wrench: Plug valves with square heads.
- D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
  - 1. Gate Valves: Rising stem.

2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  3. Butterfly Valves: Extended neck.
  4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
  2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
  3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
  4. Solder Joint Connections: ASME B16.18.
  5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  2. Solder-joint Connections: ASME B16.18.
  3. Building Services Piping Valves: ASME B31.9.
- G. Valve Materials for Potable Water: NSF 61 and NSF 372.
- H. Bronze Valves:
1. Fabricate from dezincification resistant material.
  2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

### **2.03 BRONZE BALL VALVES**

- A. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Bronze.
  5. Ends: Threaded.
  6. Seats: PTFE or TFE.
  7. Stem: Stainless steel.
  8. Ball: Stainless steel, vented.
  9. Manufacturers:
    - a. Apollo Valves; \_\_\_\_\_.
    - b. Nibco; T-585HP-66-If.
    - c. Watts LFB6080G2-SS.
    - d. Webstone; H-x170.
    - e. Jomar Valve; T-200
    - f. Substitutions: See Section 016000 - Product Requirements.

### **2.04 IRON, SINGLE FLANGE BUTTERFLY VALVES**

- A. Lug type: Bi-directional dead-end service without use of downstream flange.
1. Comply with MSS SP-67, Type I.
  2. CWP Rating: 200 psig.
  3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
  4. Stem: One or two-piece stainless steel.
  5. Seat: EPDM.
  6. Disc: Coated ductile iron.
  7. Manufacturers:
    - a. Apollo Valves; \_\_\_\_\_: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Jomar Valve; HPBFV series: [www.jomarvalve.com](http://www.jomarvalve.com).
    - c. \_\_\_\_\_.

## **2.05 BRONZE SWING CHECK VALVES**

- A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).
  - 1. Comply with MSS SP-80, Type 3.
  - 2. Design: Horizontal flow.
  - 3. Body: Bronze, lead-free, ASTM B62.
  - 4. Ends: Threaded as indicated.
  - 5. Disc: Bronze.
  - 6. Manufacturers:
    - a. Apollo Valves61YLF: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Jomar Valves; T-511G: [www.jomarvalve.com](http://www.jomarvalve.com).
    - c. \_\_\_\_\_.
    - d. Substitutions: See Section 016000 - Product Requirements.

## **2.06 IRON SWING CHECK VALVES**

- A. Class 125:
  - 1. Comply with MSS SP-71, Type I.
  - 2. CWP Rating: 200 psig.
  - 3. Design: Clear or full waterway.
  - 4. Body: ASTM A126, gray iron with bolted bonnet.
  - 5. Ends: Flanged as indicated.
  - 6. Trim: Composition.
  - 7. Seat Ring and Disc Holder: Bronze.
  - 8. Disc: PTFE or TFE.
  - 9. Gasket: Asbestos free.
  - 10. Manufacturers:
    - a. Apollo Valves; \_\_\_\_\_: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Ferguson Enterprises Inc; \_\_\_\_\_: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
- B. Class 250:
  - 1. Comply with MSS SP-71, Type I.
  - 2. CWP Rating: 500 psig.
  - 3. Design: Clear or full waterway.
  - 4. Body: ASTM A126, gray iron with bolted bonnet.
  - 5. Ends: Flanged as indicated.
  - 6. Trim: Bronze.
  - 7. Metal Seat.
  - 8. Gasket: Asbestos free.

## **2.07 IRON SWING CHECK VALVES WITH CLOSURE CONTROL**

- A. Class 125 with Lever and Spring-Closure Control.
  - 1. Comply with MSS SP-71, Type I.
  - 2. Description:
    - a. CWP Rating: 200 psig.
    - b. Design: Clear or full waterway.
    - c. Body: ASTM A126, gray iron with bolted bonnet.
    - d. Ends: Flanged as indicated.
    - e. Trim: Bronze.
    - f. Gasket: Asbestos free.
    - g. Closer Control: Factory installed, exterior lever, and weight.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

### **3.02 INSTALLATION**

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Lift Check: Install with stem plumb and vertical.
  - 2. Swing Check: Install horizontal maintaining hinge pin level.

**END OF SECTION 220523**

**SECTION 220529**  
**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment components for equipment, piping, and other plumbing work.

**1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

**1.03 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. MFMA-4 - Metal Framing Standards Publication; 2004.
- H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems and thermal insulated pipe supports.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
  - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Installer's Qualifications: Include evidence of compliance with specified requirements.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding: As specified in Section 055000.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
  - 1. Comply with MSS SP-58.
  - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: Comply with Section 055000.
- C. Metal Channel (Strut) Framing Systems:
  - 1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 2. Comply with MFMA-4.
  - 3. Channel Material:



- a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
- 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
- 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
    - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- E. Thermal Insulated Pipe Supports:
  - 1. General Construction and Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
    - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
  - 2. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    - c. Thickness: 60 mil.
  - 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- F. Pipe Supports:
  - 1. Liquid Temperatures Up To 122 degrees F:
    - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    - b. Support From Below: MSS SP-58 Types 35 through 38.
  - 2. Operating Temperatures from 122 to 446 degrees F:
    - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
- G. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
  - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- H. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
  - 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- I. Riser Clamps:
- J. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- K. Strut Clamps: Two-piece pipe clamp.
- L. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- M. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
  - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

- N. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
  - 1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
  - 2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
  - 3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
  - 4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
  - 5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
  - 6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- O. Pipe Alignment Guides: Galvanized steel.
  - 1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
  - 2. Pipe Diameter 10 inches and Larger: Roller type.
- P. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- Q. Pipe Shields for Insulated Piping:
  - 1. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    - d. Minimum Service Temperature: Minus 40 degrees F.
    - e. Maximum Service Temperature: 178 degrees F.
    - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- R. Anchors and Fasteners:
  - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  - 4. Hollow Masonry: Use toggle bolts.
  - 5. Hollow Stud Walls: Use toggle bolts.
  - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  - 7. Sheet Metal: Use sheet metal screws.
  - 8. Wood: Use wood screws.
  - 9. Plastic and lead anchors are not permitted.
  - 10. Powder-actuated fasteners are permitted only as follows:
    - a. Where approved by Architect.
  - 11. Hammer-driven anchors and fasteners are not permitted.
  - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
    - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
  - 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.

- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
  - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 220529**

**SECTION 220553**  
**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

**1.02 RELATED REQUIREMENTS**

- A. Section 099123 - Interior Painting: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Control Panels: Nameplates.
- B. Heat Transfer Equipment: Nameplates.
- C. Piping: Pipe markers.
- D. Small-sized Equipment: Tags.
- E. Valves: Tags \_\_\_\_.

**2.02 NAMEPLATES**

- A. Manufacturers:
  - 1. Brimar Industries, Inc; \_\_\_\_: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch.
  - 3. Background Color: Black.
  - 4. Plastic: Comply with ASTM D709.

**2.03 TAGS**

- A. Manufacturers:
  - 1. Brimar Industries, Inc; \_\_\_\_: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Kolbi Pipe Marker Co; \_\_\_\_: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

## **2.04 PIPE MARKERS**

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Comply with ASME A13.1.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Color code as follows:
  - 1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
  - 2. Compressed Air: Blue with white letters.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 099123 for stencil painting.

### **3.02 INSTALLATION**

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 099123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Use tags on piping 3/4 inch diameter and smaller.
  - 1. Identify service, flow direction, and pressure.
  - 2. Install in clear view and align with axis of piping.
  - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

### **3.03 SCHEDULES: INSTALL BELOW PER ANSI A13.1 STANDARDS**

- A. Equipment Type:
  - 1. Identification: Name of Equipment
  - 2. Background:
    - a. Size:
    - b. Color: Black
  - 3. Lettering:
    - a. Size:
    - b. Color: White
- B. Potable Water:
  - 1. Background:
    - a. Size: Per pipe OD
    - b. Color: Green
  - 2. Lettering:
    - a. Size: Per pipe OD

- b. Color: White
- C. Natural Gas/LP Gas:
  - 1. Background:
    - a. Size: Per pipe OD
    - b. Color: Yellow
  - 2. Lettering:
    - a. Size: Per pipe OD
    - b. Color: Black
- D. Compressed Air:
  - 1. Background:
    - a. Size: Per pipe OD
    - b. Color: Blue
  - 2. Lettering:
    - a. Size: Per pipe OD
    - b. Color: White

**END OF SECTION 220553**

**SECTION 220719  
PLUMBING PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 099123 - Interior Painting: Painting insulation jacket.
- C. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

**1.07 FIELD CONDITIONS**

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

**PART 2 - PRODUCTS**

**2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

## 2.02 GLASS FIBER

- A. Manufacturers:
  - 1. Johns Manville Corporation; Micro-Lok: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 2. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 3. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
  - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
  - 2. Maximum Service Temperature: 650 degrees F.
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
  - 1. Cloth: Untreated; 9 oz/sq yd weight.
  - 2. Blanket: 1.0 lb/cu ft density.
  - 3. Weave: 5 by 5.
- H. Indoor Vapor Barrier Finish:
  - 1. Vinyl emulsion type acrylic, compatible with insulation, white color.

## 2.03 JACKETS

- A. PVC Plastic.
  - 1. Manufacturers:
    - a. Johns Manville Corporation; \_\_\_\_\_: [www.jm.com/#sle](http://www.jm.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
  - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F.
    - b. Maximum Service Temperature: 150 degrees F.
    - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil.
    - e. Connections: Brush on welding adhesive.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.



- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
  - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

### **3.03 SCHEDULES**

- A. Plumbing Systems:
  - 1. Domestic Cold Water:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: All Sizes.
      - (a) Thickness: 1/2 inch.
  - 2. Domestic Hot Water Supply and Hot Water Recirculation:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: NPS 2" and Larger.
      - (a) Thickness: 1 inch.
      - 2) Pipe Size Range: NPS 2-1/2" and Larger.
      - (a) Thickness: 1-1/2" inch.
  - 3. Roof Drainage Run Horizontal at Roof Level: Glass Fiber Insulation, 2"

**END OF SECTION 220719**

**SECTION 221005  
PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Domestic water.
  - 3. Storm water.
  - 4. Pipe hangers and supports.
  - 5. Valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 220553 - Identification for Plumbing Piping and Equipment.
- B. Section 220719 - Plumbing Piping Insulation.
- C. Section 312316 - Excavation.
- D. Section 312316.13 - Trenching.
- E. Section 312323 - Fill.
- F. Section 330110.58 - Disinfection of Water Utility Piping Systems.

**1.03 REFERENCE STANDARDS**

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- E. ASME B31.9 - Building Services Piping; 2017.
- F. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2026.
- G. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- I. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2026.
- J. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- K. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- L. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2026.
- M. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- N. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.
- O. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.
- P. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).
- Q. AWWA C651 - Disinfecting Water Mains; 2023.

- R. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- S. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- T. NSF 61 - Drinking Water System Components - Health Effects; 2019.
- U. NSF 372 - Drinking Water System Components - Lead Content; 2016.
- V. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2017.

#### **1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Project Record Documents: Record actual locations of valves.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.07 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

### **PART 2 - PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

#### **2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.
  - 3. Tensile Strength: 21,000 psig minimum.
  - 4. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.

5. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
  1. Fittings: PVC.
  2. Joints: Solvent welded, with ASTM D2564 solvent cement.

### **2.03 SANITARY SEWER PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  1. Fittings: Cast iron.
  2. Joints: ASTM A 888 and CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
  3. CISPI, Hubless-Piping Couplings:
    - a. [Manufacturers](#): Subject to compliance with requirements. Provide products by one of the following:
      - 1) a. Ideal Tridon
      - 2) b. ANACO-Husky
      - 3) c. Tyler Couplings
      - 4) d. Mission Rubber Company
    - b. Standards: ASTM C 1277 and CISPI 310.
    - c. Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Couplings shall bear the trademark NSF International.
    - d. Couplings in "Heavy-Duty, Hubless-Piping Couplings" Paragraph below are made in NPS 1-1/2 to NPS 15.
    - e. Heavy-Duty, Hubless-Piping Couplings:
      - 1) [Manufacturers](#): Subject to compliance with requirements. Provide products by one of the following:
        - (a) a. Ideal Tridon
        - (b) b. ANACO-Husky
        - (c) c. Tyler Couplings
        - (d) d. Mission Rubber Company
      - 2) Standards: ASTM C 1540.
      - 3) Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- B. Copper Tube: ASTM B306, DWV.
  1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
  2. Joints: ASTM B32, alloy Sn50 solder.

### **2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
  1. Manufacturers:
    - a. Uponor, Inc: [www.uponorengineering.com/#sle](http://www.uponorengineering.com/#sle).
    - b. Viega LLC; PureFlow PEX with Corrugated Sleeve: [www.viega.us/#sle](http://www.viega.us/#sle).
  2. PPI TR-4 Pressure Design Basis:
  3. Fittings: Brass and engineered polymer (EP) ASTM F1960.
  4. Joints: ASTM F1960 cold-expansion fittings.

### **2.05 DOMESTIC WATER PIPING, ABOVE GRADE**

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
  1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  2. Joints: ASTM B32, alloy Sn95 solder.

3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
  - a. Manufacturers:
    - 1) Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - 2) Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - 3) Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
    - 4) Viega LLC: [www.viega.us/#sle](http://www.viega.us/#sle).
    - 5) Substitutions: See Section 016000 - Product Requirements.

## **2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
  1. Fittings: Cast iron.
  2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
  1. Fittings: PVC.
  2. Joints: Solvent welded, with ASTM D2564 solvent cement.

## **2.07 STORM WATER PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  1. Fittings: Cast iron.
  2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
  3. Heavy-Duty, Hubless-Piping Couplings: Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
    - a. Ideal Tridon
    - b. ANACO-Husky
    - c. Tyler Couplings.
    - d. Mission Rubber Company.
    - e. Standards: ASTM C 1540. Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### **3.02 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Buried PVC pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- E. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  1. Refer to Section 220719.
- H. Provide access where valves and fittings are not exposed.

- I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- L. Excavate in accordance with Section 312316.
- M. Backfill in accordance with Section 312323.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. Refer to Section 220523.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- S. Sleeve pipes passing through partitions, walls, and floors.
- T. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### **3.04 APPLICATION**

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Provide flow controls in water recirculating systems where indicated.

### **3.05 TOLERANCES**

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.

### **3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfect water distribution system in accordance with Section 330110.58.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### **3.07 SERVICE CONNECTIONS**

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.

### **3.08 SCHEDULES**

- A. Pipe Hanger Spacing:
  - 1. Metal Piping:
    - a. Pipe Size: 1/2 inches to 1-1/4 inches:
      - 1) Maximum Hanger Spacing: 6.5 ft.
      - 2) Hanger Rod Diameter: 3/8 inches.
    - b. Pipe Size: 1-1/2 inches to 2 inches:
      - 1) Maximum Hanger Spacing: 10 ft.
      - 2) Hanger Rod Diameter: 3/8 inch.
    - c. Pipe Size: 2-1/2 inches to 3 inches:
      - 1) Maximum Hanger Spacing: 10 ft.
      - 2) Hanger Rod Diameter: 1/2 inch.
    - d. Pipe Size: 4 inches to 6 inches:

**END OF SECTION 221005**

**SECTION 221006  
PLUMBING PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Drains.
- B. Cleanouts.
- C. Hydrants.
- D. Washing machine boxes and valves.
- E. Refrigerator valve and recessed box.
- F. Backflow preventers.
- G. Water hammer arrestors.
- H. Mixing valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 221005 - Plumbing Piping.
- B. Section 223000 - Plumbing Equipment.
- C. Section 224000 - Plumbing Fixtures.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.6.3 - Floor Drains; 2022.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- D. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- E. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- F. NSF 61 - Drinking Water System Components - Health Effects; 2019.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2016.
- H. PDI-WH 201 - Water Hammer Arresters; 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Manufacturer's Qualification Statement.
- F. Operation Data: Indicate frequency of treatment required for interceptors.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- H. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, \_\_\_\_\_.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**



- A. Accept specialties on site in original factory packaging. Inspect for damage.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.
- B. Refer to plumbing schedules on drawings for piping specialties requirements not defined in this section.

### **2.02 DRAINS**

- A. Roof Drains:
  - 1. Assembly: ASME A112.6.4.
  - 2. Body: Lacquered cast iron with sump.
  - 3. Strainer: Removable polyethylene dome with vandal proof screws.
  - 4. Accessories: Coordinate with roofing type, refer to Section \_\_\_\_\_:
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Adjustable under deck clamp.
    - c. Roof sump receiver.
  - 5. Manufacturers:
    - a. Jay R. Smith Manufacturing Company: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
- B. Roof Overflow Drains:
  - 1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 3 inches above flood elevation.
- C. Downspout Nozzles:
  - 1. Bronze round with straight bottom section.
- D. Floor Drains:
  - 1. Manufacturers:
    - a. Jay R. Smith Manufacturing Company: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
    - b. Zurn Industries.
- E. Floor Drain (FD-1):
  - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- F. Floor Sink (FS-1):
  - 1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, half grate.

### **2.03 CLEANOUTS**

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com/#sle](http://www.jayrsmith.com/#sle).
  - 2. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Cleanouts at Exterior Surfaced Areas (COTG):
  - 1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Exterior Unsurfaced Areas (COTG):
  - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- D. Cleanouts at Interior Finished Floor Areas (FCO):
  - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- E. Cleanouts at Interior Finished Wall Areas (WCO):

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas (FCO): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

## **2.04 HYDRANTS**

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com/#sle](http://www.jayrsmith.com/#sle).
  2. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  3. Woodford.
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Wall Hydrants:
1. ASSE 1019; freeze resistant, self-draining type with polished bronze lockable recessed box hose thread spout, lockshield and removable key, and integral vacuum breaker.

## **2.05 REFRIGERATOR VALVE AND RECESSED BOX**

- A. Box Manufacturers:
1. IPS Corporation/Water-Tite: [www.ipscorp.com/#sle](http://www.ipscorp.com/#sle).
  2. Oatey Supply Chain Services, Inc: [www.oatey.com/#sle](http://www.oatey.com/#sle).
  3. Substitutions: See Section 016000 - Product Requirements.
- B. Valve Manufacturers:
1. IPS Corporation/Water-Tite: [www.ipscorp.com/#sle](http://www.ipscorp.com/#sle).
  2. Substitutions: See Section 016000 - Product Requirements.
- C. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

## **2.06 BACKFLOW PREVENTERS**

- A. Manufacturers:
1. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  2. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  3. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
- B. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## **2.07 WATER HAMMER ARRESTORS**

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com/#sle](http://www.jayrsmith.com/#sle).
  2. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  3. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  4. Souix Chief.
- B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

## **2.08 MIXING VALVES**

- A. Thermostatic Mixing Valves:
1. Manufacturers:

- a. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
  - b. Leonard Valve Company: [www.leonardvalve.com/#sle](http://www.leonardvalve.com/#sle).
  - c. Substitutions: See Section 016000 - Product Requirements.
- 2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- 3. Accessories:
  - a. Check valve on inlets.
  - b. Volume control shut-off valve on outlet.
  - c. Stem thermometer on outlet.
  - d. Strainer stop checks on inlets.

## **2.09 AIR VENTS**

- A. Manufacturers:
  - 1. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
  - 2. ITT Bell & Gossett: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  - 3. Taco, Inc: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
- B. Float Type:
  - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

## **2.10 FLOOR DRAIN TRAP SEALS**

- A. Manufacturers:
  - 1. MIFAB, Inc: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 2. JR Smith.
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to fixture.

**END OF SECTION 221006**

**SECTION 223000  
PLUMBING EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Water Heaters:
  - 1. Commercial electric.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.

**1.02 RELATED REQUIREMENTS**

- A. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
  - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  - 2. Indicate pump type, capacity, power requirements.
  - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
  - 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
  - 1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.
- D. Project Record Documents: Record actual locations of components.
- E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
  - 1. Water Heaters: NSF approved.
  - 2. Electric Water Heaters: UL listed and labeled to UL 174.

3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

#### **1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

### **PART 2 - PRODUCTS**

#### **2.01 WATER HEATERS**

- A. Manufacturers:
  1. A.O. Smith Water Products Co: [www.hotwater.com/#sle](http://www.hotwater.com/#sle).
  2. Rheem Manufacturing Company: [www.rheem.com/#sle](http://www.rheem.com/#sle).
  3. Substitutions: See Section 016000 - Product Requirements.
- B. Commercial Electric:
  1. Type: Factory-assembled and wired, electric, vertical storage.
  2. Performance:
    - a. Refer to equipment schedules.
  3. Electrical Characteristics:
    - a. 208 volts, three phase, 60 Hz.
    - b. 37.5 amperes maximum \_\_\_\_\_.
  4. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
  5. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
  6. Accessories:
    - a. Water Connections: Brass.
    - b. Dip Tube: Brass.
    - c. Drain valve.
    - d. Anode: Magnesium.
    - e. Temperature and Pressure Relief Valve: ASME labeled.
  7. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch glass fiber; enclosed with 16 gage, 0.0598 inch steel jacket; baked enamel finish.
  8. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
  9. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

#### **2.02 DIAPHRAGM-TYPE COMPRESSION TANKS**

- A. Manufacturers:
  1. Amtrol Inc: [www.amtrol.com/#sle](http://www.amtrol.com/#sle).

2. Bell & Gossett, a xylem brand: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  3. Taco, Inc: [www.taco-hvac.com/#sle](http://www.taco-hvac.com/#sle).
  4. Elbi USA.
  5. Substitutions: See Section 016000 - Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

### **2.03 IN-LINE CIRCULATOR PUMPS**

- A. Manufacturers:
1. Armstrong Fluid Technology: [www.armstrongfluidtechnology.com/#sle](http://www.armstrongfluidtechnology.com/#sle).
  2. Bell & Gossett, a xylem brand: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  3. Taco.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Noryl.
- D. Shaft: Ceramic with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.
- G. Performance:
1. Flow: 6 gpm, at 25 feet head.
  2. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz, \_\_\_\_\_ minimum circuit ampacity.

### **2.04 ELECTRICAL WORK**

- A. Electrical characteristics to be as specified or indicated.
- B. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.
- C. Pumps:
1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
  2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

**END OF SECTION 223000**

**SECTION 224000  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Water closets.
- B. Lavatories.
- C. Sinks.
- D. Mop sinks.
- E. Under-lavatory pipe supply covers.
- F. Electric water coolers.

**1.02 RELATED REQUIREMENTS**

- A. Section 221005 - Plumbing Piping.
- B. Section 221006 - Plumbing Piping Specialties.
- C. Section 223000 - Plumbing Equipment.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- F. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- I. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2020.
- J. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- K. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. NSF 61 - Drinking Water System Components - Health Effects; 2019.
- O. NSF 372 - Drinking Water System Components - Lead Content; 2016.
- P. UL (DIR) - Online Certifications Directory; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

#### **1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

### **PART 2 - PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Refer to plumbing schedules on plumbing drawings for fixture requirements.

#### **2.02 REGULATORY REQUIREMENTS**

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

#### **2.03 FLUSH VALVE WATER CLOSETS**

- A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
  - 1. Flush Valve: Exposed (top spud).
  - 2. Flush Operation: Sensor operated.
  - 3. Handle Height: 44 inches or less.
  - 4. Supply Size: 1-1/2 inches.
  - 5. Outlet Size: 2 inches.
  - 6. Color: White.
  - 7. Manufacturers:
    - a. American Standard, Inc: [www.americanstandard-us.com/#sle](http://www.americanstandard-us.com/#sle).
    - b. Kohler Company: [www.kohler.com/#sle](http://www.kohler.com/#sle).
    - c. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
  - 1. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
  - 2. Manufacturers:
    - a. Sloan Valve Company: [www.sloanvalve.com/#sle](http://www.sloanvalve.com/#sle).
    - b. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
- C. Seats:
  - 1. Manufacturers:



- a. American Standard, Inc: [www.americanstandard-us.com/#sle](http://www.americanstandard-us.com/#sle).
    - b. Bemis Manufacturing Company: [www.bemismfg.com/#sle](http://www.bemismfg.com/#sle).
    - c. Church Seat Company: [www.churchseats.com/#sle](http://www.churchseats.com/#sle).
    - d. Olsonite: [www.olsonite.com/#sle](http://www.olsonite.com/#sle).
    - e. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
    - f. Centoco;.
    - g. Substitutions: See Section 016000 - Product Requirements.
  - 2. Solid white plastic, open front, extended back, brass bolts, without cover.
- D. Water Closet Carriers:
- 1. Manufacturers:
    - a. Jay R. Smith MFG. Co: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
    - b. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
    - c. Substitutions: See Section 016000 - Product Requirements.
  - 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

## 2.04 TANK TYPE WATER CLOSETS

- A. Tank Type Water Closet Manufacturers:
  - 1. Toto USA.
  - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Bowl: ASME A112.19.2; floor mounted, vitreous china reverse trap, close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps.
  - 1. Water Consumption: Maximum 1.28 gallons per flush.
- C. Seat Manufacturers:
  - 1. Toto USA.
  - 2. Substitutions: See Section 016000 - Product Requirements.
- D. Seat: Solid white plastic, open front, extended back, less cover, complete with self-sustaining hinge.
- E. Electric Bidet Seat:
  - 1. Solid white plastic, open front, electronic hinge, retractable washing arm, grounded electrical cord.
  - 2. Manufacturers:
    - a. Toto\_\_\_\_\_ : [www.totousa.com/#sle](http://www.totousa.com/#sle).

## 2.05 LAVATORIES

- A. Lavatory Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com/#sle](http://www.americanstandard-us.com/#sle).
  - 2. Kohler Company: [www.kohler.com/#sle](http://www.kohler.com/#sle).
  - 3. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  - 4. Sloan Valves;.
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 20 \_\_\_\_ by \_\_\_\_ inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
  - 1. Drilling Centers: 4 inch.
- C. Supply Faucet Manufacturers:
  - 1. Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
  - 2. T&S Brass;.
  - 3. Chicago Faucets;
  - 4. Substitutions: See Section 016000 - Product Requirements.

- D. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
  - 1. Spout Style: Standard.
  - 2. Power Supply: 120 VAC.
    - a. Direct wired to junction box.
    - b. For 6V or 24V applications, provide transformer.
  - 3. Mixing Valve: External lever operated.
  - 4. Water Supply: 3/8 inch compression connections.
  - 5. Aerator: Vandal resistant, 0.5 GPM.
  - 6. Automatic Shut-off: 30 seconds.
  - 7. Finish: Polished chrome.
  - 8. Lead Content: Extra low; maximum 0.25 percent by weighed average.
  - 9. Sensor Operated Faucet Manufacturers:
    - a. Sloan Valve Company; \_\_\_\_\_: [www.sloanvalve.com/#sle](http://www.sloanvalve.com/#sle).
    - b. Substitutions: See Section 016000 - Product Requirements.
- E. Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.
  - 1. Manufacturers:
    - a. Acorn Engineering Company: [www.acorneng.com/#sle](http://www.acorneng.com/#sle).
    - b. Cash Acme, a brand of Reliance Worldwide Corporation: [www.cashacme.com/#sle](http://www.cashacme.com/#sle).
    - c. Leonard Valve Company;.
    - d. Substitutions: See Section 016000 - Product Requirements.
- F. Accessories:
  - 1. Chrome plated 17 gage, 0.0538 inch brass P-trap with clean-out plug and arm with escutcheon.
  - 2. Offset waste with perforated open strainer.
  - 3. Loose-key\_\_\_\_\_ stops.
  - 4. Flexible supplies.
  - 5. Carrier:
    - a. Manufacturers:
      - 1) Jay R. Smith MFG. Co: [www.jrsmith.com/#sle](http://www.jrsmith.com/#sle).
      - 2) JOSAM Company: [www.josam.com/#sle](http://www.josam.com/#sle).
      - 3) Zurn Industries, Inc: [www.zurn.com/#sle](http://www.zurn.com/#sle).
      - 4) Wade Carriers;.
      - 5) Substitutions: See Section 016000 - Product Requirements.
    - b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.

## 2.06 SINKS

- A. Sink Manufacturers:
  - 1. Acorn-Sinks
  - 2. Just Manufacturing;.
  - 3. Elkay;
  - 4. Advance Tabco;
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Single Compartment Bowl: ASME A112.19.3; 20 gage, 0.0359 inch thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
  - 1. Drain: 1-1/2 inch chromed brass drain.
- C. Double Compartment Bowl: ASME A112.19.3; 20 gage, 0.0359 inch thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
  - 1. Drain: 1-1/2 inch chromed brass drain.
  - 2. Drain: 3-1/2 inch crumb cup and tailpiece.

## **2.07 UNDER-LAVATORY PIPE SUPPLY COVERS**

- A. Manufacturers:
  - 1. Plumberex Specialty Products, Inc: [www.plumberex.com/#sle](http://www.plumberex.com/#sle).
  - 2. Trubro, IPS Corporation; Lav Guard 2.
  - 3. McGuire; ProWrap.
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Basis of Design: Plumberex Specialty Products, Inc; [www.plumberex.com/#sle](http://www.plumberex.com/#sle).
  - 1. Under-Lavatory Covers with Snap-Lock Fasteners (Molded): Plumberex Pro-Extreme.
- C. General:
  - 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
  - 2. Adhesives, sewing threads and two ply laminated materials are prohibited.
  - 3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
  - 4. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
    - a. Provide one piece injected molded design with internal bridge at top of J-bend to prevent separating.
    - b. Comply with ASTM E84 for flame and smoke development.
    - c. Comply with ASTM C1822 Type III for covers on accessible lavatory piping.
    - d. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
    - e. Comply with ICC A117.1.
    - f. Thermal Resistance: R value of 0.504 or lower when tested by ASTM C177.
    - g. Thermal Conductivity: K value of 0.358 or density of 21.61 pcf per ASTM C518.
    - h. Microbial and Fungal Resistance for Interior and Exterior: Comply with ASTM G21.
  - 5. Color: High gloss white.
  - 6. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

## **2.08 BI-LEVEL, ELECTRIC WATER COOLERS**

- A. Bi-level, Electric Water Cooler Manufacturers:
  - 1. Elkay Manufacturing Company: [www.elkay.com/#sle](http://www.elkay.com/#sle).
  - 2. Murdock Manufacturing, Inc: [www.murdockmfg.com/#sle](http://www.murdockmfg.com/#sle).
  - 3. Oasis International: [www.oasiscoolers.com/#sle](http://www.oasiscoolers.com/#sle).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Water Cooler: Bi-level, electric, mechanically refrigerated; recessed, ADA compliant; stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
  - 1. Capacity: 8 gallons per hour of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
  - 2. Electrical: 115 V, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

## **2.09 MOP SINKS**

- A. Terrazzo Mop Sink Manufacturers:
  - 1. Acorn Engineering Company: [www.americanstandard-us.com/#sle](http://www.americanstandard-us.com/#sle).
  - 2. Stern Williams;.
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Material: Precast terrazzo composed of marble chips cast in Portland cement.
- C. Type: Rectilinear, standard height.
- D. Grid strainer: Stainless steel; integral; removable.
- E. Dimensions: As indicated on drawings.

- F. Accessories:
  - 1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
  - 2. Hose clamp hanger.
  - 3. Mop hanger.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

#### **3.02 PREPARATION**

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

#### **3.03 INSTALLATION**

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

#### **3.04 INTERFACE WITH WORK OF OTHER SECTIONS**

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

#### **3.05 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

#### **3.06 CLEANING**

- A. Clean plumbing fixtures and equipment.

#### **3.07 PROTECTION**

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

#### **3.08 SCHEDULES**

- A. Fixture Heights: Install fixtures to heights above finished floor as indicated.
  - 1. Water Closet:
    - a. Standard: 15 inches to top of bowl rim.
    - b. Accessible: 18 inches to top of seat.
  - 2. Water Closet Flush Valves:
    - a. Standard: 11 inches min. above bowl rim.
    - b. Recessed: 10 inches min. above bowl rim.
  - 3. Lavatory:
    - a. Standard: 31 inches to top of basin rim.
    - b. Accessible: 34 inches to top of basin rim.
  - 4. Drinking Fountain:
    - a. Standard Adult: 40 inches to top of basin rim.

- b. Accessible: 36 inches to top of spout.
- B. Fixture Rough-In
  - 1. Water Closet (Flush Valve Type):
    - a. Cold Water: 1 Inch.
    - b. Waste: 4 Inch.
    - c. Vent: 2 Inch.
  - 2. Water Closet (Tank Type):
    - a. Cold Water: 1/2 Inch.
    - b. Waste: 4 Inch.
    - c. Vent: 2 Inch.
  - 3. Lavatory:
    - a. Hot Water: 3/8 Inch.
    - b. Cold Water: 3/8 Inch.
    - c. Waste: 1-1/4 Inch.
    - d. Vent: 2 Inch.
  - 4. Sink:
    - a. Hot Water: 1/2 Inch.
    - b. Cold Water: 1/2 Inch.
    - c. Waste: 1-1/2 Inch.
    - d. Vent: 2 Inch.
  - 5. Drinking Fountain:
    - a. Cold Water: 1/2 Inch.
    - b. Waste: 1-1/4 Inch.
    - c. Vent: 2 Inch.

**END OF SECTION 224000**

**SECTION 230000**  
**SUPPLEMENTARY HVAC GENERAL CONDITIONS**

**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 supplementary general requirements for the following :
  - 1. Codes and Standards
  - 2. Conflicting Requirements
  - 3. Specifications and Drawing Conventions
  - 4. Fees, Permits, and Inspection
  - 5. Submittals
  - 6. Closeout Submittals
  - 7. Quality Assurance
  - 8. Product Delivery, Storage, and Handling
  - 9. Product Warranties
  - 10. Product Selection Procedures
  - 11. Delegated Design
  - 12. Coordination Drawings
  - 13. Emergency, Operation, and Maintenance Manuals
  - 14. Construction Waste
  - 15. General Coordination for HVAC Work
  - 16. Cutting and Patching
  - 17. Painting

**1.03 DEFINITIONS**

- A. "Action Submittals": Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Basis-of-Design Product": A product in which a specific manufacturer's product is named on the drawings or is accompanied by the words "basis-of-design product" in the specifications, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
- D. "Construction Waste": Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- E. "Cutting": Removal of in-place construction necessary to permit installation or performance of other work.
- F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- G. "Disposal": Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- H. "File Transfer Protocol (FTP)": Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet

protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

- I. "Furnish": To supply, deliver, unload, and inspect for damage.
- J. "General": Basic Contract definitions are included in the Conditions of the Contract.
- K. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- L. "Informational Submittals": Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- M. "Install": To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- N. "Patching": Fitting and repair work required to restore construction to original conditions after installation of other work.
- O. "Portable Document Format (PDF)": An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- P. "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. Product may be new, never before used, or re-used materials or equipment.
- Q. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- R. "Provide": Furnish and install, complete and ready for the intended use.
- S. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- T. "Salvage": Recovery of demolition and construction waste and subsequent sale or reuse in another facility.
- U. "Salvage and Reuse": Recovery of demolition and construction waste and subsequent incorporation into the Work.
- V. "System": An organized collection of parts, equipment, or subsystems united by regular interaction.
- W. "Subsystem": A portion of a system with characteristics similar to a system.

#### 1.04 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|      |                                                        |                |
|------|--------------------------------------------------------|----------------|
| AABC | Associated Air Balance Council                         | (202) 737-0202 |
|      | www.aabchq.com                                         |                |
| AGA  | American Gas Association                               | (202) 824-7000 |
|      | www.aga.org                                            |                |
| AHRI | Air Conditioning, Heating, and Refrigeration Institute | (703) 524-8800 |

|        |                                                                           |                |
|--------|---------------------------------------------------------------------------|----------------|
|        | www.ahrinet.org                                                           |                |
| AIA    | American Institute of Architects (The)                                    | (800) 242-3837 |
|        | www.aia.org                                                               | (202) 626-7300 |
| AMCA   | Air Movement and Control Association International, Inc.                  | (847) 394-0150 |
|        | www.amca.org                                                              |                |
| ANSI   | American National Standards Institute                                     | (202) 293-8020 |
|        | www.ansi.org                                                              |                |
| ARI    | Air-Conditioning & Refrigeration Institute                                | (703) 524-8800 |
|        | www.ari.org                                                               |                |
| ASCE   | American Society of Civil Engineers                                       | (800) 548-2723 |
|        | www.asce.org                                                              | (703) 295-6300 |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers | (800) 527-4723 |
|        | www.ashrae.org                                                            | (404) 636-8400 |
| ASME   | ASME International                                                        | (800) 843-2763 |
|        | (American Society of Mechanical Engineers International)                  | (973) 882-1170 |
|        | www.asme.org                                                              |                |
| ASTM   | ASTM International                                                        | (610) 832-9500 |
|        | (American Society for Testing and Materials International)                |                |
|        | www.astm.org                                                              |                |
| AWS    | American Welding Society                                                  | (800) 443-9353 |
|        | www.aws.org                                                               | (305) 443-9353 |
| CGA    | Compressed Gas Association                                                | (703) 788-2700 |
|        | www.cganet.com                                                            |                |
| CIMA   | Cellulose Insulation Manufacturers Association                            | (888) 881-2462 |
|        | www.cellulose.org                                                         | (937) 222-2462 |
| CSI    | Construction Specifications Institute (The)                               | (800) 689-2900 |
|        | www.csinet.org                                                            | (703) 684-0300 |
| CTI    | Cooling Technology Institute                                              | (281) 583-4087 |
|        | www.cti.org                                                               |                |
| EJMA   | Expansion Joint Manufacturers Association, Inc.                           | (914) 332-0040 |
|        | www.ejma.org                                                              |                |



|         |                                                                                                                                                             |                                  |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| HI      | Hydronics Institute<br>www.gamanet.org                                                                                                                      | (908) 464-8200                   |
| HI/GAMA | Hydronics Institute/Gas Appliance Manufacturers Association<br>Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)<br>www.ahrinet.org | (908) 464-8200                   |
| IGMA    | Insulating Glass Manufacturers Alliance<br>www.igmaonline.org                                                                                               | (613) 233-1510                   |
| ISA     | Instrumentation, Systems, and Automation Society, The<br>www.isa.org                                                                                        | (919) 549-8411                   |
| ISO     | International Organization for Standardization<br>www.iso.ch                                                                                                | 41 22 749 01 11                  |
| MSS     | Manufacturers Standardization Society of The Valve and Fittings Industry Inc.<br>www.mss-hq.com                                                             | (703) 281-6613                   |
| NADCA   | National Air Duct Cleaners Association<br>www.nadca.com                                                                                                     | (202) 737-2926                   |
| NEBB    | National Environmental Balancing Bureau<br>www.nebb.org                                                                                                     | (301) 977-3698                   |
| NEMA    | National Electrical Manufacturers Association<br>www.nema.org                                                                                               | (703) 841-3200                   |
| NFPA    | NFPA<br>(National Fire Protection Association)<br>www.nfpa.org                                                                                              | (800) 344-3555<br>(617) 770-3000 |
| SMACNA  | Sheet Metal and Air Conditioning Contractors' National Association<br>www.smacna.org                                                                        | (703) 803-2980                   |
| STI     | Steel Tank Institute<br>www.steeltank.com                                                                                                                   | (847) 438-8265                   |
| TEMA    | Tubular Exchanger Manufacturers Association<br>www.tema.org                                                                                                 | (914) 332-0040                   |

|       |                                                  |                |
|-------|--------------------------------------------------|----------------|
| UL    | Underwriters Laboratories Inc.                   | (877) 854-3577 |
|       | <a href="http://www.ul.com">www.ul.com</a>       | (847) 272-8800 |
| USGBC | U.S. Green Building Council                      | (800) 795-1747 |
|       | <a href="http://www.usgbc.org">www.usgbc.org</a> |                |
|       |                                                  |                |

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|     |                                                      |                |
|-----|------------------------------------------------------|----------------|
| ICC | International Code Council                           | (888) 422-7233 |
|     | <a href="http://www.iccsafe.org">www.iccsafe.org</a> |                |
|     |                                                      |                |

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|      |                                                                 |                |
|------|-----------------------------------------------------------------|----------------|
| DOE  | Department of Energy                                            | (202) 586-9220 |
|      | <a href="http://www.energy.gov">www.energy.gov</a>              |                |
| EPA  | Environmental Protection Agency                                 | (202) 272-0167 |
|      | <a href="http://www.epa.gov">www.epa.gov</a>                    |                |
| FCC  | Federal Communications Commission                               | (888) 225-5322 |
|      | <a href="http://www.fcc.gov">www.fcc.gov</a>                    |                |
| OSHA | Occupational Safety & Health Administration                     | (800) 321-6742 |
|      | <a href="http://www.osha.gov">www.osha.gov</a>                  | (202) 693-1999 |
| PHS  | Office of Public Health and Science                             | (202) 690-7694 |
|      | <a href="http://www.hhs.gov/ophs/">http://www.hhs.gov/ophs/</a> |                |
| USP  | U.S. Pharmacopeia                                               | (800) 227-8772 |
|      | <a href="http://www.usp.org">www.usp.org</a>                    |                |
| USPS | Postal Service                                                  | (202) 268-2000 |
|      | <a href="http://www.usps.com">www.usps.com</a>                  |                |

- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|       |                                                                                        |                |
|-------|----------------------------------------------------------------------------------------|----------------|
| ADAAG | Americans with Disabilities Act (ADA)                                                  | (800) 872-2253 |
| CFR   | Code of Federal Regulations                                                            | (866) 512-1800 |
|       | Available from Government Printing Office                                              | (202) 512-1800 |
|       | <a href="http://www.gpoaccess.gov/cfr/index.html">www.gpoaccess.gov/cfr/index.html</a> |                |

## **1.05 CODES AND STANDARDS**

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.
- B. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.
  - 1. Building Codes for Arkansas
    - a. Arkansas Fire Prevention Code 2021
    - b. National Electrical Code 2020
    - c. Arkansas Fuel Gas Code 2018
    - d. Arkansas Energy Code 2011 (based on ANSI/ASHRAE/IESNA Standard 90.1-2007)
    - e. Arkansas State Plumbing Code 2018
    - f. International Mechanical Code 2021

## **1.06 CONFLICTING REQUIREMENTS**

- A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

## **1.07 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
  - 4. The HVAC Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over HVAC Drawings. Because of the small scale of the HVAC Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his

work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

#### **1.08 FEES, PERMITS, AND INSPECTIONS**

- A. All required fees, permits and inspections of all kind shall be obtained and paid for by the Contractor under the section of the specifications for which they are required.
- B. Certificate of Final Inspection: Under each applicable section of the specifications, the Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

#### **1.09 SUBMITTALS**

- A. Submittal Schedule
  - 1. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
    - a. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
    - b. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
    - c. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      - 1) Submit revised submittal schedule to reflect changes in current status and timing for submittals.
    - d. Format: Arrange the following information in a tabular format:
      - 1) Scheduled date for first submittal.
      - 2) Specification Section number and title.
      - 3) Submittal category: Action; informational.
      - 4) Name of subcontractor.
      - 5) Description of the Work covered.
      - 6) Scheduled date for Engineer's final release or approval.
- B. Submittal Administrative Requirements
  - 1. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
    - a. Submit submittals to Engineer through the Architect.
    - b. Engineer, through Architect, will return annotated file.
  - 2. Digital Data Files:
    - a. Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
    - b. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
    - c. Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings, or Revit model.
  - 3. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
    - a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

- b. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - c. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - d. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - 1) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- 4. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - a. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
  - b. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - c. Resubmittal Review: Allow 14 days for review of each resubmittal.
- 5. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
  - a. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  - b. Name file with submittal number or other unique identifier, including revision identifier.
    - 1) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  - c. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
  - d. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
    - 1) Project name.
    - 2) Name and address of Architect.
    - 3) Name and address of Engineer.
    - 4) Name of Contractor.
    - 5) Name of firm or entity that prepared submittal.
    - 6) Names of subcontractor, manufacturer, and supplier.
    - 7) Category and type of submittal.
    - 8) Submittal purpose and description.
    - 9) Specification Section number and title.
    - 10) Specification paragraph number or drawing designation and generic name for each of multiple items.
    - 11) Drawing number and detail references, as appropriate.
    - 12) Location(s) where product is to be installed, as appropriate.
    - 13) Related physical samples submitted directly.
    - 14) Indication of full or partial submittal.
    - 15) Transmittal number.
    - 16) Submittal and transmittal distribution record.
    - 17) Other necessary identification.
    - 18) Remarks.

- e. Metadata: Include the following information as keywords in the electronic submittal file metadata:
  - 1) Project name.
  - 2) Number and title of appropriate Specification Section.
  - 3) Manufacturer name.
  - 4) Product name.
6. Options: Identify options requiring selection by Engineer.
7. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
8. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - a. Note date and content of previous submittal.
  - b. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - c. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
9. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
10. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
11. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - a. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - b. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor through Architect of approval or rejection of proposed comparable product request within 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - 1) Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

#### **1.10 CLOSEOUT SUBMITTALS**

- A. Closeout submittals shall include, but not limited to, the following:
  1. Operation and Maintenance Materials
  2. Final Approved Submittals
- B. Operation and Maintenance Materials Submittals
  1. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
    - a. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
    - b. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
  2. Format: Submit operations and maintenance manuals in the following format:
    - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
      - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

- 2) Enable inserted reviewer comments on draft submittals.
- b. In addition to the electronic submit provide two paper copies of the corrected final submittal as part of the "Closeout Documents". Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer, through Architect, will return two copies. The two paper copies will be provided to the Owner as part of the "Closeout Documents"
3. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 days before commencing demonstration and training. Engineer will return copy with comments.
  - a. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.
- C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
- F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."
- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

- H. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- Q. Pre-construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

#### **1.11 QUALITY ASSURANCE**

- A. Products:
  - 1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
    - a. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.



- b. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

#### **1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage..
  - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 6. Protect stored products from damage and liquids from freezing.

#### **1.13 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submit warranties in accordance with "Closeout Procedures."

#### **1.14 FIELD CONDITIONS**

- A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

## **1.15 WARRANTY**

- A. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the HVAC under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

## **PART 2 PRODUCTS**

### **2.01 DELEGATED-DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 2 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

### **2.02 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Where two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 5. Where products are accompanied by the term "as selected," Architect will make selection.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  - 7. Products containing asbestos shall not be used.
- B. Product Selection Procedures:
  - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed

- product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
    - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
  5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Selection Procedure: Where Specifications include the phrase "as selected by Architect" or similar phrase, select a product that complies with requirements. Architect will select option from manufacturer's product line that includes both standard and premium items.
- D. Comparable Products
1. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
    - a. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
    - b. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - c. Evidence that proposed product provides specified warranty.
    - d. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
    - e. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections,

## **2.03 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the

information and resolution of conflicts between installed components before submitting for review.

- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed valves and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, low voltage, and electrical work. Show locations of visible ceiling mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, plumbing, fire protection, low voltage, and electrical equipment, and related work.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, low voltage, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:
  - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
  - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
7. Fire-Protection System: Show the following:
  - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: DXF operating in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and supply Portable Data File (PDF) format.

## **2.04 EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  1. List of documents.
  2. List of systems.
  3. List of equipment.
  4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
- F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- G. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- H. Operation Manual
  1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
    - a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
    - b. Performance and design criteria if Contractor has delegated design responsibility.
    - c. Operating standards.
    - d. Operating procedures.
    - e. Operating logs.
    - f. Wiring diagrams.
    - g. Control diagrams.
    - h. Piped system diagrams.
    - i. Precautions against improper use.
    - j. License requirements including inspection and renewal dates.
  2. Descriptions: Include the following:
    - a. Product name and model number. Use designations for products indicated on Contract Documents.
    - b. Manufacturer's name.
    - c. Equipment identification with serial number of each component.

- d. Equipment function.
- e. Operating characteristics.
- f. Limiting conditions.
- g. Performance curves.
- h. Engineering data and tests.
- i. Complete nomenclature and number of replacement parts.
- 3. Operating Procedures: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Instructions on stopping.
  - f. Normal shutdown instructions.
  - g. Seasonal and weekend operating instructions.
  - h. Required sequences for electric or electronic systems.
  - i. Special operating instructions and procedures.
- 4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- I. Maintenance Manuals
  - 1. Content: Organize manual into a separate section for each product, system, subsystem, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
  - 2. Source Information: List each product, system, or subsystem included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
  - 3. Product Information: Include the following, as applicable:
    - a. Product name and model number.
    - b. Manufacturer's name.
    - c. Color, pattern, and texture.
    - d. Material and chemical composition.
    - e. Reordering information for specially manufactured products.
    - f. Standard maintenance instructions and bulletins.
    - g. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
    - h. Identification and nomenclature of parts and components.
    - i. List of items recommended to be stocked as spare parts.
  - 4. Maintenance Procedures: Include manufacturer's written recommendations and the following:
    - a. Inspection procedures.
    - b. Types of cleaning agents to be used and methods of cleaning.
    - c. List of cleaning agents and methods of cleaning detrimental to product.
    - d. Schedule for routine cleaning and maintenance.
    - e. Repair instructions.
    - f. Test and inspection instructions.
    - g. Troubleshooting guide.
    - h. Precautions against improper maintenance.
    - i. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    - j. Aligning, adjusting, and checking instructions.
    - k. Demonstration and training video recording, if available.

5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - a. Include procedures to follow and required notifications for warranty claims.
7. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
8. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
9. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
10. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - a. Include procedures to follow and required notifications for warranty claims.

## **PART 3 EXECUTION**

### **3.01 CONTRACTOR'S SUBMITTAL REVIEW**

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### **3.02 ENGINEER'S SUBMITTAL ACTION**

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to the Architect to forward to the appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

### **3.03 CONSTRUCTION WASTE**

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Disposal: Remove waste materials from Owner's property and legally dispose of them

### 3.04 GENERAL COORDINATION FOR HVAC WORK

- A. The Contractor shall compare the HVAC Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the HVAC Work. The HVAC Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the HVAC Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of pipes, ductwork, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.
  - 1. Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
  - 2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.
  - 3. Installation and Arrangement: The Contractor shall install all HVAC Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, fan shafts and wheels, filters, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
  - 4. Ductwork: The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Engineer prior to fabrication of ductwork requiring such changes.
  - 5. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.
- E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, ductwork, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from



the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

- F. Connections: All piping connecting to equipment shall be installed without strain at the piping connection
- G. Inaccessible Equipment
  - 1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
  - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
- H. Electrical Coordination
  - 1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
  - 2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
  - 3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26. The Contractor shall coordinate between this Division and Division 26 to ensure that all disconnects required for the Project are furnished and installed.
  - 4. The Contractor of this Division shall furnish and install any low voltage relays, pressure switches, and similar items required for the proper operation of the HVAC equipment.
- I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints. Provide 18 gauge (minimum) galvanized, 4 inch (minimum) deep drain pans under piping and ductwork located or passing over electrical equipment. Pipe 1" drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold 4 inches of water without collapse.
- J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Pump shafts, fan shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

### **3.05 CUTTING AND PATCHING**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.

2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.
  3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  5. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.06 PAINTING**

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment

specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.

- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include 2 finish coats over galvanized metal primer.
  3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  4. Do not paint piping specialties with factory-applied finish.
  5. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
  6. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

**END OF SECTION 230000**

**SECTION 230529**  
**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

**1.02 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
  - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.05 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- 1. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
- B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 2. Comply with MFMA-4.
  - 3. Channel Material:
    - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
  - 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
  - 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    - c. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- D. Pipe Supports:
  - 1. Liquid Temperatures Up To 122 degrees F:
    - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    - b. Support From Below: MSS SP-58 Types 35 through 38.
  - 2. Operating Temperatures from 122 to 446 degrees F:
    - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
    - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
    - c. Sliding Support: MSS SP-58 Types 35 through 38.
- E. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
  - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
  - 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. Riser Clamps:
  - 1. Provide copper plated clamps for copper tubing support.
  - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- H. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

- I. Strut Clamps: Two-piece pipe clamp.
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- J. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- K. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
  - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- L. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
  - 1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
- M. Pipe Alignment Guides: Galvanized steel.
  - 1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
- N. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- O. Pipe Shields for Insulated Piping:
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  - 2. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    - d. Minimum Service Temperature: Minus 40 degrees F.
    - e. Maximum Service Temperature: 178 degrees F.
    - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
  - 3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  - 4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  - 5. Sheet Metal: Use sheet metal screws.
  - 6. Plastic and lead anchors are not permitted.
  - 7. Powder-actuated fasteners are not permitted.
  - 8. Hammer-driven anchors and fasteners are not permitted.
  - 9. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Architect.
- F. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- G. Secure fasteners according to manufacturer's recommended torque settings.
- H. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 230529**

**SECTION 230548**  
**VIBRATION AND SEISMIC CONTROLS FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

**1.02 DEFINITIONS**

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

**1.03 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- F. MFMA-4 - Metal Framing Standards Publication; 2004.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  - 5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.



## 1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  - 2. Seismic Controls: Include seismic load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
  - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
- D. Shop Drawings - Seismic Controls:
  - 1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  - 2. Identify mounting conditions required for equipment seismic qualification.
  - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
  - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  - 6. Indicate locations of seismic separations where applicable.
- E. Seismic Design Data:
  - 1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
    - a. Component operating weight and center of gravity.
    - b. Component elevation in the building in relation to the roof elevation (z/h).
    - c. Component importance factor ( $I_p$ ).
    - d. For distributed systems, component materials and connection methods.
    - e. Component amplification factor ( $a_p$ ) and component response modification factor ( $R_p$ ), determined in accordance with ASCE 7 tables.
    - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
  - 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- F. Certification for seismically qualified equipment; identify basis for certification.
- G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Evidence of qualifications for seismic controls designer.
- J. Evidence of qualifications for manufacturer.
- K. Manufacturer's detailed field testing and inspection procedures.
- L. Field quality control test reports.

## 1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Thrust Restraint Applications:
  - 1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
  - 2. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

#### **2.02 SEISMIC CONTROL REQUIREMENTS**

- A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.
- B. Seismic Design Criteria: As indicated on the drawings. If information is not available on the drawings, the contractor will use the ASCE Hazzard Tool to determine.  
<https://ascehazardtool.org>.
- C. Component Importance Factor (Ip): HVAC components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
  - 1. HVAC components required to function for life safety purposes after an earthquake.
  - 2. HVAC components that support or otherwise contain hazardous substances.
- D. Seismic Qualification of Equipment:
  - 1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.

4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Premanufactured Modular HVAC Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- F. Seismic Restraints:
  1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  2. Seismic Restraint Exemptions:
    - a. Exemptions for Seismic Design Category D, E, and F:
      - 1) Discrete HVAC components that are positively attached to the structure where either of the following apply:
        - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor ( $I_p$ ) is 1.0.
        - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
      - 2) HVAC piping with component importance factor ( $I_p$ ) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor ( $I_p$ ) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
    - b. Duct System Exemptions, All Seismic Design Categories:
      - 1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor ( $I_p$ ) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported duct with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
        - (b) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
        - (c) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
        - (d) Hanger supported duct with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
      - 2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet and weighs 20 pounds per foot or less.

- c. HVAC Piping Exemptions, All Seismic Design Categories:
  - 1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
    - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
    - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
    - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
    - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
    - (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.
- 3. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 4. Seismic Type Vibration Isolators:
  - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 5. External Seismic Snubber Assemblies:
  - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
  - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
- 6. Seismic Restraint Systems:
  - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
  - b. Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
  - c. Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.

- d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain HVAC component in all lateral directions; consider bracket geometry in anchor load calculations.
  - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.
  - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.
  - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
  - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
  - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
7. Ductwork Applications:
- a. Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds.
  - b. Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.
- G. Seismic Attachments:
- 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
  - 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
  - 3. Do not use power-actuated fasteners.
  - 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
  - 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  - 6. Concrete Housekeeping Pads:
    - a. Increase size of pad as required to comply with anchor requirements.
    - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- H. Seismic Interactions:
- 1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.
  - 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- I. Seismic Relative Displacement Provisions:
- 1. Use suitable fittings or flexible connections to accommodate:
    - a. Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.
    - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    - c. Design displacements at seismic separations.

- d. Anticipated drifts between floors.

### **2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

- A. Manufacturers:
  - 1. Vibration-Isolated Equipment Support Bases:
  - 2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
  - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  - 2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
- C. Vibration-Isolated Concrete Inertia Bases:
  - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  - 2. Minimum Base Depth: 6 inches.
  - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
  - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
  - 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.
  - 6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
  - 7. Pump Applications: Size and configure bases for piping elbow supports as required.

### **2.04 VIBRATION ISOLATORS**

- A. Manufacturers:
  - 1. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
  - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  - 2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  - 3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
  - 1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
  - 2. Resilient Material Isolator Mounts, Nonseismic:

- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
- 3. Open (Unhoused) Spring Isolators:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
  - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
- 4. Housed Spring Isolators:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
  - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
  - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - d. Furnished with integral leveling device for positioning and securing supported equipment.
- 5. Restrained Spring Isolators, Nonseismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
  - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
- 6. Resilient Material Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. Spring Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 9. Thrust Restraints:
  - a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.
- D. Vibration Isolators for Seismic Applications:
  - 1. Resilient Material Isolator Mounts, Seismic:

- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
  - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

## **2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES**

- A. Manufacturers:
  1. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
  1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
  2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

## **2.06 SEISMIC RESTRAINT SYSTEMS**

- A. Manufacturers:
  1. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.



- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
  - 1. Comply with ASCE 19.
  - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
  - 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
  - 3. Installation and anchorage of ductwork designed to carry hazardous materials for Seismic Design Categories C, D, E and F; periodic inspection.
  - 4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
  - 5. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

### **3.03 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- D. Vibration Isolation Systems:

1. Vibration-Isolated Equipment Support Bases:
    - a. Provide specified minimum clearance beneath base.
  2. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  3. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  4. Thrust Restraints:
    - a. Adjust restraint movement under normal operating static pressure.
  5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  7. Adjust isolators to be free of isolation short circuits during normal operation.
  8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- E. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
  2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
  4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
  5. Concrete Housekeeping Pads:
    - a. Size in accordance with seismic design to meet anchor requirements.
    - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
  6. Seismic Restraint Systems:
    - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    - b. Install restraints within permissible angles in accordance with seismic design.
    - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

### **3.04 FIELD QUALITY CONTROL**

- A. See Division 01 for additional requirements.

- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
  - 1. Verify isolator static deflections.
  - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
  - 1. Verify snubbing element air gaps.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 230548**

**SECTION 230553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

**1.02 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.03 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Advanced Graphic Engraving, LLC: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com)
- B. Brimar Industries, Inc: [www.pipemarker.com](http://www.pipemarker.com)
- C. Craftmark Pipe Markers: [www.craftmarkid.com](http://www.craftmarkid.com)
- D. Seton Identification Products, a Tricor Direct Company: [www.seton.com](http://www.seton.com)
- E. Substitutions: See Section 016000-Product Requirements.

**2.02 IDENTIFICATION APPLICATIONS**

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units (VAV Boxes): Nameplates.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Instrumentation: Tags.
- F. Major Control Components: Nameplates.
- G. Piping: Pipe markers.
- H. Rooftop Exhaust Fans: Nameplates.
- I. Rooftop Units: Nameplates
- J. Small-sized Equipment: Nameplates

**2.03 NAMEPLATES**

- A. Letter Color: Black.
- B. Background Color: White.
- C. Minimum Size: 3" x 1"
- D. Rooftop Units and Air Handling Units Minimum Size: 6" x 3"
- E. Plastic: Comply with ASTM D709.

## **2.04 TAGS**

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### **3.02 INSTALLATION**

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions. Include directional arrow banding.
- D. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION 230553**

**SECTION 230593**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.

**1.02 REFERENCE STANDARDS**

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).
- C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

**1.03 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
  - 1. Include at least the following in the plan:
    - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    - d. Final test report forms to be used.
    - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
  - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 5. Units of Measure: Report data in I-P (inch-pound) units only.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
  - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
  - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.

### **3.02 EXAMINATION**

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  1. Systems are started and operating in a safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

### **3.03 PREPARATION**

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

### **3.04 ADJUSTMENT TOLERANCES**

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

### **3.05 RECORDING AND ADJUSTING**

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. Check and adjust systems approximately six months after final acceptance and submit report.

### **3.06 AIR SYSTEM PROCEDURE**

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- K. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- L. On fan powered VAV boxes, adjust air flow switches for proper operation.

### **3.07 SCOPE**

- A. Test, adjust, and balance the following:
  - 1. Packaged Roof Top Heating/Cooling Units.
  - 2. Air Coils.
  - 3. Air Handling Units.
  - 4. Fans.
  - 5. Air Terminal Units.
  - 6. Air Inlets and Outlets.

### **3.08 MINIMUM DATA TO BE REPORTED**

- A. Cooling Coils:
  - 1. Identification/number.
  - 2. Location.
  - 3. Service.
  - 4. Manufacturer.
  - 5. Air flow, design and actual.
  - 6. Entering air DB temperature, design and actual.
  - 7. Entering air WB temperature, design and actual.
  - 8. Leaving air DB temperature, design and actual.
  - 9. Leaving air WB temperature, design and actual.
  - 10. Saturated suction temperature, design and actual.
  - 11. Air pressure drop, design and actual.
- B. Heating Coils:
  - 1. Identification/number.
  - 2. Location.
  - 3. Service.
  - 4. Manufacturer.
  - 5. Air flow, design and actual.
  - 6. Entering air temperature, design and actual.
  - 7. Leaving air temperature, design and actual.
  - 8. Air pressure drop, design and actual.
- C. Air Moving Equipment:



1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Arrangement/Class/Discharge.
  6. Air flow, specified and actual.
  7. Return air flow, specified and actual.
  8. Outside air flow, specified and actual.
  9. Total static pressure (total external), specified and actual.
  10. Inlet pressure.
  11. Discharge pressure.
  12. Sheave Make/Size/Bore.
  13. Number of Belts/Make/Size.
  14. Fan RPM.
- D. Return Air/Outside Air:
1. Identification/location.
  2. Design air flow.
  3. Actual air flow.
  4. Design return air flow.
  5. Actual return air flow.
  6. Design outside air flow.
  7. Actual outside air flow.
  8. Return air temperature.
  9. Outside air temperature.
  10. Required mixed air temperature.
  11. Actual mixed air temperature.
  12. Design outside/return air ratio.
  13. Actual outside/return air ratio.
- E. Exhaust Fans:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Air flow, specified and actual.
  6. Total static pressure (total external), specified and actual.
  7. Inlet pressure.
  8. Discharge pressure.
  9. Sheave Make/Size/Bore.
  10. Number of Belts/Make/Size.
  11. Fan RPM.
- F. Duct Traverses:
1. System zone/branch.
  2. Duct size.
  3. Area.
  4. Design velocity.
  5. Design air flow.
  6. Test velocity.
  7. Test air flow.
  8. Duct static pressure.
  9. Air temperature.
  10. Air correction factor.

- G. Duct Leak Tests:
  - 1. Description of ductwork under test.
  - 2. Duct design operating pressure.
  - 3. Duct design test static pressure.
  - 4. Duct capacity, air flow.
  - 5. Maximum allowable leakage duct capacity times leak factor.
  - 6. Test apparatus:
    - a. Blower.
  - 7. Test static pressure.
  - 8. Test orifice differential pressure.
  - 9. Leakage.
- H. Terminal Unit Data:
  - 1. Manufacturer.
  - 2. Type, constant, variable, single, dual duct.
  - 3. Identification/number.
  - 4. Location.
  - 5. Model number.
  - 6. Size.
  - 7. Minimum static pressure.
  - 8. Minimum design air flow.
  - 9. Maximum design air flow.
  - 10. Maximum actual air flow.
  - 11. Inlet static pressure.
- I. Air Distribution Tests:
  - 1. Air terminal number.
  - 2. Room number/location.
  - 3. Terminal type.
  - 4. Terminal size.
  - 5. Design air flow.
  - 6. Test (final) air flow.
  - 7. Percent of design air flow.

**END OF SECTION 230593**

## **SECTION 230713 DUCT INSULATION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Jackets.
- C. Duct liner.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 233100 - HVAC Ducts and Casings

#### **1.03 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### **1.07 FIELD CONDITIONS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

### **PART 2 PRODUCTS**

#### **2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

## **2.02 MANUFACTURES**

- A. Johns Manville[<>]: [www.jm.com](http://www.jm.com)
- B. Knauf Insulation; Atmosphere Duct Wrap: [www.knaufinsulation.com](http://www.knaufinsulation.com)
- C. Owens Corning Corporation[<>]: [www.ocbuildingspec.com](http://www.ocbuildingspec.com)
- D. Substitutions: See Division 01 for additional requirements.

## **2.03 GLASS FIBER, FLEXIBLE**

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. K value: 0.29 at 75 degrees F @ Labeled Thickness, when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 250 degrees F.
  - 3. Maximum Water Vapor Absorption: <5 percent by weight.
- B. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

## **2.04 GLASS FIBER, RIGID**

- A. Insulation: ASTM C612; rigid, noncombustible blanket.
  - 1. K Value: 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 450 degrees F.
  - 3. Maximum Water Vapor Absorption: <2.0 percent by weight at 120 degrees F, 95% RH.
  - 4. Maximum Density: 3 lb/cu ft.
- B. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: 0.04 perm inch, when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

## **2.05 JACKETS**

- A. Aluminum Jacket: ASTM B209 (ASTM B209M).
  - 1. Thickness: 0.016 inch sheet.
  - 2. Finish: Smooth.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

- B. Install in accordance with NAIMA National Insulation Standards.
- C. Ducts Exposed in Mechanical Equipment Rooms (below 10 feet above finished floor): Finish with aluminum jacket.
- D. External Duct Insulation Application: Glass Fiber, Flexible
  1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
  2. Secure insulation without vapor barrier with staples, tape, or wires.
  3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
  4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  5. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
  6. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- E. Exterior Applications: Install outdoor weather-proof insulation system in strict accordance with manufacturer's instructions.

### **3.03 SCHEDULES**

- A. Supply Ducts: 2" Glass Fiber, Flexible
- B. Return Ducts: 2" Glass Fiber, Flexible
- C. Outside Air Ducts: 2" Glass Fiber, Flexible
- D. Exhaust Ducts Within 10ft of Exterior Openings" 2" Glass Fiber, Flexible
- E. Transfer Ducts: 1" Duct Liner, Rigid
- F. Ducts Exposed to Outdoors: 2" Glass Fiber, Rigid Insulation covered with Outdoor Weather-Proof Insulation System.

**END OF SECTION 230713**

**SECTION 230934  
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

**1.02 RELATED REQUIREMENTS**

- A. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

**1.03 REFERENCE STANDARDS**

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- D. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives; 2026.
- E. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).
- F. NEMA IS 10035 - Application Guide for AC Adjustable Speed Drive Systems; 2021 (Reaffirmed 2025).
- G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2005.
- H. NEMA MG 00001 - Motors and Generators; 2024.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
  - 2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
  - 3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
  - 5. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

### **1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum 1 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. ABB; [www.abb.com](http://www.abb.com).
- B. Danfoss; [www.danfoss.com](http://www.danfoss.com).
- C. Siemens; [www.siemens.com](http://www.siemens.com)
- D. Yaskawa; [www.yaskawa.com](http://www.yaskawa.com).
- E. Substitutions: See Section 016000 - Product Requirements.

### **2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS**

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Controller Assemblies: Comply with NEMA IS 10033, NEMA IS 10034, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA IS 10035, NEMA MG 00001 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
  - 1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 00001 design letter or inverter duty rating for induction motors.
  - 2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
  - 3. Motor nameplate data.
  - 4. Requirements for speed control range, speed regulation, and braking.
  - 5. Motor suitability for bypass starting method, where applicable.
- E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- F. Operating Requirements:
  - 1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
  - 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
  - 3. Efficiency: Minimum of 96 percent at full speed and load.
  - 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
  - 5. Overload Rating:
    - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
    - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- G. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
  - 1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.
- H. Control System:

1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
3. Control Functions:
  - a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
    - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
    - 2) Vector Control: Provide selectable autotuning function.
  - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
  - c. Selectable braking control; DC injection or flux braking.
  - d. Adjustable minimum/maximum speed limits.
  - e. Adjustable pulse width modulation switching carrier frequency.
  - f. Adjustable motor slip compensation.
  - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
4. Status Indications:
  - a. Motor run/stop status.
  - b. Motor forward/reverse status.
  - c. Local/remote control status.
  - d. Output voltage.
  - e. Output current.
  - f. Output frequency.
  - g. DC bus voltage.
  - h. Motor speed.
5. Protective Functions/Alarm Indications:
  - a. Overcurrent.
  - b. Motor overload.
  - c. Undervoltage.
  - d. Overvoltage.
  - e. Controller overtemperature.
  - f. Input/output phase loss.
  - g. Output short circuit protection.
  - h. Output ground fault protection.
6. Inputs:
  - a. Digital Input(s): Three.
  - b. Analog Input(s): Two.
7. Outputs:
8. Features:
  - a. Password-protected security access.
  - b. Event log.
- I. Power Conditioning/Filtering:
  1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
  2. Reactor Impedance: 3 percent, unless otherwise indicated or required.
- J. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
  1. Disconnects: Circuit breaker or disconnect switch type.



- a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
  - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
  - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
- 2. Provide door-mounted remote operator interface.
- K. Service Conditions:
  - 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
    - a. Altitude: Less than 3,300 feet.
    - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
  - 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- L. Short Circuit Current Rating:
  - 1. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- M. Conductor Terminations: Suitable for use with conductors to be installed.
- N. Enclosures:
  - 1. Comply with NEMA IA 10030.
  - 2. NEMA EN 10250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
  - 3. Finish: Manufacturer's standard unless otherwise indicated.
  - 4. Cooling: Forced air or natural convection as determined by manufacturer.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 230529.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding.
- H. Install field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

### **3.02 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

### **3.03 CLEANING**

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

- B. Repair scratched or marred exterior surfaces to match original factory finish.

## **SECTION 232300 REFRIGERANT PIPING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Filter-driers.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 230719 - HVAC Piping Insulation.

#### **1.03 REFERENCE STANDARDS**

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- B. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- D. ASME B31.9 - Building Services Piping; 2017.
- E. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- F. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

#### **1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

### **PART 2 PRODUCTS**

#### **2.01 REGULATORY REQUIREMENTS**

- A. Comply with ASME B31.9 for installation of piping system.

#### **2.02 PIPING**

- A. Copper Tube: ASTM B280, H58 hard drawn.
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
  - 1. Fittings: ASME B16.26 cast copper.
  - 2. Joints: Flared.
- C. Refrigerant: R-32 as defined in ASHRAE Std 34.

- D. Refrigerant: R-454B as defined in ASHRAE Std 34.

### **2.03 MOISTURE AND LIQUID INDICATORS**

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

### **2.04 FILTER-DRIERS**

1. Flow Capacity - Liquid Line: (Refer to schedules) ton, minimum, rated in accordance with AHRI 710.
2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
3. Connections: As specified for applicable pipe type.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### **3.02 INSTALLATION**

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Insulate piping; refer to Section and Section 230716.
- H. Fully charge completed system with refrigerant after testing.

### **3.03 FIELD QUALITY CONTROL**

- A. Test refrigeration system in accordance with ASME B31.5.

### **3.04 SCHEDULES**

- A. Hanger Spacing for Copper Tubing.
  1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

**END OF SECTION 232300**

**SECTION 233100  
HVAC DUCTS AND CASINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Casing and plenums.

**1.02 RELATED REQUIREMENTS**

- A. Section 230713 - Duct Insulation: External insulation and duct liner.

**1.03 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; 2020.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide data for duct materials and duct connections.
- C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

**1.06 FIELD CONDITIONS**

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

**PART 2 PRODUCTS**

**2.01 DUCT ASSEMBLIES**

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply: 2 inch w.g. pressure class, galvanized steel.
- D. Medium and High Pressure Supply: 10 inch w.g. pressure class, galvanized steel.
- E. Return and Relief: 2" inch w.g. pressure class, galvanized steel.
- F. General Exhaust: 2" inch w.g. pressure class, galvanized steel.

**2.02 MATERIALS**

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
  - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.

### 2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

### 2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Rectangular Ductwork: Shall conform to SMACNA HVAC Duct Construction Standards, Metal and Flexible or SMACNA Rectangular Industrial Duct Construction Standards.
  - 1. Cross-Breaking:
    - a. Sheet metal ducts and fittings over 19" wide be beaded, cross-broken, or otherwise stiffened, to eliminate oil canning or vibration.
    - b. Vertical and horizontal sheet metal barriers, duct offsets, and elbows 19" wide or larger shall be cross-broken.
    - c. Cross-breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of cross-break shall be of the required height to assure surfaces being rigid.
  - 2. Radius Elbows: Radius elbows with a rectangular cross section shall have a centerline radius of not less than the width of the duct or shall be furnished with single thickness splitter vanes. A single splitter vane shall be used for elbows with a ratio of inside radius to duct width of 0.5 to 0.2. Two splitter vanes shall be used for ratios less than 0.20.
  - 3. Square Elbows: Square elbows shall be equipped with either single or double thickness turning vanes, with a radius of 4.5", and a separation of 3.25", pre-assembled on runners constructed per SMACNA Accepted Industry Practice for Industrial Duct Design. Vanes shall be securely attached to the runners. Vanes shall be welded to the runners in systems with pressures greater than 6" w.g. or velocities greater than 3000 FPM. The maximum unsupported length of vanes shall be 36".
- B. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
  - 2. Insulation Thickness: 2 inch
- C. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
- D. Round Ducts: Round lockseam duct with galvanized steel outer wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
- E. Acoustic Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
  - 1. Insulation: 2" Fiberglass insulation with reinforced vapor barrier.
  - 2. Inner Core: Spun-bonded, non-woven inner core.
  - 3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative. (4"-12" ID)
  - 4. Maximum Velocity: 5,000 fpm.}]
  - 5. Temperature Range: Minus 20 degrees F to 210 degrees F.

### 2.05 CASINGS

- A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Flexible Ducts: Connect to metal ducts with liquid adhesive plus tape.
- E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Connect diffusers plenum boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- H. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

### **3.02 CLEANING**

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

**END OF SECTION 233100**

**SECTION 233300  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Backdraft dampers - metal.
- B. Duct access doors.
- C. Duct test holes.
- D. Flexible duct connectors.
- E. Volume control dampers.

**1.02 RELATED REQUIREMENTS**

- A. Section 233100 - HVAC Ducts and Casings.

**1.03 REFERENCE STANDARDS**

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- B. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- D. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- E. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades.

**PART 2 PRODUCTS**

**2.01 BACKDRAFT DAMPERS - METAL**

- A. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

**2.02 DUCT ACCESS DOORS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.



1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.

### **2.03 DUCT TEST HOLES**

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

### **2.04 FIRE DAMPERS**

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- C. Fusible Links: UL 33, separate at 165 degrees F with adjustable link straps for combination fire/balancing dampers.

### **2.05 FLEXIBLE DUCT CONNECTORS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
  1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    - a. Net Fabric Width: Approximately 3 inches wide.
  2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

### **2.06 SMOKE DAMPERS**

- A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- C. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

### **2.07 VOLUME CONTROL DAMPERS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers:
  1. Fabricate for duct sizes up to 6 by 30 inch.
  2. Blade: 24 gage, 0.0239 inch, minimum.
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
  1. Blade: 18 gage, 0.0478 inch, minimum.
- D. Quadrants:
  1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  3. Where rod lengths exceed 30 inches provide regulator at both ends.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

**END OF SECTION 233300**

**SECTION 233423  
HVAC POWER VENTILATORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof exhausters.
- B. Ceiling exhaust fans.

**1.02 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.03 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.05 FIELD CONDITIONS**

- A. Permanent ventilators may not be used for ventilation during construction.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Carnes, a division of Carnes Company Inc: [www.carnes.com](http://www.carnes.com)
- B. Greenheck Fan Corporation: [www.greenheck.com](http://www.greenheck.com)
- C. Loren Cook Company: [www.lorencook.com](http://www.lorencook.com)
- D. Or Approved Equal: See Division 01 for additional requirements.

**2.02 ROOF EXHAUSTERS**

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Roof Curb: 14 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

**2.03 CEILING EXHAUST FANS**

- A. Centrifugal Fan Unit: Direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.
- C. Grille: Molded white plastic.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Install backdraft dampers on inlet to roof and wall exhausters.
- E. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

**END OF SECTION 233423**

## **SECTION 233600 AIR TERMINAL UNITS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Single-duct terminal units.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 233100 - HVAC Ducts and Casings.

#### **1.03 REFERENCE STANDARDS**

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- B. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### **1.05 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### **1.07 WARRANTY**

- A. Provide five year manufacturer warranty for air terminal units.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Titus; [www.titus-hvac.com](http://www.titus-hvac.com)
- B. Trane; [www.trane.com](http://www.trane.com)
- C. Price Industries; [www.priceindustries.com](http://www.priceindustries.com)
- D. Or Approved Equal: See Division 01 for additional requirements.

#### **2.02 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS**

- A. General:
  - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.

2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- B. Unit Casing:
1. Minimum 22 gage, 0.0299 inch galvanized steel.
  2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Acceptable Liners:
    - a. 1/2 inch thick, coated, fibrous-glass complying with ASTM C1071.
      - 1) Secure with adhesive.
      - 2) Coat edges exposed to airstream with NFPA 90A approved sealant.
      - 3) Cover liner with non-porous foil.
    - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- C. Damper Assembly:
1. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  2. Incorporate low leak damper blades for tight airflow shutoff.
- D. Electric Heating Coil:
1. Listed and provided by the terminal unit manufacturer.
  2. Heating Elements: Nickel chrome, supported by ceramic insulators.
  3. Integral Control Panel: NEMA EN 10250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
  4. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
  5. Provide the following additional components, mounted and/or wired within the control enclosure:
    - a. Fused or non-fused door interlocking disconnect switch.
    - b. Mercury contactors.
    - c. Fuse block.
  6. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.
  7. Provide SCR (Silicon Controlled Rectifier) controller.
- E. Controls:
1. Electric:
    - a. Damper Actuator: 24 volt, powered closed, spring return open.
    - b. Wall-mounted thermostat with Celsius and Fahrenheit display including clock display and set-point of occupied space.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. See drawings for the size(s) and duct location(s) of the air terminal units.
- D. Provide ceiling access doors or locate units above easily removable ceiling components.
- E. Do not support from ductwork.

- F. Connect to ductwork in accordance with Section 233100.
- G. Verify that electric power is available and of the correct characteristics.

### **3.03 ADJUSTING**

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

### **3.04 FIELD QUALITY CONTROL**

- A. Provide manufacturer's field representative to test and inspect field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

### **3.05 CLEANING**

- A. Vacuum clean coils and inside of units.
- B. Install new filters.

**END OF SECTION 233600**

**SECTION 233700  
AIR OUTLETS AND INLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Diffusers.
- B. Registers/grilles.

**1.02 REFERENCE STANDARDS**

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

**1.03 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.05 MANUFACTURERS**

- A. Hart & Cooley, Inc; \_\_\_\_\_: [www.hartandcooley.com/#sle](http://www.hartandcooley.com/#sle).
- B. Krueger-HVAC; \_\_\_\_\_: [www.krueger-hvac.com/#sle](http://www.krueger-hvac.com/#sle).
- C. Price Industries: [www.price-hvac.com](http://www.price-hvac.com)
- D. Ruskin Company: [www.ruskin.com](http://www.ruskin.com)
- E. Titus, a brand of Air Distribution Technologies: [www.titus-hvac.com](http://www.titus-hvac.com)
- F. Tuttle and Bailey: [www.tuttleandbailey.com](http://www.tuttleandbailey.com)
- G. Or Approved Equal: See Division 01 for additional requirements.

**PART 3 EXECUTION**

**2.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black.



**SECTION 237416**  
**PACKAGED ROOFTOP AIR-CONDITIONING UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Packaged, small-capacity, rooftop air-conditioning units.
- B. Packaged, intermediate-capacity, rooftop air-conditioning units.

**1.02 RELATED REQUIREMENTS**

- A. Section 230548 - Vibration and Seismic Controls for HVAC.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Trane Technologies, PLC; \_\_\_\_\_: [www.trane.com/#sle](http://www.trane.com/#sle).
- B. Daikin.
- C. York
- D. Greenheck
- E. Substitutions: See Section 016000 - Product Requirements.

**2.02 CASING**

- A. Cabinet: Steel with baked enamel finish, including access doors with piano hinges and locking handle. Structural members to be minimum 18 gauge, 0.0478 inch, with access doors or panels of minimum 20 gauge, 0.0359 inch.

**2.03 FANS**

- A. Supply and Return Fan: Forward curved centrifugal type, resiliently mounted with direct drive, and rubber isolated hinge mounted. Provide with high efficiency motor or direct drive as indicated. Isolate complete fan assembly. See Section 230548.

**2.04 ELECTRIC HEATING COIL**

- A. Finned tube heating elements easily accessible with automatic reset thermal cut-out. Provide with built-in magnetic contactors, galvanized steel frame, control circuit transformer and fuse, manual reset thermal cut-out, airflow proving device, load fuses.
- B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

**2.05 EVAPORATOR COIL**

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

**2.06 CONDENSER COIL**

- A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
- C. Provide refrigerant pressure switches to cycle condenser fans.

**2.07 COMPRESSORS**

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

- B. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

## **2.08 OPERATING CONTROLS**

- A. Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.
  - 1. Include system selector switch heat-off-cool and auto-on fan control switch.
- B. Provide remote-mounted auto-on fan control switch.
- C. Provide low-limit thermostat in supply air to close outside air damper and stop supply fan.
- D. Provide night control energized by central time clock to maintain lower thermostat setting, lock out refrigeration, close outside air damper and open return air damper, stop supply air fan, for night and unoccupied operation. Provide time delay to maintain outside air damper closed and return air damper open after switching to day and occupied operation.
- E. Provide remote readout panels containing signal lights indicating system status, heating system failure, cooling system failure, and dirty filters; check switches proving signal light operations; system on-off switch, and cooling system on-off switch.
- F. Provide in panel manual 12-hour timer to override night control, remote damper control, low limit manual reset, and remote thermostat temperature setpoint.

## **2.09 ROOF CURBS**

- A. Roof Mounting Curb: 14 inches high, galvanized steel, channel frame with gaskets, nailer strips.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that roof is ready to receive work and opening dimensions are as required by manufacturer.
- B. Verify that proper power supply is available.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- C. Locate remote panels where indicated on drawings.

### **3.03 SYSTEM STARTUP**

- A. Prepare and start equipment. Adjust for proper operation.

**END OF SECTION 237416**

**SECTION 238126.13**  
**SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor air handling (fan and coil) units for ductless systems.
- D. Controls.

**1.02 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2026.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants; 2019.
- D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- G. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
- H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

**1.03 SUBMITTALS**

- A. See Division 01 for additional requirements.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.05 WARRANTY**

- A. See Division 01 for additional requirements.
- B. Provide five year manufacturers warranty for compressors.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Trane Inc: [www.trane.com](http://www.trane.com)
- B. Daikin:
- C. LG
- D. Or Approved Equal: See Division 01 for additional requirements.

## **2.02 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS**

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
  - 1. Cabinet: Galvanized steel.
    - a. Finish: White.
  - 2. Fan: Line-flow fan direct driven by a single motor.
  - 3. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
  - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

## **2.03 OUTDOOR UNITS**

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
  - 1. Comply with AHRI 210/240.
  - 2. Refrigerant: R-32.
  - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
  - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
  - 1. Condenser Fans: Direct-drive propeller type.
- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
  - 1. Provide thermostatic expansion valves.
  - 2. Provide heat pump reversing valves (for heat pump units).
- F. Operating Controls:
  - 1. Control by room thermostat to maintain room temperature setting.

## **2.04 ACCESSORY EQUIPMENT**

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
  - 1. Automatic switching from heating to cooling.
  - 2. Preferential rate control to minimize overshoot and deviation from setpoint.
  - 3. Thermostat Display:
    - a. Time of day.
    - b. Actual room temperature.
    - c. Programmed temperature.
    - d. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Provide vent connections in accordance with NFPA 211 and manufacturer's recommendations.
- D. Install refrigeration systems in accordance with ASHRAE Std 15 and manufacturer's recommendations. Sleeve and seal all pipe penetrations into building.
- E. Pipe drain from cooling coils as shown on the drawings. If no route is shown, the contractor shall propose one going to the nearest floor drain (where allowed) or to the exterior.
- F. Mount condensing units on 4" concrete housekeeping pad, unless otherwise shown on the drawings.

**END OF SECTION 238126.13**

**SECTION 260000**  
**SUPPLEMENTARY ELECTRICAL GENERAL CONDITIONS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section includes supplementary general requirements for the following:
1. Codes and Standards
  2. Conflicting Requirements
  3. Specifications and Drawing Conventions
  4. Fees, Permits, and Inspection
  5. Submittals
  6. Products
  7. Warranties
  8. Electrical License Requirement
  9. Operation and Maintenance Manuals
  10. Demolition, Salvage, and Waste
  11. General Coordination for Electrical Work
  12. Cutting and Patching
  13. Excavation and Trenching
  14. Painting
  15. Continuity Tests
  16. Connection Torque Tests
  17. Mechanical Operation Tests
  18. Rotational Tests

**1.03 CODES, STANDARDS, AND REFERENCES**

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.
- B. The **latest applicable edition** of specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:
1. National Electrical Code
  2. National Fire Protection Association's Recommended Practices
  3. Local, City & State Codes & Ordinances
  4. National Electrical Safety Code
  5. Underwriter's Laboratories, Inc.
  6. Illumination Engineering Society
  7. Institute of Electrical & Electronic Engineers
  8. Insulated Power Cable Engineers Association
  9. National Electrical Manufacturers Association
  10. Earthquake Requirement of the International Building Code
  11. American Society for Testing Materials
  12. Occupational Safety & Health Act
  13. Service requirements of serving utility company
  14. Americans with Disabilities Act (ADA)
  15. ASHRAE / IESNA Standard 90.1
  16. Arkansas Energy Code

**1.04 CONFLICTING REQUIREMENTS**

- A. Conflicting requirements: If compliance with standards, codes, regulations, and specifications establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

#### **1.05 SPECIFICATION AND DRAWING CONVENTIONS**

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

#### **1.06 FEES, PERMITS, AND INSPECTIONS**

- A. This Contractor shall be responsible for all costs incurred by any serving utility, municipal authority, and/or Owner for the relocation, removal, and installation of temporary or new services.
- B. The Contractor shall be responsible for coordinating and providing the exact service equipment and installation methods with the serving utility, municipal authority, and/or Owner prior to bidding. Failure to do so will not constitute sufficient grounds for an authorized change order to the project.

#### **1.07 PROJECT / SITE CONDITIONS:**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Architect / Owner reserves the right to relocate any device a maximum distance of 6' - 0" at the time of installation without an extra cost being incurred.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect / Engineer before proceeding.

#### **1.08 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
  - 2. The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this

specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.

3. Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
4. All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
5. The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
6. The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
7. The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
8. The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.
9. Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
10. All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
11. The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
12. The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
13. Engineer will return annotated file.



- B. Digital Data Files:
  - 1. Electronic digital data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
  - 2. Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form. A signed release form and any payment required must be returned to the Engineer prior to the transmission of an electronic digital data files.
  - 3. Electronic digital data file formats may include AutoCAD drawings, Revit converted to AutoCAD drawings or Revit Model.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
  - 2. Resubmittal Review: Allow 14 days for review of each resubmittal.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
  - 1. Name file with submittal number or other unique identifier, including revision identifier.
  - 2. Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
    - a. Project name.
    - b. Name and address of Engineer.
    - c. Name of Construction Manager.
    - d. Name of Contractor.
    - e. Name of firm or entity that prepared submittal.
    - f. Names of subcontractor, manufacturer, and supplier.
    - g. Category and type of submittal.
    - h. Specification Section number and title.
    - i. Indication of full or partial submittal.
    - j. Remarks.
- F. Options: Identify options requiring selection by Engineer.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 2. Resubmit submittals until they are marked with approval notation from Engineer.

## **1.09 CLOSEOUT SUBMITTALS**

- A. Closeout submittals shall include, but not limited to, the following:
  - 1. Operation and Maintenance Materials
  - 2. Record Drawings
  - 3. Demonstration and Training Materials

## **1.10 QUALITY ASSURANCE**

- A. Products:
  - 1. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
    - a. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

- b. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

#### **1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.
  - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 6. Protect stored products from damage and liquids from freezing.
  - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

#### **1.12 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Submit warranties in accordance with "Closeout Procedures."

#### **1.13 FIELD CONDITIONS**

- A. The Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

#### **1.14 GUARANTEE/WARRANTY**

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

- B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of 1 full year after acceptance by the Engineer and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for 1 full year after final acceptance by the Engineer.

#### **1.15 ELECTRICAL LICENSE REQUIREMENT**

- A. No person shall perform electrical work on the contract without possessing a Master's or Journeyman's License from the State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

### **PART 1 PRODUCTS**

#### **2.01 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Submit electronic submittals to Engineer.
    - a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. Mark each copy of each submittal to show which products and options are applicable.
  - 2. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
  - 3. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale and sufficiently large to show all pertinent features of the item, method of connections, and notations clearly legible. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.

#### **2.02 DELEGATED-DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

#### **2.03 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Where two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Where products are accompanied by the term "as selected," Engineer will make selection.
  - 5. Products containing asbestos shall not be used.
  - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
  - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - 3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience shall be considered.
  - 4. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## **2.04 COMPARABLE PRODUCTS**

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections.

## **2.05 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. After approval of materials and equipment for use in this project, a copy of an Operation and Maintenance Manual shall be submitted for approval.
- B. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of equipment.
  - 3. Table of contents.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Architect and hold two (2) copies for instruction of Owner as hereinafter specified.

## **2.06 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## **2.07 EQUIPMENT AND MATERIALS:**

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. When 2 or more units of materials or equipment of the same type or class are required, these units shall be products of 1 manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- D. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
- F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

- G. It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.
- H. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

## **2.08 EQUIPMENT ACCESSORIES:**

- A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.
- B. Connections: All final connections to equipment shall be installed as required by the manufacturer and/or Vendor.
- C. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes. The Contractor shall provide any additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

## **PART 1 - EXECUTION**

### **3.01 CONTRACTOR'S SUBMITTAL REVIEW**

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### **3.02 ENGINEER'S SUBMITTAL ACTION**

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may be returned by the Engineer without action.

### **3.03 DISPOSAL OF WASTE**

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Disposal: Remove waste materials from Owner's property and legally dispose of them

#### **3.04 RECORD DRAWING RECORDING AND MAINTENANCE**

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

#### **3.05 COORDINATION OF WORK**

- A. The Contractor shall compare the Electrical Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the Electrical Work. The Electrical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the Electrical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of conduits, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.
  1. Installation and Arrangement: The Contractor shall install all Electrical Work to permit removal (without damage to other parts) of coils, heat exchanger bundles, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
  2. Access: The Contractor shall provide all necessary access panels in walls, ceilings, equipment, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.
- E. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in conduit, back box, device locations, etc. The Contractor shall provide any additional conduit, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All

changes shall be made at no increase in the contract amount or additional cost to the other trades.

- F. Connections: All conduit connecting to equipment shall be installed without strain at the conduit connection
- G. Inaccessible Equipment
  - 1. Where the Engineer or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
  - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
- H. Electrical Coordination
  - 1. Power: All power and motor wiring shall be performed under Division 26 unless otherwise noted for specific items. Control and interlock wiring shall be done by the Contractor of this Division.
  - 2. Starters and Drives: All motor starters and drives unless included in other sections of the specifications shall be by Division 26. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.
  - 3. Disconnects: All equipment furnished under this Division required to have a means of disconnect shall be supplied with a disconnect or a disconnect shall be furnished and installed by Division 26.
- I. Dedicated Electrical Space: The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. The area above the dedicated space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks or breaks in foreign systems. Every effort shall be made to eliminate foreign systems above equipment to the structural ceiling. If this is not possible, the Contractor shall encase any pipe in a second pipe with a minimum number of joints.
- J. Lubrication: The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Fan shafts, pump shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

### **3.06 CUTTING AND PATCHING**

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
  - 2. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of fault, error or tardiness or because of any damage done by own workmanship.
  - 3. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.



- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements the "Occupant Coordination" article.
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  - 4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.07 EXCAVATION AND TRENCHING FOR ELECTRICAL CONDUIT**

- A. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other methods. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if the conduit or sleeves can be safely and properly installed and backfill can be properly tamped in such tunnel sections.
- B. Trench Excavation: Trenches shall be of necessary width for proper laying of the conduit, and the banks shall be as nearly vertical as practical. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for the conduit on undisturbed soil at every point along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum overdepth of 4 inches below the trench depths indicated on the drawings, or specified. Overdepths in the rock excavation and unauthorized overdepths shall be backfilled with loose, granular, moist earth, thoroughly tamped. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of

the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade coarse sand, fine gravel or other suitable materials, as hereinafter specified.

- C. Depth of Cover: Trenches for utilities shall be of a depth that will provide the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown. Exact depth of cover by Utility.
- D. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

### **3.08 BACKFILLING OF TRENCHES**

- A. Trenches shall not be backfilled until the utilities systems as installed confirm to the requirements of the drawings and specifications.
- B. Normal Backfill: Where compacted backfill is not specified the trenches shall be carefully backfilled with the materials approved for backfilling (See appropriate section), deposited in 6" layers and thoroughly and carefully rammed until the pipe has a cover of not less than one foot. The remainder of the backfill material shall then be carefully placed in the trench in one foot layers and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition. Surface condition shall be equipment to match the existing condition prior to trenching (sod, asphalt, etc.).
- C. Compacted backfill shall be used under slabs on grade, building structure, concrete paving and asphaltic concrete paving. The soils used in the fill shall be granular in nature and shall not contain roots, sod, rubbish or stones over 1-1/2" maximum dimension.

### **3.09 PAINTING**

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
  - 1. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
  - 2. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound. Any equipment scratched, marred or damaged will be repainted to the original condition.

### **3.10 CONTINUITY TEST:**

- A. The Contractor shall perform a continuity test on the affected portion of the electrical system prior to energizing the system to insure proper cable connections.

### **3.11 CONNECTION TORQUE TESTS:**

- A. All larger conductor bolted connections shall be torque tested using a torque wrench. Torque shall be to National Electrical Testing Association's (NETA) Standards.

### **3.12 MECHANICAL OPERATION TESTS:**

- A. All electrical equipment, such as switches, circuit breakers, etc., shall be tested by operating the device to verify that the mechanical portions of the device are functioning.

### **3.13 ROTATIONAL TESTS:**

- A. The Contractor shall assist all other trades in performing rotational tests on all motors provided under this contract. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.

**SECTION 260519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Service entrance cable.
- D. Metal-clad cable.
- E. Power and control tray cable.
- F. Variable-frequency drive cable.
- G. Wiring connectors.
- H. Electrical tape.
- I. Heat shrink tubing.
- J. Oxide inhibiting compound.
- K. Wire pulling lubricant.
- L. Cable ties.
- M. Firestop sleeves.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

**1.03 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
- F. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable; 2004 (Corrigendum 2014).
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- S. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

#### **1.08 FIELD CONDITIONS**

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

### **PART 2 - PRODUCTS**

#### **2.01 CONDUCTOR AND CABLE APPLICATIONS**

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
  - 1. Exceptions:
    - a. Use power and control tray cable or metal-clad cable for installation in cable tray.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Armored cable is not permitted.
- E. Metal-clad cable is not permitted.

#### **2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 260526.
- H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- I. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- J. Conductor Material:
  - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
- K. Minimum Conductor Size:
  - 1. Branch Circuits: 12 AWG.
- L. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- M. Conductor Color Coding:
  - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  - 2. Color Coding Method: Integrally colored insulation.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  - 3. Color Code:
    - a. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - b. Equipment Ground, All Systems: Green.
    - c. Travelers for 3-Way and 4-Way Switching: Pink.
    - d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
    - e. For control circuits, comply with manufacturer's recommended color code.

## **2.03 SINGLE CONDUCTOR BUILDING WIRE**

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. Encore Wire Corporation
    - b. General Cable Technologies Corporation
    - c. Southwire Company
    - d. Advance Wire and Cable, Inc

- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    - a. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

#### **2.04 POWER AND CONTROL TRAY CABLE**

- A. Manufacturers:
  - 1. Encore Wire Corporation
  - 2. General Cable Technologies Corporation
  - 3. Southwire Company
- B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.
- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type XHHW or XHHW-2.
- F. Jacket: PVC or Chlorinated Polyethylene (CPE).

#### **2.05 WIRING CONNECTORS**

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors, mechanical connectors, or compression connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- C. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

1. Manufacturers:
  - a. 3M
  - b. Ideal Industries, Inc
  - c. NSI Industries LLC
- G. Mechanical Connectors: Provide bolted type or set-screw type.
  1. Manufacturers:
    - a. Burndy LLC
    - b. Ilsco
    - c. Thomas & Betts Corporation
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
  1. Manufacturers:
    - a. Burndy LLC
    - b. Ilsco
    - c. Thomas & Betts Corporation

## **2.06 ACCESSORIES**

- A. Electrical Tape:
  1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
  2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
  3. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- D. Wire Pulling Lubricant:
  1. Manufacturers:
    - a. 3M:
    - b. American Polywater Corporation
    - c. Ideal Industries, Inc
  2. Listed and labeled as complying with UL 267.
  3. Suitable for use with conductors/cables and associated insulation/jackets to be installed, when tested in accordance with IEEE 1210; approved by conductor/cable manufacturer.
  4. Suitable for use at installation temperature.
- E. Cable Ties: Material and tensile strength rating suitable for application.
- F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  1. Products:
    - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### **3.03 INSTALLATION**

- A. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated without specific routing, determine exact routing required.
  - 3. Arrange circuiting to minimize splices.
  - 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  - 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  - 6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
    - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
    - b. Increase size of conductors as required to account for ampacity derating.
    - c. Size raceways, boxes, etc. to accommodate conductors.
  - 7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
  - 8. Provide oversized neutral/grounded conductors where indicated and as specified below.
    - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
    - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.



1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
  2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC):
    - a. Use listed fittings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- H. Install conductors with a minimum of 12 inches of slack at each outlet.
- I. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  3. Do not remove conductor strands to facilitate insertion into connector.
  4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
  5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

**END OF SECTION 260519**

**SECTION 260526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Chemically-enhanced ground electrodes.
- G. Ground plate electrodes.
- H. Ground enhancement material.

**1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

**1.03 REFERENCE STANDARDS**

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
  - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

**1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- C. Field quality control test reports.
- D. Project Record Documents: Record actual locations of grounding electrode system components and connections.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. ANSI/IEEE Compliance: Comply with C114.1 (IEEE Std 142) and IEEE Std Nos. 241 and 242 pertaining to grounding and ground-fault protection of power systems.
- D. ANSI/UL Compliance: Comply with requirements of ANSI/UL and UL standards pertaining to grounding and ground-fault protection equipment and devices. Provide products which have been UL-listed and labeled.
- E. NEMA Compliance: Comply with NEMA Std Pub Nos. PB 1.2 and AB 1, pertaining to construction and installation of ground-fault protection devices and molded-case circuit breakers.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 - PRODUCTS**

#### **2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
  - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    - a. Provide continuous grounding electrode conductors without splice or joint.
    - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
  - 2. Metal Underground Water Pipe(s):
    - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.

- b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
  - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
- 3. Metal In-Ground Support Structure:
  - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
- 4. Concrete-Encased Electrode:
  - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
- 5. Ground Rod Electrode(s):
  - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
  - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
  - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
- 6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- G. Service-Supplied System Grounding:
  - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
  - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Separately Derived System Grounding:
  - 1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
    - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
    - c. Generators, when neutral is switched in the transfer switch.
  - 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
  - 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
  - 4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
  - 5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
  - 6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

- I. Bonding and Equipment Grounding:
  - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
  - 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
  - 8. Provide bonding for metal building frame.
- J. Communications Systems Grounding and Bonding:
  - 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
  - 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
    - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
    - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
    - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- K. Pole-Mounted Luminaires: Also comply with Section 265600.

## **2.02 GROUNDING AND BONDING COMPONENTS**

- A. General Requirements:
  - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
  - 1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
      - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
  - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
  - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
  - 4. Manufacturers - Mechanical and Compression Connectors:
    - a. Advanced Lightning Technology (ALT)
    - b. Burndy LLC

- c. Harger Lightning & Grounding
  - d. Thomas & Betts Corporation
- 5. Manufacturers - Exothermic Welded Connections:
  - a. Burndy LLC
  - b. thermOweld, subsidiary of Continental Industries; division of Burndy LLC
- D. Ground Bars:
  - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  - 2. Size: As indicated.
  - 3. Holes for Connections: As indicated or as required for connections to be made.
  - 4. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Harger Lightning & Grounding
    - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC
- E. Ground Rod Electrodes:
  - 1. Comply with NEMA GR 1.
  - 2. Material: Copper-bonded (copper-clad) steel.
  - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
  - 4. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Galvan Industries, Inc
    - c. Harger Lightning & Grounding
- F. Chemically-Enhanced Ground Electrodes:
  - 1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
  - 2. Length: 10 feet.
  - 3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
  - 4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.
  - 5. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Harger Lightning & Grounding
- G. Ground Plate Electrodes:
  - 1. Material: Copper.
  - 2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.
  - 3. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Harger Lightning & Grounding
    - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC
- H. Ground Enhancement Material:
  - 1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
  - 2. Manufacturers:
    - a. Harger Lightning & Grounding
    - b. thermOweld, subsidiary of Continental Industries; division of Burndy LLC

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that work likely to damage grounding and bonding system components has been completed.

- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
  - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
- D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.
- E. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- F. Identify grounding and bonding system components in accordance with Section 260553.
- G. Neutrals of lighting systems shall be grounded independently and in accordance with the National Electrical Code.
- H. All metal raceway system, including cabinets, conduit and boxes, shall be grounded to a water pipe with UL approved grounding clamp in accordance with the National Electrical Code.
- I. An equipment ground conductor shall be installed in all conduits.

### **3.03 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 260526**

**SECTION 260529**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

**1.02 RELATED REQUIREMENTS**

- A. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- C. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
  - 2. Coordinate work to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
  - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

**PART 2 - PRODUCTS**

**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:



1. Comply with the following. Where requirements differ, comply with most stringent.
  - a. NFPA 70.
  - b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
  - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
  - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
  - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
  1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
  1. Manufacturers:
    - a. HoldRite, a brand of Reliance Worldwide Corporation
- D. Metal Channel/Strut Framing Systems:
  1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  2. Comply with MFMA-4.
  3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
  4. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
  1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2-inch diameter.
    - b. Busway Supports: 1/2-inch diameter.
    - c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
    - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
    - e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
    - f. Outlet Boxes: 1/4-inch diameter.
    - g. Luminaires: 1/4-inch diameter.
- F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
  1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
  2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- G. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Stud Walls: Use toggle bolts.
  5. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  6. Sheet Metal: Use sheet metal screws.
  7. Wood: Use wood screws.
  8. Plastic and lead anchors are not permitted.
  9. Powder-actuated fasteners are not permitted.
  10. Hammer-driven anchors and fasteners are not permitted.
  11. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
    - b. Comply with MFMA-4.
    - c. Channel Material: Use galvanized steel.
    - d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners in accordance with manufacturer's recommended torque settings.

- J. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 260529**

**SECTION 260533.13**  
**CONDUIT FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Galvanized steel intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Galvanized steel electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Liquidtight flexible nonmetallic conduit (LFNC).
- J. Reinforced thermosetting resin conduit (RTRC).

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

**1.03 REFERENCE STANDARDS**

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- M. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

- P. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- Q. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- R. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- S. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- T. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- U. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- V. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- W. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- X. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- Y. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- Z. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.
- AA. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
  - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

#### **1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Shop Drawings:
  - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
  - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

#### **1.06 QUALITY ASSURANCE**

- A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

### **PART 2 - PRODUCTS**

## 2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
  - 5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.
  - 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
  - 7. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Embedded Within Concrete:
  - 1. Within Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.
  - 2. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC),

stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.

3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) where emerging from concrete.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
1. Locations subject to physical damage include, but are not limited to:
    - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
    - b. Where exposed below 20 feet in warehouse areas.
- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- M. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC),

stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).

1. Corrosive locations include, but are not limited to:
  - a. Cooling towers.
- N. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).
- O. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
  1. Maximum Length: 6 feet.
- P. Flexible Connections to Vibrating Equipment:
  1. Dry Locations: Use flexible metal conduit (FMC).
  2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
  3. Maximum Length: 6 feet unless otherwise indicated.
  4. Vibrating equipment includes, but is not limited to:
    - a. Transformers.
    - b. Motors.

## **2.02 CONDUIT - GENERAL REQUIREMENTS**

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- B. Electrical Service Conduits: See Section 262100 for additional requirements.
- C. Fittings for Grounding and Bonding: See Section 260526 for additional requirements.
- D. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
  1. Branch Circuits: 3/4 inch (21 mm) trade size.
  2. Branch Circuit Homeruns: 3/4-inch trade size.
  3. Control Circuits: 1/2 inch (16 mm) trade size.
  4. Underground, Interior: 3/4-inch trade size.
  5. Underground, Exterior: 1-inch trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

## **2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

- A. Manufacturers:
  1. Allied Tube & Conduit
  2. Republic Conduit
  3. Wheatland Tube, a Division of Zekelman Industries
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co
  2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.



4. Material: Use steel or malleable iron.
  - a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

#### **2.04 ALUMINUM RIGID METAL CONDUIT (RMC)**

- A. Manufacturers:
  1. Allied Tube & Conduit
  2. Republic Conduit
  3. Wheatland Tube, a Division of Zekelman Industries
- B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co
  2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A
  3. Material: Use aluminum.
  4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

#### **2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)**

- A. Manufacturers:
  1. Allied Tube & Conduit
  2. Republic Conduit
  3. Wheatland Tube, a Division of Zekelman Industries
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co
  2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
  3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
  4. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.
  5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

#### **2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

- A. Manufacturers:
  1. Robroy Industries
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- D. PVC-Coated Boxes and Fittings:
  1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.

2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
  3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
  4. Material: Use steel or malleable iron.
  5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

## **2.07 FLEXIBLE METAL CONDUIT (FMC)**

- A. Manufacturers:
1. AFC Cable Systems, Inc
  2. Electri-Flex Company
  3. International Metal Hose
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.

## **2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)**

- A. Manufacturers:
1. AFC Cable Systems, Inc
  2. Electri-Flex Company
  3. International Metal Hose
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.

## **2.09 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)**

- A. Manufacturers:
1. Allied Tube & Conduit
  2. Republic Conduit
  3. Wheatland Tube, a Division of Zekelman Industries
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Electric Co

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
  - a. Do not use die cast zinc fittings.
4. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

## **2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Manufacturers:
  1. Cantex Inc
  2. JM Eagle
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

## **2.11 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)**

- A. Manufacturers:
  1. AFC Cable Systems, Inc
  2. Electri-Flex Company
  3. International Metal Hose
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

## **2.12 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)**

- A. Manufacturers:
  1. Champion Fiberglass, Inc
  2. FRE Composites
  3. United Fiberglass of America, Inc
- B. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- C. Supports: As recommended by manufacturer.
- D. Fittings: Same type and manufacturer as conduit to be connected.
  1. Cement-Tight Joints: Use bonded coupling or bell and spigot.
  2. Cement-Tight and Watertight Joints: Use adhesive and manufacturer's standard gaskets.

## **2.13 ACCESSORIES**

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

- E. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- F. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.
- G. Sealing Systems for Concrete Penetrations:
  - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
  - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
- H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
  - 1. Products:
    - a. Menzies Metal Products; Electrical Roof Stack and Cap
    - b. Menzies Metal Products; Electrical Retro Box
- I. 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.
  - 1. Products:
    - a. Quickflash Weatherproofing Products, Inc
- J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  - 1. Products:
    - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
- K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.
  - 1. Products:
    - a. Advance Products & Systems, LLC; Duct Bank Spacers
- L. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.
  - 1. Products:
    - a. Advance Products & Systems, LLC; Bore Spacers

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

- H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
- I. Conduit Routing:
  - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
  - 2. When conduit destination is indicated without specific routing, determine exact routing required.
  - 3. Conceal conduits unless specifically indicated to be exposed.
  - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Mechanical equipment rooms.
    - c. Within joists in areas with no ceiling.
  - 5. Unless otherwise approved, do not route exposed conduits:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
  - 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
  - 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
  - 9. Arrange conduit to provide no more than 150 feet between pull points.
  - 10. Route conduits above water and drain piping where possible.
  - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
  - 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
  - 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    - a. Heaters.
    - b. Hot water piping.
    - c. Flues.
  - 14. Group parallel conduits in same area on common rack.
- J. Conduit Support:
  - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
  - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  - 4. Use conduit strap to support single surface-mounted conduit.
    - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
  - 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
  - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
  - 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
  - 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
  - 9. Use of spring steel conduit clips for support of conduits is not permitted.
  - 10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

K. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

L. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Install firestopping to preserve fire resistance rating of partitions and other elements.

M. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:
  - a. Underground, Exterior: 18 inches.
  - b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 260553.

N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

P. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
  2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
    - a. Where conduits pass from outdoors into conditioned interior spaces.
    - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- Q. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- R. Provide grounding and bonding; see Section 260526.
- S. Identify conduits; see Section 260553.

### **3.03 FIELD QUALITY CONTROL**

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

### **3.04 CLEANING**

- A. Clean interior of conduits to remove moisture and foreign matter.

### **3.05 PROTECTION**

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

**END OF SECTION 260533.13**

**SECTION 260533.16**  
**BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Boxes for hazardous (classified) locations.
- E. Floor boxes.
- F. Underground boxes/enclosures.
- G. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.
  - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 - Wiring Devices:
  - 1. Wall plates.
  - 2. Poke-through assemblies.
  - 3. Additional requirements for locating boxes for wiring devices.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**



- A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  6. Coordinate the work with other trades to preserve insulation integrity.
  7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
  8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
  2. Keys for Lockable Enclosures: Two of each different key.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 - PRODUCTS**

#### **2.01 BOXES**

- A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  3. Use suitable concrete type boxes where flush-mounted in concrete.
  4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  5. Use raised covers suitable for the type of wall construction and device configuration where required.
  6. Use shallow boxes where required by the type of wall construction.
  7. Do not use "through-wall" boxes designed for access from both sides of wall.
  8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
  12. Minimum Box Size, Unless Otherwise Indicated:
    - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
  13. Wall Plates: Comply with Section 262726.
  14. Manufacturers:
    - a. Hubbell Incorporated; Bell Products
    - b. Hubbell Incorporated; RACO Products
    - c. O-Z/Gedney, a brand of Emerson Electric Co
    - d. Thomas & Betts Corporation
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, painted steel.
    - b. Outdoor Locations: Type 3R, painted steel.
  3. Junction and Pull Boxes Larger Than 100 cubic inches:
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
  4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    - b. Back Panels: Painted steel, removable.
    - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
  5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
  6. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation
    - b. Hoffman, a brand of Pentair Technical Products
    - c. Hubbell Incorporated; Wiegmann Products

- D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
  - 1. Manufacturers:
    - a. Hubbell Incorporated
- E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
  - 1. Manufacturers:
    - a. Appleton, a brand of Emerson Electric Co
    - b. Cooper Crouse-Hinds, a division of Eaton Corporation
    - c. Hubbell Incorporated; Killark Products

## **2.02 ACCESSORIES**

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
  - 1. Manufacturers:
    - a. Quickflash Weatherproofing Products, Inc: [www.quickflashproducts.com/#sle](http://www.quickflashproducts.com/#sle).

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels as required where approved by the Architect.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - 3. Locate boxes as required for devices installed under other sections or by others.
    - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
  - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.

9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
  - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
  - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
  - a. Concealed above accessible suspended ceilings.
  - b. Within joists in areas with no ceiling.
  - c. Electrical rooms.
  - d. Mechanical equipment rooms.
- I. Box Supports:
  1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
  1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
  2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- M. Install boxes as required to preserve insulation integrity.
- N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements.
- P. Close unused box openings.
- Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- R. Provide grounding and bonding in accordance with Section 260526.
- S. Identify boxes in accordance with Section 260553.

### **3.03 CLEANING**

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

### **3.04 PROTECTION**

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION 260533.16**

**SECTION 260536**  
**CABLE TRAYS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal cable tray systems:
  - 1. Metal ladder cable tray.
  - 2. Metal ventilated trough cable tray.
  - 3. Metal single rail/center spine cable tray.
  - 4. Metal wire mesh/basket cable tray.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA FG 1 - Fiberglass Cable Tray Systems; 1993 (Revised 1994).
- C. NEMA BI 50015 - Metal Cable Tray Systems; 2024.
- D. NEMA VE 2 - Cable Tray Installation Guidelines; 2018.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
  - 2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
  - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 4. Notify of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.
- C. Sequencing:
  - 1. Do not begin installation of cables until installation of associated cable tray run is complete.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.

**1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2, except do not store cable tray outdoors without cover as permitted in NEMA VE 2.
- B. Handle products carefully to avoid damage to finish.

## **PART 2 - PRODUCTS**

### **2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS**

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA BI 50015.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA BI 50015 including applicable allowable tolerances.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.
- C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- D. Arrange cable tray to provide required clearances and maintain cable access.
- E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
- F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
  - 1. Inside Radius of Fittings: As indicated on drawings.
- G. Cable Tray Movement Provisions:
  - 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
    - a. Where cable tray crosses structural joints intended for expansion.
    - b. Long straight cable tray runs in accordance with NEMA VE 2.
  - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
  - 3. Set gaps for expansion fittings in accordance with NEMA VE 2.
- H. Cable Provisions:

1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
  2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
  3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
- I. Provide end closures at unconnected ends of cable tray runs.
- J. Cable Tray Support:
1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment in accordance with Section 260529, where not furnished by cable tray manufacturer.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- K. Grounding and Bonding Requirements, in Addition to Requirements of Section 260526:
1. Comply with grounding and bonding requirements of NEMA VE 2.
- L. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 078400.
- M. Identification Requirements, in Addition to Those Specified in Section 260553.
- N. Install cable tray covers where indicated and as follows:

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect cable tray system for damage and defects.
- C. Correct deficiencies and replace damaged or defective cable tray system components.

### **3.04 CLEANING**

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### **3.05 PROTECTION**

- A. Protect cable tray system from subsequent construction operations.

**END OF SECTION 260536**



**SECTION 260553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

**1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 260536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- C. Section 271000 - Structured Cabling: Identification for communications cabling and devices.

**1.03 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

**1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

**1.07 FIELD CONDITIONS**

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

**PART 2 - PRODUCTS**

**2.01 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Identify ampere rating.
      - 2) Identify voltage and phase.
      - 3) Identify power source and circuit number. Include location when not within sight of equipment.
      - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
      - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
    - b. Transformers:
      - 1) Identify kVA rating.
      - 2) Identify voltage and phase for primary and secondary.
      - 3) Identify power source and circuit number. Include location when not within sight of equipment.
      - 4) Identify load(s) served. Include location when not within sight of equipment.
    - c. Enclosed switches, circuit breakers, and motor controllers:
      - 1) Identify voltage and phase.
      - 2) Identify power source and circuit number. Include location when not within sight of equipment.
      - 3) Identify load(s) served. Include location when not within sight of equipment.
  2. Service Equipment:
    - a. Use identification nameplate to identify each service disconnecting means.
  3. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
  4. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    - a. Service equipment.
    - b. Industrial control panels.
    - c. Motor control centers.
    - d. Elevator control panels.
    - e. Industrial machinery.
  5. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
    - a. Minimum Size: 3.5 by 5 inches.
    - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
    - c. Service Equipment: Include the following information in accordance with NFPA 70.
      - 1) Nominal system voltage.
      - 2) Available fault current.
      - 3) Clearing time of service overcurrent protective device(s).
      - 4) Date label applied.
- B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
  2. Identification for Communications Conductors and Cables: Comply with Section 271000.
  3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
  5. Use underground warning tape to identify direct buried cables.
- C. Identification for Raceways:
1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
    - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
      - 1) Color Code:
        - (a) Emergency Power System: Red.
      - 2) Field-Painting: Comply with Section 099123 and 099113.
      - 3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
  2. Use underground warning tape to identify underground raceways.
- D. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 271000.

## **2.02 IDENTIFICATION NAMEPLATES AND LABELS**

- A. Identification Nameplates:
1. Manufacturers:
    - a. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
    - b. Kolbi Pipe Marker Co; \_\_\_\_\_: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
    - c. Seton Identification Products; \_\_\_\_\_: [www.seton.com/#sle](http://www.seton.com/#sle).
  2. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
  4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
  5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
  6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Manufacturers:
    - a. Brady Corporation; \_\_\_\_\_: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
    - b. Brother International Corporation: [www.brother-usa.com/#sle](http://www.brother-usa.com/#sle).
    - c. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
  2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend:
    - a. System designation where applicable:

- 1) Emergency Power System: Identify with text "EMERGENCY".
  - 2) Fire Alarm System: Identify with text "FIRE ALARM".
- b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
  - a. System Designation: 1 inch.
  - b. Equipment Designation: 1/2 inch.
5. Color:
  - a. Normal Power System: White text on black background.
  - b. Emergency Power System: White text on red background.
  - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
  1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/4 inch.
  5. Color: Black text on white background unless otherwise indicated.

### **2.03 WIRE AND CABLE MARKERS**

- A. Manufacturers:
  1. Brady Corporation; \_\_\_\_\_: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. HellermannTyton; \_\_\_\_\_: [www.hellermannntyton.com/#sle](http://www.hellermannntyton.com/#sle).
  3. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

### **2.04 VOLTAGE MARKERS**

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Minimum Size:
  1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
- C. Legend:
  1. Markers for System Identification:
- D. Color: Black text on orange background unless otherwise indicated.

### **2.05 UNDERGROUND WARNING TAPE**

- A. Manufacturers:
  1. Brady Corporation; \_\_\_\_\_: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  3. Seton Identification Products; \_\_\_\_\_: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:

## **2.06 WARNING SIGNS AND LABELS**

- A. Manufacturers:
  1. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  2. Clarion Safety Systems, LLC; \_\_\_\_\_: [www.clarionsafety.com/#sle](http://www.clarionsafety.com/#sle).
  3. Seton Identification Products; \_\_\_\_\_: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
  1. Materials:
  2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
  1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
  2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  3. Minimum Size: 2 by 4 inches unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  1. Surface-Mounted Equipment: Enclosure front.
  2. Flush-Mounted Equipment: Inside of equipment door.
  3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  4. Elevated Equipment: Legible from the floor or working platform.
  5. Branch Devices: Adjacent to device.
  6. Interior Components: Legible from the point of access.
  7. Conduits: Legible from the floor.
  8. Conductors and Cables: Legible from the point of access.
  9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

- G. Mark all handwritten text, where permitted, to be neat and legible.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

**END OF SECTION 260553**

## **SECTION 260583 WIRING CONNECTIONS**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 262816.16 - Enclosed Switches.

#### **1.03 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  - 2. Determine connection locations and requirements.
- B. Sequencing:
  - 1. Install rough-in of electrical connections before installation of equipment is required.
  - 2. Make electrical connections before required start-up of equipment.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Comply with NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 262726.
- D. Flexible Conduit: As specified in Section 260533.13.
- E. Wire and Cable: As specified in Section 260519.
- F. Boxes: As specified in Section 260533.16.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

### **3.02 ELECTRICAL CONNECTIONS**

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

**END OF SECTION 260583**



**SECTION 260923  
LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Occupancy sensors.
- B. Outdoor photo controls.
- C. Lighting contactors.
- D. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- E. Section 265100 - Interior Lighting.
- F. Section 265600 - Exterior Lighting.

**1.03 REFERENCE STANDARDS**

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment—Nonlocking (Button)—Type Photocontrols; 2026.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- H. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.
- I. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- L. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- M. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- N. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- O. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- P. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

- Q. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
  2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
  3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
  4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
  5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND PROTECTION**

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.09 WARRANTY**

- A. Provide five year manufacturer warranty for all occupancy sensors.
- B. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

## **PART 2 - PRODUCTS**

### **2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

### **2.02 OCCUPANCY SENSORS**

- A. Manufacturers:
  - 1. Hubbell Incorporated
  - 2. Lutron Electronics Company, Inc
  - 3. Sensor Switch Inc
  - 4. WattStopper
  - 5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
  - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  - 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  - 7. Sensitivity: Field adjustable.
  - 8. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
  - 9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
  - 10. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
- C. Wall Switch Occupancy Sensors:
  - 1. All Wall Switch Occupancy Sensors:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
    - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.

- d. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
    - e. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
    - f. Finish: Color to be selected by Architect..
  - 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Ceiling Mounted Occupancy Sensors:
  - 1. All Ceiling Mounted Occupancy Sensors:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
    - c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
    - d. Finish: White unless otherwise indicated.
  - 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
  - 3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
  - 4. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- E. Directional Occupancy Sensors:
  - 1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
    - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
    - b. Provide field selectable setting for disabling LED motion detector visual indicator.
    - c. Finish: White unless otherwise indicated.
  - 2. Passive Infrared (PIR) Directional Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
    - b. Long Range Sensors: Capable of detecting motion within a distance of 80 feet at a mounting height of 10 feet.
  - 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
- F. Power Packs for Low Voltage Occupancy Sensors:
  - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
  - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
  - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
  - 4. Load Rating: As required to control the load indicated on drawings.
- G. Power Packs for Wireless Occupancy Sensors:
  - 1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
  - 2. Input Supply Voltage: Dual rated for 120/277 V ac.

3. Load Rating: As required to control the load indicated on drawings.

## **2.03 OUTDOOR PHOTO CONTROLS**

- A. Manufacturers:
  1. Intermatic, Inc; \_\_\_\_\_: [www.intermatic.com/#sle](http://www.intermatic.com/#sle).
  2. Tork, a division of NSI Industries LLC; \_\_\_\_\_: [www.tork.com/#sle](http://www.tork.com/#sle).
- B. Stem-Mounted Outdoor Photo Controls:
  1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
  2. Housing: Weatherproof, impact resistant polycarbonate.
  3. Photo Sensor: Cadmium sulfide.
  4. Provide external sliding shield for field adjustment of light level activation.
  5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
  6. Voltage: As required to control the load indicated on the drawings.
  7. Failure Mode: Fails to the on position.
  8. Load Rating: As required to control the load indicated on the drawings.
- C. Locking Receptacle-Mounted Outdoor Photo Controls
  1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
  2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
  3. Photo Sensor: Cadmium sulfide.
  4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
  5. Voltage: As required to control the load indicated on the drawings.
  6. Failure Mode: Fails to the on position.
  7. Load Rating: As required to control the load indicated on the drawings.
  8. Surge Protection: 160 joule metal oxide varistor.
- D. Button Type Outdoor Photo Controls
  1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
  2. Housing: Weather resistant polycarbonate.
  3. Photo Sensor: Cadmium sulfide.
  4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
  5. Voltage: As required to control the load indicated on the drawings.
  6. Failure Mode: Fails to the on position.
  7. Load Rating: As required to control the load indicated on the drawings.

## **2.04 LIGHTING CONTACTORS**

- A. Manufacturers:
  1. ABB/GE
  2. Eaton Corporation
  3. Rockwell Automation Inc; Allen-Bradley Products;
  4. Schneider Electric; Square D Products
  5. Siemens Industry, Inc;
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
- C. Short Circuit Current Rating:

1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Enclosures:
  1. Comply with NEMA IA 10030.
  2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
    - b. Outdoor Locations: Type 3R or Type 4.
  3. Finish: Manufacturer's standard unless otherwise indicated.

## **2.05 ACCESSORIES**

- A. Auxiliary Contacts:
  1. Comply with NEMA IA 10039.
  2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.03 INSTALLATION**

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Install lighting control relays furnished under Section 253626
- C. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
  1. Mounting Heights: Unless otherwise indicated, as follows:
    - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
    - b. In-Wall Time Switches: 48 inches above finished floor.
    - c. In-Wall Interval Timers: 48 inches above finished floor.
  2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
  3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- D. Install lighting control devices in accordance with manufacturer's instructions.

- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- H. Provide required supports in accordance with Section 260529.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
  - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Outdoor Photo Control Locations:
  - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
  - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- N. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.
- O. Where indicated or required, provide cabinet or enclosure in accordance with Section 260533.16 for mounting of lighting control device system components.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

### **3.05 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

- E. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

### **3.06 CLEANING**

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### **3.07 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
  - 4. Location: At project site.

**END OF SECTION 260923**



**SECTION 262100**  
**LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical service requirements.

**1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260533.13 - Conduit for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262416 - Panelboards: Service entrance equipment.
- G. Section 262816.16 - Enclosed Switches: Service entrance equipment.

**1.03 DEFINITIONS**

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

**1.04 REFERENCE STANDARDS**

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
  - 1. Verify the following with Utility Company representative:
    - a. Utility Company requirements, including division of responsibility.
    - b. Exact location and details of utility point of connection.
    - c. Utility easement requirements.
    - d. Utility Company charges associated with providing service.
  - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
  - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
  - 1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

2. Arrange for inspections necessary to obtain Utility Company approval of installation.

#### **1.06 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations of equipment and installed service routing.

#### **1.07 QUALITY ASSURANCE**

- A. Comply with the following:
  1. IEEE C2 (National Electrical Safety Code).
  2. NFPA 70 (National Electrical Code).
  3. The requirements of the Utility Company.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

### **PART 2 - PRODUCTS**

#### **2.01 ELECTRICAL SERVICE REQUIREMENTS**

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility:
  1. Pad-Mounted Utility Transformers:
    - a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
    - b. Transformers: Furnished and installed by Utility Company.
    - c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
    - d. Primary:
      - 1) Trenching and Backfilling: Provided by Contractor.
      - 2) Conduits: Furnished and installed by Contractor.
      - 3) Conductors: Furnished and installed by Utility Company.
    - e. Secondary:
      - 1) Trenching and Backfilling: Provided by Contractor.
      - 2) Conduits: Furnished and installed by Contractor.
      - 3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
  2. Terminations at Service Point: Provided by Utility Company.
  3. Metering Provisions:
    - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
    - b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
    - c. Metering Compartments in Service Entrance Equipment: Furnished and installed by Contractor per Utility Company requirements.
    - d. Metering Transformers: Furnished and installed by Utility Company.

- e. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
- f. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
- g. Communications Conduits for Meters: Furnished and installed by Contractor per Utility Company requirements.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Verify and mark locations of existing underground utilities.

### **3.03 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required protective bollards in accordance with Utility Company requirements.
- E. Provide required support and attachment components in accordance with Section 260529.
- F. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.
- G. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

### **3.04 PROTECTION**

- A. Protect installed equipment from subsequent construction operations.

**END OF SECTION 262100**

## **SECTION 262416 PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.

#### **1.03 REFERENCE STANDARDS**

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
- C. Manufacturer's equipment seismic qualification certification.
- D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Panelboard Keys: Two of each different key.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Eaton Corporation
- B. Schneider Electric; Square D Products
- C. Siemens Industry, Inc

#### **2.02 PANELBOARDS - GENERAL REQUIREMENTS**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  1. Altitude: Less than 6,600 feet.
  2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

- C. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
    - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
    - c. Provide removable end walls for NEMA Type 1 enclosures.
    - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
  - 3. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
    - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.
- L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
- M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- N. Load centers are not acceptable.
- O. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Feed-through lugs.
  - 2. Sub-feed lugs.

## 2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  - 1. Phase and Neutral Bus Material: Copper.
  - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
  - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
- E. Enclosures:
  - 1. Provide surface-mounted enclosures unless otherwise indicated.

#### **2.04 LIGHTING AND APPLIANCE PANELBOARDS**

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
  - 2. Phase and Neutral Bus Material: Copper.
  - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
  - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
  - 2. Provide clear plastic circuit directory holder mounted on inside of door.

#### **2.05 OVERCURRENT PROTECTIVE DEVICES**

- A. Molded Case Circuit Breakers:
  - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
  - 2. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - 3. Conductor Terminations:
    - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
  - 6. Provide the following circuit breaker types where indicated:
    - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

- b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
- c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
- d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
- e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- 7. Do not use tandem circuit breakers.
- 8. Do not use handle ties in lieu of multi-pole circuit breakers.
- 9. Provide the following features and accessories where indicated or where required to complete installation:
  - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

## **2.06 SOURCE QUALITY CONTROL**

- A. Factory test panelboards according to NEMA PB 1.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
  - 1. Fire detection and alarm circuits.

### **3.03 FIELD QUALITY CONTROL**



- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than \_\_\_\_\_ amperes. Tests listed as optional are not required.
- C. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- D. Test GFCI circuit breakers to verify proper operation.
- E. Test AFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

#### **3.04 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

#### **3.05 CLEANING**

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 262416**

**SECTION 262816.16  
ENCLOSED SWITCHES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Enclosed safety switches.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

**1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Eaton Corporation
- B. Schneider Electric; Square D Products
- C. Siemens Industry, Inc
- D. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

### **2.02 ENCLOSED SAFETY SWITCHES**

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
  - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
  - 2. Minimum Ratings:
    - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
    - b. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- M. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

- O. Heavy Duty Switches:
  - 1. Comply with NEMA BS 31047.
  - 2. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Lug Material: Copper, suitable for terminating copper conductors only.
  - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
    - a. Provide means for locking handle in the ON position where indicated.
- P. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
  - 2. Integral fuse pullers.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.

### **3.03 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

### **3.04 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

### **3.05 CLEANING**

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 262816.16**

**SECTION 264113**  
**LIGHTNING PROTECTION FOR STRUCTURES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Strike (air) terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems: Electrical system grounds.
- B. Surge Protection for Wiring Systems: Specified in individual system requirements.

**1.03 REFERENCE STANDARDS**

- A. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2026.
- B. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
  - 1. Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.
  - 2. Include engineering analysis of equalization of potential to metal bodies within the structure.
- C. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Installation Certification: Submit copy of certification agency's approval.
- F. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

**1.05 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced system design standard on site.
- B. Installer Qualifications: Capable of providing the specified certification of the installed system.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Lightning Protection Components:
  - 1. Paxton Lightning Protection

**2.02 LIGHTNING PROTECTION SYSTEM**

- A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.
  - 1. Provide system that protects:
    - a. The entire structure.
    - b. Open air areas within 100 feet of exterior walls at grade level.
    - c. Open air areas within building footprint.
  - 2. Coordinate with other grounding and bonding systems specified.
  - 3. Determine ground resistance by field measurement.
  - 4. Provide copper, bronze, or stainless steel components, as applicable; no aluminum.

5. Provide system certified by Underwriters Laboratories or the Lightning Protection Institute.
- B. Strike Terminals: Provide strike (air) terminals on the following:
  1. Roofs.
  2. Penthouse roofs.
  3. Parapets.
  4. Roof mounted equipment.
  5. Stacks.

### **2.03 COMPONENTS**

- A. All Components: Complying with applicable requirements of UL 96.
- B. Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.
- C. Grounding Rods: Solid copper.
- D. Ground Plate: Copper.
- E. Conductors: Copper cable.
- F. Connectors and Splicers: Bronze.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated on shop drawings.
- B. Coordinate work with installation of roofing and exterior and interior finishes.

### **3.02 INSTALLATION**

- A. Install in accordance with referenced system standards and as required for specified certification.
- B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

### **3.03 FIELD QUALITY CONTROL**

- A. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.
- B. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.
- C. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

**END OF SECTION 264113**

## **SECTION 265100 INTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Lamps.
- F. Accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260923 - Lighting Control Devices.
  - 1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
  - 2. Includes lighting contactors.
- D. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 265600 - Exterior Lighting.

#### **1.03 REFERENCE STANDARDS**

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc.

- required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

#### **1.05 SUBMITTALS**

- A. Shop Drawings:
  1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
  2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- C. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND PROTECTION**

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.09 WARRANTY**

- A. Provide three year manufacturer warranty for LED luminaires, including drivers.
- B. Provide five year pro-rata warranty for batteries for emergency lighting units.
- C. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

### **PART 2 - PRODUCTS**

#### **2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.

#### **2.02 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.



- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
  - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
  - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
  - 1. LED Tape - General Requirements:
    - a. Listed.
    - b. Designed for field cutting in accordance with listing.
    - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
- J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

### **2.03 EMERGENCY LIGHTING UNITS**

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
  - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
  - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- G. Accessories:
  - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

### **2.04 EXIT SIGNS**

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.
  2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

## **2.05 BALLASTS AND DRIVERS**

- A. Ballasts/Drivers - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
  2. Control Compatibility: Fully compatible with the dimming controls to be installed.
    - a. Wall Dimmers: See Section 262726.

## **2.06 LAMPS**

- A. Lamps - General Requirements:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
  3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
  5. Unless otherwise noted, color temperature shall be 3500k for indoor fixtures and 4000k for exterior fixtures.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.03 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

- G. Suspended Ceiling Mounted Luminaires:
  - 1. Do not use ceiling tiles to bear weight of luminaires.
  - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  - 3. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  - 4. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
  - 5. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
  - 1. Install trims tight to mounting surface with no visible light leakage.
  - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
  - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
  - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
  - 2. Install canopies tight to mounting surface.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Emergency Lighting Units:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- M. Exit Signs:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Install lamps in each luminaire.
- O. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### **3.05 ADJUSTING**

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

### **3.06 CLEANING**

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### **3.07 CLOSEOUT ACTIVITIES**

### **3.08 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION 265100**

**SECTION 265600  
EXTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Exterior luminaires.
- B. Ballasts.
- C. Poles and accessories.
- D. Luminaire accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. IES RP-8 - Recommended Practice: Lighting Roadway and Parking Facilities; 2025, with Errata (2026).
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
  - 2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

**1.05 SUBMITTALS**

- A. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
  - 3. Provide structural calculations for each pole proposed for substitution.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
  - 1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
  - 2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- D. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### **1.08 WARRANTY**

- A. Provide three year manufacturer warranty for all LED luminaires, including drivers.

### **PART 2 - PRODUCTS**

#### **2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.

#### **2.02 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
  - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
  - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- I. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

- K. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

## **2.03 BALLASTS AND DRIVERS**

- A. Ballasts/Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

## **2.04 POLES**

- A. All Poles:
  - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
  - 2. Structural Design Criteria:
    - a. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
  - 3. Material: Steel, unless otherwise indicated. Fiberglass and Resin poles will not be accepted.
  - 4. Shape: Square straight, unless otherwise indicated.
  - 5. Finish: Match luminaire finish, unless otherwise indicated.
  - 6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
  - 7. Unless otherwise indicated, provide with the following features/accessories:
    - a. Top cap.
    - b. Anchor bolts with leveling nuts or leveling shims.
    - c. Anchor base cover.
    - d. Provision for pole-mounted weatherproof GFI receptacle where indicated.

## **2.05 ACCESSORIES**

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.03 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Recessed Luminaires:
  - 1. Install trims tight to mounting surface with no visible light leakage.
  - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
  - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Pole-Mounted Luminaires:
  - 1. Maintain the following minimum clearances:
    - a. Comply with IEEE C2.
    - b. Comply with utility company requirements.
  - 2. Foundation-Mounted Poles:
    - a. Install foundations plumb.
    - b. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
    - c. Tighten anchor bolt nuts to manufacturer's recommended torque.
  - 3. Grounding:
    - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
  - 4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- I. Install accessories furnished with each luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Install lamps in each luminaire.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### **3.05 ADJUSTING**

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

### **3.06 CLEANING**

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### **3.07 CLOSEOUT ACTIVITIES**

- A. Just prior to Substantial Completion, replace all lamps that have failed.

### **3.08 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION 265600**



**SECTION 270529  
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

**1.02 RELATED REQUIREMENTS**

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 271000 - Structured Cabling.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- F. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- G. MFMA-4 - Metal Framing Standards Publication; 2004.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- L. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
  - 2. Coordinate work to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
  - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

**1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
  - 1. Fiberglass Channel/Strut Framing Systems: Include requirements for strength derating according to ambient temperature.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

## **1.06 QUALITY ASSURANCE**

- A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
  - 1. Comply with the following. Where requirements differ, comply with most stringent.
    - a. TIA-569.
    - b. NFPA 70.
    - c. Applicable building code.
    - d. Requirements of authorities having jurisdiction.
  - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
  - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  - 6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
  - 1. Manufacturers:
  - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  - 3. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Noncontinuous Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
  - 1. Applications:
    - a. Do not exceed 5 feet between cable supports.
    - b. Maximum Number of Cables per Cable Support:
      - 1) J-Hooks: 40 percent of fill capacity.
    - c. Allowable Cable Types:
      - 1) J-Hooks: Category 3, Category 5e, and Category 6.

2. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
3. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
  - a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
  - b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
  - c. Provide multitiered J-hooks where required to support multiple cabling systems.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- E. Metal Channel/Strut Framing Systems:
  1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  2. Comply with MFMA-4.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
  1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2-inch diameter.
    - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
    - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
    - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
    - e. Outlet Boxes: 1/4-inch diameter.
- G. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
  1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
  2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- H. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  7. Sheet Metal: Use sheet metal screws.
  8. Wood: Use wood screws.
  9. Plastic and lead anchors are not permitted.
  10. Powder-actuated fasteners are not permitted.
  11. Hammer-driven anchors and fasteners are not permitted.
  12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
    - b. Comply with MFMA-4.
    - c. Channel Material: Use galvanized steel.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.

- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide required seismic controls.
- I. Equipment Support and Attachment:
  - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners in accordance with manufacturer's recommended torque settings.
- L. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 270529**

## **SECTION 271000 STRUCTURED CABLING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Communications system design requirements.
- B. Communications pathways.
- C. Copper cable and terminations.
- D. Fiber optic cable and interconnecting devices.
- E. Communications equipment room fittings.
- F. Communications outlets.
- G. Communications grounding and bonding.
- H. Communications identification.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products.

#### **1.03 REFERENCE STANDARDS**

- A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.
- C. ICEA S-83-596 - Indoor Optical Cable; 2021.
- D. ICEA S-90-661 - Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communication Wiring Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; 1988a (Reaffirmed 2012).
- G. TIA-492AAAC - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; 2009b.
- H. TIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 Edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement; 2015a (Reaffirmed 2022).
- I. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; IEC 61280-4.1 Edition 3.1, Fiber Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement; 2023d.
- J. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2024.
- K. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2024e.
- L. TIA-568.3 - Optical Fiber Cabling and Components Standard; 2022e.
- M. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- N. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.

- O. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.
- P. UL 444 - Communications Cables; Current Edition, Including All Revisions.
- Q. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- R. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.
- S. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
  - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
  - 3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
- C. Evidence of qualifications for installer.
- D. Field Test Reports.
- E. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
  - 1. Record actual locations of outlet boxes and distribution frames.
  - 2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
  - 3. Identify distribution frames and equipment rooms by room number on drawings.
- F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

#### **1.06 QUALITY ASSURANCE**

- A. Products: Listed, classified, and labeled as suitable for the purpose intended.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

#### **1.08 WARRANTY**

- A. Correct defective Work within a 2 year period after Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 SYSTEM DESIGN**

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
  - 1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).

2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
  3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
  4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
1. Locate main distribution frame as indicated on the drawings.
- C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

## **2.02 COPPER CABLE AND TERMINATIONS**

- A. Manufacturers:
1. CommScope
  2. General Cable Technologies Corporation
  3. Siemon Company
- B. Copper Backbone Cable:
1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2, ICEA S-90-661, and listed and labeled as complying with UL 444; arranged in 25-pair binder groups.
  2. Cable Type: TIA-568.2 Category 3 UTP (unshielded twisted pair); 24 AWG.
  3. Cable Capacity: Quantity of pairs as indicated on drawings.
  4. Cable Applications:
    - a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
    - b. Riser Applications: Use listed NFPA 70 Type CMR riser cable or Type CMP plenum cable.
- C. Copper Horizontal Cable:
1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
  2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
  3. Cable Capacity: 4-pair.
  4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
  5. Cable Jacket Color - Voice and Data Cable: Blue.
  6. Product(s):
    - a. CommScope; SYSTIMAX Twisted Pair Cables; GigaSPEED XL Category 6 U/UTP Cable
    - b. CommScope; Uniprise Twisted Pair Cables; CS34 Series Category 6 U/UTP Cable
    - c. General Cable Technologies Corporation; GenSPEED Cables:
- D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
1. Performance: 500 mating cycles.
  2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
  3. Product(s):
    - a. CommScope; SYSTIMAX RJ45 Jacks; MGS400 Series Category 6 U/UTP Modular Jacks
    - b. CommScope; Uniprise RJ45 Jacks; UNJ600 Series Category 6 U/UTP Modular Jacks

- E. Copper Patch Cords:
  - 1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
  - 2. Patch Cords for Patch Panels:
    - a. Quantity: One for each pair of patch panel ports.
    - b. Length: \_\_\_\_\_ feet.
  - 3. Product(s):
    - a. CommScope; SYSTIMAX Category 6 U/UTP Patch Cords
    - b. CommScope; Uniprise Category 6 U/UTP Patch Cords

## **2.03 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES**

- A. Manufacturers:
  - 1. CommScope
  - 2. General Cable Technologies Corporation
  - 3. Siemon Company
- B. Fiber Optic Horizontal Cable:
  - 1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
  - 2. Cable Type: Multimode, laser-optimized 50/125 um (OM3) complying with TIA-492AAAC.
  - 3. Cable Capacity: 2-fiber.
  - 4. Cable Applications: Use listed NFPA 70 Type OFNP plenum cable unless otherwise indicated.
  - 5. Cable Jacket Color:
    - a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.
    - b. Multimode Fiber (OM1/OM2): Orange.
    - c. Single-Mode Fiber (OS1/OS2): Yellow.
  - 6. Product(s):
    - a. CommScope Fiber Optic Cables; TeraSpeed Zero Water Peak Single-Mode Fiber
- C. Fiber Optic Interconnecting Devices:
  - 1. Connector Type: Type LC.
  - 2. Connector Performance: 500 mating cycles, when tested in accordance with TIA-455-21.
  - 3. Maximum Attenuation/Insertion Loss: 0.3 dB.
  - 4. Product(s):
    - a. CommScope Fiber Optic Connectors; QWIK II-LC Fiber Connectors
- D. Fiber Optic Patch Cords:
  - 1. Description: Factory-fabricated 2-fiber cable assemblies with suitable connectors at each end.
  - 2. Patch Cords for Patch Panels:
    - a. Quantity: One for each pair of patch panel ports.
    - b. Length: \_\_\_\_\_ feet.
  - 3. Product(s):
    - a. CommScope Fiber Optic Patch Cords; TeraSpeed Fiber Patch Cords

## **2.04 COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

- A. Copper Cross-Connection Equipment:
  - 1. Manufacturers:
    - a. CommScope
    - b. Siemon Company
  - 2. Connector Blocks for Category 3 Cabling: Type 66 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.
  - 3. Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.



4. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
    - a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
    - b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
    - c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
    - d. Provide incoming cable strain relief and routing guides on back of panel.
  5. Product(s):
    - a. CommScope; SYSTIMAX Copper Panels; 360-IPR-1100-XX Series Patch Panels
    - b. CommScope; Uniprise Copper Panels; UNP-XX-DM Series Patch Panels
- B. Fiber Optic Cross-Connection Equipment:
1. Manufacturers:
    - a. CommScope
    - b. Siemon Company
  2. Patch Panels for Fiber Optic Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum.
    - a. Adapters: As specified above under FIBER OPTIC CABLE AND INTERCONNECTING DEVICES; maximum of 24 duplex adaptors per standard panel width.
    - b. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
    - c. Provide incoming cable strain relief and routing guides on back of panel.
    - d. Provide rear cable management tray at least 8 inches deep with removable cover.
    - e. Provide dust covers for unused adapters.
  3. Product(s):
    - a. CommScope; SYSTIMAX Fiber Panels; HD Series Patch Panels:  
[www.commscope.com/#sle](http://www.commscope.com/#sle).
    - b. CommScope; Uniprise Fiber Panels; SD Series Patch Panels:  
[www.commscope.com/#sle](http://www.commscope.com/#sle).
- C. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.
1. Do not paint over UL label.
- D. Equipment Frames, Racks and Cabinets:
1. Manufacturers:
    - a. CommScope
    - b. Siemon Company
  2. Component Racks: EIA/ECA-310 standard 19 inch wide.
  3. Floor Mounted Racks: Aluminum or steel construction with corrosion resistant finish; vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
- E. Cable Management:
1. Manufacturers:
    - a. CommScope
    - b. Siemon Company
  2. Product(s):
    - a. CommScope Cable Runway
    - b. CommScope Horizontal/Vertical Cable Managers; HCM-SS-XX-XX/VCM-DS-XX-XX Series
    - c. CommScope FiberGuide Raceway

## 2.05 COMMUNICATIONS OUTLETS

- A. Manufacturers:

1. CommScope
  2. Siemon Company
- B. Outlet Boxes: Comply with Section 260533.16.
1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
  2. Minimum Size, Unless Otherwise Indicated:
    - a. Voice Only Outlets: 4 inch by 2 inch by 2-1/8 inch deep (100 by 50 by 54 mm) trade size.
    - b. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
    - c. Fiber Optic Outlets: 4-11/16 inch square by 2-1/8 inch deep (119 by 54 mm) trade size.
- C. Wall Plates:
1. Comply with system design standards and UL 514C.
  2. Accepts modular jacks/inserts.
  3. Capacity:
    - a. As indicated on drawings.

## **2.06 GROUNDING AND BONDING COMPONENTS**

- A. Comply with TIA-607.

## **2.07 IDENTIFICATION PRODUCTS**

- A. Comply with TIA-606.

## **2.08 SOURCE QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test cables according to TIA-568 (SET).

# **PART 3 - EXECUTION**

## **3.01 INSTALLATION - GENERAL**

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

## **3.02 INSTALLATION OF PATHWAYS**

- A. Install pathways with the following minimum clearances:
1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
  2. 12 inches from power conduits and cables and panelboards.
  3. 5 inches from fluorescent and high frequency lighting fixtures.
  4. 6 inches from flues, hot water pipes, and steam pipes.
- B. Outlet Boxes:
1. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of telecommunications outlets provided under this section.
    - a. Mounting Heights: Unless otherwise indicated, as follows:
      - 1) Telephone and Data Outlets: 18 inches above finished floor.
      - 2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches above finished floor to top of telephone.
      - 3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches above finished floor to top of telephone.

- b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
- c. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
- d. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
- e. Locate outlet boxes so that wall plate does not span different building finishes.
- f. Locate outlet boxes so that wall plate does not cross masonry joints.

### **3.03 INSTALLATION OF EQUIPMENT AND CABLING**

- A. Cabling:
  - 1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
  - 2. Do not over-cinch or crush cables.
  - 3. Do not exceed manufacturer's recommended cable pull tension.
  - 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
  - 1. At Distribution Frames: 120 inches.
  - 2. At Outlets - Optical Fiber: 39 inches.
- C. Copper Cabling:
  - 1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
  - 2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
  - 3. Use T568B wiring configuration.
- D. Fiber Optic Cabling:
  - 1. Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
  - 2. Support vertical cable at intervals as recommended by manufacturer.
- E. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.
- F. Identification:
  - 1. Use wire and cable markers to identify cables at each end.
  - 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
  - 3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

### **3.04 FIELD QUALITY CONTROL**

- A. Comply with inspection and testing requirements of specified installation standards.
- B. Visual Inspection:
  - 1. Inspect cable jackets for certification markings.
  - 2. Inspect cable terminations for color coded labels of proper type.
  - 3. Inspect outlet plates and patch panels for complete labels.
- C. Testing - Copper Cabling and Associated Equipment:
  - 1. Test backbone cables after termination but before cross-connection.
  - 2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
  - 3. Test operation of shorting bars in connection blocks.
  - 4. Category 3 Backbone: Perform attenuation test.

5. Category 3 Links: Test each pair for short circuit continuity, short to ground, crosses, reversed polarity, operational and ring-back, and dial tone.
  6. Category 5e and Above Backbone: Perform near end cross talk (NEXT) and attenuation tests.
  7. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.
- D. Testing - Fiber Optic Cabling:
1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.
  2. Multimode Backbone: Perform tests in accordance with TIA-526-14.
  3. Single Mode Backbone: Perform tests in accordance with TIA-526-7.
- E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

**END OF SECTION 271000**

**SECTION 284600  
FIRE DETECTION AND ALARM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Maintenance of fire alarm system under contract for specified warranty period.

**1.02 RELATED REQUIREMENTS**

- A. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- B. Section 213000 - Fire Pumps: Supervisory devices.
- C. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

**1.03 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 SUBMITTALS**

- A. Proposal Documents: Submit the following with cost/time proposal:
  - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
  - 3. Certification by Contractor that the system design will comply with Contract Documents.
  - 4. Proposed maintenance contract.
- B. Drawings must be prepared using Autocad or Revit..
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
  - 1. Copy (if any) of list of data required by authority having jurisdiction.
  - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
  - 4. System zone boundaries and interfaces to fire safety systems.
  - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
  - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.

7. List of all devices on each signaling line circuit, with spare capacity indicated.
  8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
  9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
  10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
  11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
  12. Certification by Contractor that the system design complies with Contract Documents.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
  2. Submit documentation of satisfactory inspections and tests.
  3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
  2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
  3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
  4. List of recommended spare parts, tools, and instruments for testing.
  5. Replacement parts list with current prices, and source of supply.
  6. Detailed troubleshooting guide and large scale input/output matrix.
  7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
  8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- J. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
  2. "As installed" wiring and schematic diagrams, with final terminal identifications.
  3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- K. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
  2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
  3. Certificate of Occupancy.
  4. Maintenance contract.
- L. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
2. In addition to the items in quantities indicated in PART 2, furnish the following:
  - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
  - b. One copy, on CD-ROM, of all software not resident in read-only-memory.
  - c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

#### **1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- C. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

#### **1.06 WARRANTY**

- A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Fire Alarm Control Units and Accessories:
  1. Honeywell Security & Fire Solutions/Gamewell-FCI:
  2. Honeywell Security & Fire Solutions/Notifier
  3. Siemens Building Technologies, Inc
  4. Provide control units made by the same manufacturer.
  5. Manufacturers owned by one of the companies listed above, but not directly listed will not be accepted.
- B. Initiating Devices and Notification Appliances:
  1. Same manufacturer as control units.
  2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

#### **2.02 FIRE ALARM SYSTEM**

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
  1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
  2. Protected Premises: Entire building shown on drawings.
  3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
    - a. ADA Standards.
    - b. The requirements of the State Fire Marshal.
    - c. The requirements of the local authority having jurisdiction.
    - d. Applicable local codes.
    - e. Contract Documents (drawings and specifications).
    - f. NFPA 101.

- g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
- 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
- 5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
- 6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
- 7. Program notification zones and voice messages as directed by Owner.
- 8. Fire Alarm Control Unit: New, located at supervising station.
- B. Supervising Stations and Fire Department Connections:
  - 1. Public Fire Department Notification: By on-premises supervising station.
  - 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at \_\_\_\_\_.
  - 3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.
- C. Circuits:
  - 1. Initiating Device Circuits (IDC): Class B, Style A.
  - 2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
  - 3. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Spare Capacity:
  - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
  - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
  - 3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
  - 1. Primary: Dedicated branch circuits of the facility power distribution system.
  - 2. Secondary: Storage batteries.
  - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
  - 4. Each Computer System: Provide uninterruptible power supply (UPS).

## **2.03 FIRE SAFETY SYSTEMS INTERFACES**

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
  - 1. Sprinkler water control valves.
  - 2. Dry-pipe sprinkler system pressure.
  - 3. Dry-pipe sprinkler valve room low temperature.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
  - 1. Sprinkler water flow.
- C. HVAC:
  - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

## **2.04 COMPONENTS**

- A. General:
  - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
  - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.



- C. Master Control Unit: \_\_\_\_\_.
- D. Remote Annunciators
- E. Initiating Devices:
  - 1. Addressable Systems:
    - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
    - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
  - 2. Manual Pull Stations:
    - a. Provide 1 extra.
  - 3. Smoke Detectors:
    - a. Provide 1 extra.
  - 4. Heat Detectors:
    - a. Provide 1 extra.
- F. Notification Appliances:
  - 1. Horns:
    - a. Provide 1 extra.
  - 2. Strobes:
    - a. Provide 1 extra.
- G. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
- H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- I. Locks and Keys: Deliver keys to Owner.
- J. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
  - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
  - 2. Provide one for each control unit where operations are to be performed.
  - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
  - 4. Provide extra copy with operation and maintenance data submittal.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

### **3.02 INSPECTION AND TESTING FOR COMPLETION**

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
  - 1. Record all system operations and malfunctions.
  - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
  - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
  - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

### **3.03 OWNER PERSONNEL INSTRUCTION**

- A. Provide the following instruction to designated Owner personnel:
  - 1. Hands-On Instruction: On-site, using operational system.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
  - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
  - 1. Initial Training: 1 session pre-closeout.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

### **3.04 CLOSEOUT**

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
  - 1. Be prepared to conduct any of the required tests.
  - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
  - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
  - 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
  - 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
  - 1. Specified diagnostic period without malfunction has been completed.
  - 2. Approved operating and maintenance data has been delivered.
  - 3. Spare parts, extra materials, and tools have been delivered.
  - 4. All aspects of operation have been demonstrated to Owner.
  - 5. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
  - 6. Occupancy permit has been granted.
  - 7. Specified pre-closeout instruction is complete.

### **3.05 MAINTENANCE**

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
  - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
  - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
  - 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Owner:
  - 1. Provide on-site response within 2 hours of notification.
  - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
  - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

**END OF SECTION 284600**

**SECTION 31 00 00  
EARTHWORK**

**PART 1 - GENERAL**

Drawings, Geotechnical Investigation Report, Standard General Conditions of Contract, Special Conditions and Division-1 Specification sections, apply to work of this section.

**1.1 DESCRIPTION**

- A. Staking
- B. Excavation
- C. Filling
- D. Preparation of Raw Subgrade

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Geotechnical Investigation
- B. Section 32 91 19 Topsoil

**1.3 PROTECTION**

- A. Protect all reference points, benchmarks and property corner monuments from damage or dislocation. Replace or repair immediately all points damaged, destroyed or dislocated.
- B. Sprinkle and dampen all dusty material from the beginning of work to its completion.
- C. Protect and maintain all conduits, inlets, sewers, pipes and wires that are to remain.
- D. Provide, erect and maintain all lights, barricades, warning signs and guards as necessary for the protection of roads, sidewalks and all adjoining structures.
- E. Shore and use sheet piling to prevent caving of earth banks and side walls of trenches as required by OSHA and State Regulations for safety.
- F. Cover holes and trenches when work is not in progress. Fence or barricade changes of grade more than 45° and more than three feet in height.

- G. Remove shoring, sheet piling and protection as work progresses. Temporary wood shall not be left in concrete or fill.
- H. Keep trenches and excavated areas free from water by pumping or draining. Grade to drain surface water away from excavations, distributing discharge to prevent excessive erosion.
- I. Protect adjacent lawn or surface areas outside the construction limits from damage. If damaged as a result of building operations or storage of materials, clear off debris and restore it to original grades and condition.
- J. Protect finished subgrade from erosion, as directed by the Owner's Representative Engineer, by the use of organic erosion netting or fabric and/or the use of hay bale barricades. All areas of erosion are to be repaired and compacted by the contractor and approved by the Owner's Representative.

#### 1.4 CLASSIFICATION OF EXCAVATION

##### A. Unclassified Excavation

- 1. Refers to any and all materials encountered during construction except for materials specifically referenced below in parts B through D.

##### B. Trench Rock Excavation

- 1. DESCRIPTION – Work under this item shall include rock excavation in trenches at any and all depths in formation which cannot be excavated efficiently in the opinion of the Engineer, with a Volvo 360 track-hoe (73,600 lbs.) or equivalent, a Hensley V-Bottom Rock Bucket, or Hensley #50 Teeth or equivalent. This item shall consist of rock excavation for ditch excavation, storm drains, sanitary sewer and water mains and shall be done in strict accordance with the plans and specifications.
- 2. CONSTRUCTION METHODS – Construction Methods shall conform to Part 2 of the “Detailed Specifications” as applicable.
- 3. MEASUREMENT AND PAYMENT – Rock excavation in utility trenches shall be measured by the cross-section method after the trench has been excavated. All labor, equipment, and materials necessary to properly backfill trenches as specified herein, shall be included in the unit price bid per cubic yard for “Trench Rock Excavation”, which shall be full payment for completion of the work ready for use. CONTRACTOR shall notify ENGINEER and OWNER when rock is encountered on site and measurements must be made.

4. The maximum quantity for "Rock Excavation in Utility Trenches" shall not exceed 100 cubic yards.

C. Mass Rock Excavation

1. DESCRIPTION – Work under this item shall include rock excavation with the site grading limits at any and all depths in formation which cannot be excavated efficiently in the opinion of the Engineer, with a Volvo 360 track-hoe (73,600 lbs.) or equivalent, a Hensley V-Bottom Rock Bucket, or Hensley #50 Teeth or equivalent. This item shall consist of rock excavation for site grading building pad construction and shall be done in strict accordance with the plans and specifications.
2. CONSTRUCTION METHODS – Construction Methods shall conform to Part 2 of the "Detailed Specifications" as applicable.
3. MEASUREMENT AND PAYMENT – Rock excavation within the site grading limits shall be measured by the cross-section method after the rock has been excavated. All labor, equipment, and materials necessary to properly backfill trenches as specified herein, shall be included in the unit price bid per cubic yard for "Rock Excavation", which shall be full payment for completion of the work ready for use. CONTRACTOR shall notify ENGINEER and OWNER when rock is encountered on site and measurements must be made.
4. The maximum quantity for "Mass Rock Excavation" shall not exceed 200 cubic yards.

D. Excavation Undercut

1. DESCRIPTION – Work under this item shall include excavation of unsatisfactory material within the building pad & paving limits. This item shall consist of excavation for site paving and building pad construction and shall be done in strict accordance with the plans and specifications.
2. CONSTRUCTION METHODS – Construction Methods shall conform to Part 2 of the "Detailed Specifications" as applicable.
3. MEASUREMENT AND PAYMENT – Excavation undercut within the site paving & building pad limits shall be measured by the cross-section method after the unsatisfactory material has been excavated. All labor, equipment, and materials necessary to properly backfill as specified herein, shall be included in the unit price bid per cubic yard for "Excavation Undercut", which shall be full payment for completion of the work ready for

use. CONTRACTOR shall notify ENGINEER and OWNER when unsatisfactory material is encountered on site and measurements must be made.

4. The maximum quantity for "Excavation Undercut" shall not exceed 800 cubic yards.

## 1.5 DEFINITIONS

### A. Satisfactory Materials

Materials classified in Unified Soil Classification System as GW, SP, GC, GM, SW, SP, SM, SC, CL and CH.

### B. Unsatisfactory Materials

Materials classified in Unified Soil Classification System as Pt, OH, OL, ML and MH.

### C. Cohesionless and Cohesive Materials

Cohesive materials include materials classified as GC, SC, ML, CL MH and CH. Cohesionless materials include materials classified in Unified Soil Classification System as GW, GP, SW and GP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero. Testing required for classifying materials shall be in accordance with ASTM C136, D422 and D1140.

### D. Degree of Compaction

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D698.

### E. Topsoil

Topsoil shall be defined as natural, friable surface soil possessing the characteristics of representative soils in the vicinity that produce heavy growth of crops, grass, or other vegetation.

### F. Existing Grades

Existing grades shall be defined as grades which are represented by contours on the drawings.

## 1.6 BLASTING

Blasting will be permitted.

## 1.7 UTILIZATION OF EXCAVATED MATERIALS

All unsatisfactory materials removed from excavations shall be disposed of onsite as directed by the Geotechnical Engineer. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, subgrades, bedding, and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. No excavated material shall be disposed of in such a manner as to endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## 1.8 FIELD TESTING CONTROL

Field density testing shall be performed by an Independent Testing Laboratory selected by the Contractor and approved by the Owner. Costs of initial testing will be paid by the Contractor. Should the material fail to meet the specified density, material shall be scarified, recompact and tested until specified densities are obtained. All subsequent testing of material shall be paid for by the Contractor.

# **PART 2 - PRODUCTS**

## 2.1 MATERIALS

### A. Approved Excavated Material and Select Fill

Excavated material determined by the testing laboratory to be suitable for use in embankment and backfill shall be used after freeing it of rock larger than 8-inches in greatest dimension for backfill.

### B. Clayey sands free of organic materials and having a plasticity index between 4 and 15, a liquid limit of 40 or less and between 20 and 45 percent passing a No. 200 sieve. Submit tests to Engineer as directed, verify that selected fill meets these requirements.



### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Construction surveying, staking and layout shall be performed at the Contractor's expense by a surveyor licensed in the State of Arkansas (RPS).
- B. The rough grading shall be performed to the lines and elevations indicated on the drawings in accordance with these specifications. Should the Contractor, through negligence or other fault, excavate below the designated lines, he shall replace the excavation with approved materials, in an approved manner and condition, at his own expense. The Owner's Representative shall have complete control over the excavation, moving, placing and disposition of all materials and shall determine the suitability of material to be placed in embankments. All material determined unsuitable shall be disposed of off-site or in waste areas as directed. Topsoil shall not be used in fills or in subgrades but shall be stockpiled, handled, and placed as directed.
- C. The Contractor shall inform and satisfy himself as to the character, quantity, and distribution of all material to be excavated.
- D. If it is necessary to interrupt existing surface drainage, sewers or underdrainage, conduits, utilities or similar underground structure, or parts thereof, the Contractor shall be responsible for and shall take all necessary precautions to protect and preserve or provide temporary services. When such facilities are encountered, the Contractor shall notify the Consultants who shall arrange for their removal, if necessary. The Contractor shall, at his own expense, satisfactorily repair all damage to such facilities or structures which may result from any of his operations during the period of the contract.

#### **3.2 STRIPPING OF TOPSOIL**

- A. As directed by the Owner's Representative, topsoil shall be stripped. Topsoil shall be transported and deposited in stockpiles. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2-inches in diameter, and other materials that would interfere with planting and maintenance operations.

### 3.3 EXCAVATION

- A. The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades and elevations indicated and as specified herein. Grading shall be in conformity with the drawings and the tolerances specified in Paragraph 3.08 - Finishing. Satisfactory excavated materials shall be transported to and placed in fill within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Unsatisfactory excavated material shall be incorporated into fills onsite as directed. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times.

### 3.4 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 95 percent of its maximum dry density in accordance with ASTM D698, at optimum moisture minus 2 point to plus 2 points, in such a manner as to prevent wedging action or eccentric loading upon or against any structure. Ground surface on which backfill is to be placed shall be prepared as specified in Paragraph 3.5 - Preparation of Ground Surface for Fill. Compaction requirements for backfill materials shall also conform to the applicable portion of Paragraphs 3.5 - Preparation of Ground Surface for Fill, 3.6 - Fills, and 3.7 - Raw Subgrade Preparation, below. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel wheeled rollers, vibratory compactors, or other approved equipment well-suited to the material being compacted.

### 3.5 PREPARATION OF GROUND SURFACE FOR FILL

Ground surface on which fill is to be placed shall be stripped of live, dead or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 95 percent of maximum density at paved areas and a maximum of 90% at turf areas in accordance with ASTM D698, at a moisture content between the optimum moisture value and 5 percent above optimum. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well-suited to the material being compacted. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of fill materials to assure adequate bond between fill and the prepared ground surface.

### 3.6 FILLS

Earth Fills: Earth fills shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 8 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall

be spread uniformly on a soil surface that has been moistened or aerated as necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 95 percent of its maximum dry density, at moisture contents between optimum and 5 percent above optimum. Compaction requirements for the upper portion of earth fills forming subgrade for pavements shall be identical with those requirements specified in Paragraph 3.7 - Raw Subgrade Preparation. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well-suited to the material being compacted.

### 3.7 RAW SUBGRADE PREPARATION

#### A. Construction

Raw subgrade shall be shaped to line, grade and cross section and compacted as specified. This operation shall include plowing, diskings and any moistening or aerating required to contain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6-inches below finished grade for the raw subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade and cross section and compacted as specified.

#### B. Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well-suited to the material being compacted. Subgrade shall be compacted to at least 95% of its maximum dry density in accordance with ASTM D698, at a moisture content between optimum and 5% above the optimum moisture value, for a minimum depth of 6-inches.

### 3.8 FINISHING

The surface of all excavations, fills, and raw subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades and cross sections or elevation shown. The degree of finish for all graded areas under buildings shall be within 0.1 foot of the grades and elevations indicated. The degree of finish for all other graded areas shall be within 0.3 foot of the grades and elevations indicated. All finish grades will be checked by an Owner's representative in a random manner, as to insure proper grades prior to approval of the work.

### 3.9 RAW SUBGRADE AND FILL OR EMBANKMENT PROTECTION

During construction, fills and excavations shall be kept shaped and drained. Ditches and drains along raw subgrade shall be maintained in such a manner as to drain effectively at all times. The finished raw subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition.

END OF SECTION

**SECTION 31 22 00  
GRADING**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Removal and storage of topsoil.
- B. Rough grading and excavating the site for site structures, building pads, and paving.
- C. Finish grading.

**1.02 RELATED SECTIONS**

- A. Section 00 30 10 - Geotechnical Investigation.
- B. Section 02 20 00 - Site Preparation.
- C. Section 31 23 16 - Excavation.
- D. Section 31 23 23 - Fill and Backfill: Filling and compaction.
- E. Section 31 23 17 - Trenching for Site Utilities: Trenching and backfilling for utilities.

**1.03 SUBMITTALS**

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

**1.04 PROJECT CONDITIONS**

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, and other features to remain as a portion of final landscaping.
- C. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. Topsoil: Topsoil excavated on-site.
  - 1. Graded.
  - 2. Free of roots, rocks larger than 1 inch, subsoil, debris, large weeds and foreign matter.
- B. Other Fill Materials: See Section 31 23 23.

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

### **3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain from damage.

### **3.03 ROUGH GRADING**

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- C. Do not remove wet subsoil unless it is subsequently processed to obtain optimum moisture content.
- D. See Section 31 23 23 for filling procedures.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

### **3.04 SOIL REMOVAL**

- A. Stockpile excavated topsoil on site or incorporate into fill as directed.
- B. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

### **3.05 FINISH GRADING**

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.

### **3.06 TOLERANCES**

- A. Top Surface of Subgrade: Plus, or minus 1/10 foot from required elevation under building.
- B. Top Surface of Subgrade: Plus, or minus 3/10 foot except as above.

### **3.07 FIELD QUALITY CONTROL**

- A. See Section 31 23 23 for compaction density testing.

### **3.08 CLEANING AND PROTECTION**

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

**END OF SECTION**

## **SECTION 31 23 16 EXCAVATION**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Excavating footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building.

#### **1.02 RELATED SECTIONS**

- A. Section 00 3110 - Geotechnical Investigation
- B. Section 31 23 17 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.
- C. Section 31 23 23 - Fill and Backfill: Fill materials, filling, and compacting.
- D. Section 31 22 00 - Grading: Soil removal from surface of site.

#### **1.03 PROJECT CONDITIONS**

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.
- B. Protect plants, lawns, and other features to remain.
- C. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### **PART 2 - PRODUCTS - NOT USED**

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect them from damage.
- C. Notify the utility company to remove and relocate utilities.

#### **3.02 EXCAVATING**

- A. Excavate to accommodate new structures and construction operations in accordance with requirements of the geotechnical investigation and as indicated on Drawings.
- B. Notify Architect and geotechnical engineer of unexpected subsurface conditions and discontinue Work in affected area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.



- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut utility trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.
- H. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site in accordance with Section 32 22 13.
- K. Remove excess excavated material from site.

### **3.03 PROTECTION**

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

**END OF SECTION**

**SECTION 31 23 17**  
**TRENCHING FOR SITE UTILITIES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Backfilling and compacting for utilities outside the building to utility main connections.

**1.02 RELATED SECTIONS**

- A. Section 00 3110 - Geotechnical Investigation
- B. Section 31 23 16 - Excavation: Building and foundation excavating.
- C. Section 31 23 23 - Fill and Backfill: Backfilling at building and foundations.
- D. Section 31 22 00 - Grading: Site grading.

**1.03 REFERENCES**

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2000a.
- C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2002.
- E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).
- F. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.

**1.04 DEFINITIONS**

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 8 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

## **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Compaction Density Test Reports.

## **1.06 PROJECT CONDITIONS**

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. Verify that survey benchmarks and intended elevations for the Work are as indicated.
- C. Protect plants, lawns, rock outcroppings, and other features to remain.
- D. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

## **PART 2 – PRODUCTS**

### **2.01 FILL MATERIALS**

- A. General Fill: (to be used in areas not within 5' of building perimeter):
  - 1. Graded.
  - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
  - 3. Conforming to ASTM D 2487 Group Symbol CL.
- B. Structural Fill: (to be used under all building areas and 5' outside of all building areas): Low plasticity sandy clay, clayey sand or clay and gravel blends, SC, SM, or GC. Fill should have a Plasticity Index between 5 and 20.
- C. Concrete for Fill (Flowable Fill - utility trenches passing under footings): Compressive strength of 2500 psi in conformance with AHTD Standard Specification for Highway Construction, Section 206.
- D. Granular Fill for drainage fill below slabs on grade - Gravel: Angular crushed stone; "C" Ballast, free of shale, clay, friable material and debris, with a minimum of "fines".
- E. Sand: Conforming to State of Arkansas Highway Department standard.
- F. Topsoil: See Section 32 22 13.

### **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.

- D. Provide materials of each type from the same source throughout the Work.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect them from damage.
- C. Notify the utility company to remove and relocate utilities.
- D. See Section 31 20 00 for additional requirements.

#### **3.02 TRENCHING**

- A. Notify Architect of unexpected subsurface conditions and discontinue work in affected area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.

#### **3.03 PREPARATION FOR UTILITY PLACEMENT**

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

#### **3.04 BACKFILLING**

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches

compacted depth.

- G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
  - 1. Thrust bearing surfaces: Fill with concrete.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

### **3.05 BEDDING AND FILL AT SPECIFIC LOCATIONS**

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping, Conduits, and Duct Bank:
  - 1. Bedding: Use structural fill.
  - 2. Cover with general fill.
  - 3. Fill up to subgrade elevation.
  - 4. Compact in maximum 8 inch lifts to within two percentage points of optimum moisture content to 95 percent of Modified Proctor density.
- C. At Pipe Culverts:
  - 1. Bedding: Use structural fill.
  - 2. Cover with general fill.
  - 3. Fill up to subgrade elevation.
  - 4. Compact in maximum 8 inch lifts to within two percentage points of optimum moisture content to 95 percent of Modified Proctor density.
- D. Top Surface of General Backfilling: Plus, or minus 3 inch from required elevations.
- E. Top Surface of Backfilling Building Areas: Plus, or minus 1 inch from required elevations.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace, and retest.

### **3.07 CLEAN-UP**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

**END OF SECTION**

**SECTION 31 23 23**  
**FILL AND BACKFILL**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.

**1.02 RELATED SECTIONS**

- A. Section 02 20 00 - Site Preparation: Site grading.
- B. Section 00 30 10 - Geotechnical Investigation.
- C. Section 32 14 13 - Cast-in-Place Concrete.
- D. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.
- E. Section 31 23 17 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.
- F. Section 32 13 14 – Integrally Colored Concrete Paving
- G. Section 31 22 00 - Grading: Removal and handling of soil to be re-used.
- H. Section 31 22 00 - Grading: Site grading.

**1.03 REFERENCES**

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2000a.
- C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2002.
- E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).
- F. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.

- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.

#### **1.04 DEFINITIONS**

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 6 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- C. Compaction Density Test Reports.

#### **1.06 PROJECT CONDITIONS**

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. Verify that survey benchmarks and intended elevations for the Work are as indicated.

### **PART 2 – PRODUCTS**

#### **2.01 FILL MATERIALS**

- A. General Fill: (to be used in areas not within 5' of building perimeter):
  - 1. Graded.
  - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
  - 3. Conforming to ASTM D 2487 Group Symbol CL.
  - 4. All fill material to be placed in a city right-of-way must be approved by the proper municipal department prior to placement.
- B. Structural Fill: (to be used under all building areas and 5' outside of all building areas): Low plasticity sandy clay, clayey sand or clay and gravel blends, SC, SM, or GC. Fill should have a Plasticity Index between 5 and 20.
- C. Concrete for Fill (Flowable Fill - utility trenches passing under footings): Compressive strength of 2500 psi in conformance with AHTD Standard Specification for Highway Construction, Section 206.
- D. Granular Fill for drainage, fill below slabs on grade - Gravel: Angular crushed stone; "C" Ballast, free of shale, clay, friable material and debris, with a minimum of "fines".



- E. Granular Fill for Compacted Base Course - Gravel: Natural washed stone or crushed stone, free of shale, clay, friable material, and debris.
  - 1. Graded in accordance with ASTM D 2487 Group Symbol CL.
- F. Sand: Conforming to State of Arkansas Highway Department standard.
- G. Topsoil: See Section 31 22 13.

## **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from the same source throughout the Work.

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

### **3.02 PREPARATION**

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill. Undercut unsuitable foundation or subgrade soils per the geotechnical investigation and replace with suitable fill compacted within two percentage points of optimum moisture content to a minimum of 95 % of the Modified Proctor (ASTM D-1557) as described below, placed in maximum 8" lifts.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

### **3.03 FILLING**

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.

- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 8 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
  - 1. Load-bearing foundation surfaces and undercut areas within 5' of building perimeter: Use Structural Fill as described above.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under all building areas and 8' outside of all building areas: within two percentage points of optimum moisture content to a minimum 95 percent of Modified Proctor (ASTM D 1557).
  - 2. At other locations: 95 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

### **3.04 FILL AT SPECIFIC LOCATIONS**

- A. Use general fill for areas not under building or 5' outside of building perimeter, or paving.
- B. Use Structural Fill at all areas under buildings and pavement including the area outside the building perimeter within 6 feet of the building.
  - 1. Use structural fill.
  - 2. Fill up to subgrade elevations.
  - 3. Maximum depth per lift: 8 inches, compacted.
  - 4. Compact to within two percentage points of optimum moisture content to a minimum 95 percent of Modified Proctor (ASTM D 1557).
- C. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
  - 1. Bedding: Use structural fill.
  - 2. Cover with general fill.
  - 3. Fill up to subgrade elevation.
  - 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- D. At Lawn Areas:
  - 1. Use general fill.
  - 2. Fill up to subgrade elevations.
  - 3. Compact to 95 percent of maximum dry density.
  - 4. See Section 31 22 00 for topsoil placement.

### **3.05 TOLERANCES**

- A. Top Surface of General Filling: Plus, or minus 1 inch from required elevations.
- B. Top Surface of Filling under Paved Areas: Plus, or minus 1 inch from required elevations.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: for Building areas including areas within 10'-0" outside of building perimeter lines, not less than one test for every 500 sq. ft; for parking areas not less than one test per 7500 sq. ft.

### **3.07 CLEAN-UP**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

**END OF SECTION**

**SECTION 31 25 00**  
**EROSION AND SEDIMENT CONTROL**

**PART 1 – GENERAL**

**1.1 SECTION INCLUDES**

- A. Furnish all labor, equipment and materials needed to complete the Work as shown on the Plans and specified herein.
- B. The work performed under this section shall comply with the plan requirements for this project and with the requirements and intent of the NPDES Storm Water Discharge Permit program to the extent that it applies to this project.

**1.2 RELATED SECTIONS**

- A. Section 31 00 00 - EARTHWORK

**1.3 QUALITY ASSURANCE**

- A. Comply with applicable requirements of all governing authorities having jurisdiction. The Specifications and the Plans are not represented as being comprehensive, but rather to convey the intent to provide complete slope protection and erosion control for both the Owner's and adjacent property.
- B. Erosion control measures shall be established at the beginning of construction and maintained during the entire length of construction. On-site areas which are subject to severe erosion and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation are to be identified and receive additional erosion control measures as directed by the Owner.
- C. All land-disturbing activities shall be planned and conducted to minimize the size of the area to be exposed at any one time and to minimize the time of exposure.
- D. Surface water runoff originating upgrade of exposed area shall be controlled to reduce erosion and sediment loss during the period of exposure.
- E. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving ditch or stream, the Contractor shall install measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream as directed by the Owner.

- F. All land-disturbing activities shall be planned and conducted so as to minimize off-site sedimentation damage.
- G. The Contractor shall be responsible for periodically cleaning out and disposing of all sediment once the storage capacity of the drainage feature or structure receiving the sediment is reduced by one-half. The Contractor shall also be responsible for cleaning out and disposing of all sediment at the time of completion of the Work.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Silt Fence Fabric:
  - 1. MISF1776, Propex 2130, TerraTexSC, or approved equal.
  - 2. Minimum bursting strength: 300 psi.
  - 3. Edges treated to prevent unraveling.
  - 4. Furnished with O-rings or clips to facilitate attachment to woven wire fabric.
- B. Wire Fencing: Steel wire fencing (hog wire) with a minimum of 14 gauge wire and a maximum 14 gauge wire and a maximum opening of 6 inches.
- C. Posts:
  - 1. Steel, T-section minimum 4 feet 6 inches long, minimum of 1.3 pounds per foot without anchor plate.
  - 2. Anchor plate attached before coating.
  - 3. Fabricate with lugs or other approved means to prevent vertical movement from the wire fencing.
- D. Tie Wire: Galvanized in accordance with ASTM A112.
- E. Temporary cover for graded areas shall be undamaged, air-dry threshed straw free from weed seeds.

## **PART 3 - EXECUTION**

### **3.1 CONDITION OF SUBSTRATE:**

- A. Erosion control measures must be implemented prior to the commencement of any soil disturbing activity.
- B. Stabilize fill and grade of areas to receive soil erosion and sediment control in accordance with Section 31 00 00, "EARTHWORK". Maintain positive drainage to sediment and erosion control devices during and after grading operations.

### **3.2 SILT FENCE:**

- A. Install posts on a minimum of 6-foot centers. Minimum embedment of 6".
- B. Minimum height of the silt fence to be 2 feet 6 inches with a 6-inch clearance between the top of the silt fence and the top of the posts.
- C. Install the steel posts on a slight angle towards the anticipated runoff surface.
- D. Trench in the toe of the silt fence so that the down slope face of the trench is flat and perpendicular to the line of flow.
- E. Minimum trench depth: 6 inches.
- F. Trench width: 6 inches.
- G. Attach wire fence (hog wire) to the posts.
- H. Attach the silt fence fabric to the wire fence (hog wire) and secure with a minimum of two wire ties per post.
- I. Backfill over the silt fence fabric in the trench.
- J. When buildup of soil, silt, or any other material behind the silt fence reaches a height of 6 inches or when the silt fence is no longer functioning efficiently, remove all accumulated material and repair the silt fence as needed.

### **3.3 DUST CONTROL**

- A. Dust control of the Contractor's performance of the Work shall be performed by the Contractor by applying water.

- B. Dust control shall be provided in the amounts and locations as ordered by the Owner's Representative.

### 3.4 PROTECTION AND MAINTENANCE:

- A. Protect erosion and sediment control devices from damage. Repair and replace dikes, silt fences and other measures when damaged by construction, natural and other physical causes. All soil erosion and sediment control devices shall be repaired or replaced at the expense of the Contractor and shall function as originally intended.
- B. Periodically (at least once every 7 days and after each rainfall event) inspect and maintain erosion and sediment control structures, until final stabilization of disturbed ground areas is achieved.
- C. All stockpiled soil shall be surrounded by a silt fence to properly control sediment runoff.
- D. Inspection services provided by the Owner's Representatives do not relieve the Contractor's responsibility for inspection and maintenance of the erosion control measures.
- E. The Contractor is responsible for modifying or providing additional erosion control devices to control erosion from his operations on the site. This may become necessary due to disturbance of additional areas or phasing of the Contractor's operations.

### 3.5 HYDROMULCHING (SPECIAL PROVISION)

- A. DESCRIPTION – Work under this item shall include hydromulching of disturbed areas after completion of site grading. This item shall be done in strict accordance with the plans and specifications.
- B. CONSTRUCTION METHODS – Construction Methods shall conform to Part 2 of the “Detailed Specifications” as applicable.
- C. MEASUREMENT AND PAYMENT – Hydromulching shall be measured by the area of application. All labor, equipment, and materials necessary to properly hydromulch as specified herein, shall be included in the unit price bid per acre for “Hydromulching”, which shall be full payment for completion of the work ready for use.
- D. The maximum quantity for “Hydromulching” shall not exceed 0.25 acres.

### 3.5 STAGING AREAS:

At such time when the specific location of the staging areas are determined, silt fences, diversions, or equivalent sediment controls are required for all side slope and down slope boundaries of the staging area and shall be provided by the Contractor. The erosion control plan for each staging area shall be approved by the Owner's Representative and devices shall be in place prior to occupation of the staging areas. All relative material and labor to construct and maintain the staging area erosion control plans shall be subsidiary to the other items of work.

- 3.6 The Contractor shall be responsible for complying with the Storm Water Pollution Prevention Plan as provided by Owner's Representative.

END OF SECTION



**SECTION 31 3116  
TERMITE CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Chemical soil treatment.

**1.02 REFERENCE STANDARDS**

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- E. Manufacturer's Instructions: Indicate caution requirement.
- F. Record and document moisture content of soil before application.
- G. Maintenance Data: Indicate re-treatment schedule and \_\_\_\_.
- H. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing this type of work and:
  - 1. Approved by manufacturer of treatment materials.
  - 2. Licensed in the State of Arkansas.

**1.05 WARRANTY**

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
  - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.

**PART 2 PRODUCTS**

**2.01 CHEMICAL SOIL TREATMENT**

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
  - 1. Bayer Environmental Science Corp; \_\_\_\_: [www.backedbybayer.com/pest-management/#sle](http://www.backedbybayer.com/pest-management/#sle).
  - 2. FMC Professional Solutions; \_\_\_\_: [www.fmcprosolutions.com/#sle](http://www.fmcprosolutions.com/#sle).
  - 3. Syngenta Professional Products; \_\_\_\_: [www.syngentaprofessionalproducts.com/#sle](http://www.syngentaprofessionalproducts.com/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

### **3.02 APPLICATION - CHEMICAL TREATMENT**

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- D. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- E. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- F. Re-treat disturbed treated soil with same toxicant as original treatment.
- G. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

**END OF SECTION**

**SECTION 32 11 23**  
**AGGREGATE BASE COURSE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aggregate base course.

**1.02 RELATED SECTIONS**

- A. Section 31 23 17 - Trenching for Site Utilities: Compacted fill over utility trenches under base course.
- B. Section 31 23 23 - Fill and Backfill: Compacted fill under base course.
- C. Section 32 12 16 - Bituminous Concrete Paving: Binder and finish asphalt courses.
- C. Section 31 22 00 - Grading: Preparation of site for base course.

**1.03 REFERENCES**

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2000).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- C. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2001.
- D. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2000a.
- E. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- F. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2002.
- G. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.
- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- I. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.
- J. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2000.

#### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Compaction Density Test Reports.

#### **1.05 PROJECT CONDITIONS**

- A. Provide sufficient quantities of aggregate to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate stockpiles where indicated.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey benchmarks and intended elevations for the Work are as indicated.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Compacted Aggregate Base Course: AHTD Class 7.

#### **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D 2487 classification, test and analyze samples for compliance before delivery to site.
- C. Provide materials of each type from the same source throughout the Work.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

#### **3.02 PREPARATION**

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

### **3.03 INSTALLATION**

- A. Under Bituminous or Portland Cement Concrete Paving:
  - 1. Place Compacted Aggregate Base Course to a total compacted thickness as indicated on Drawings.
  - 2. Compact within two percentage points of optimum moisture content to 95 % Modified Proctor density.
- B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

### **3.04 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1557.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

### **3.06 CLEAN-UP**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

**END OF SECTION**

**SECTION 32 12 16**  
**BITUMINOUS CONCRETE PAVING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving.

**1.02 RELATED SECTIONS**

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill and Backfill: Compacted subgrade for paving.
- C. Section 32 11 23 - Aggregate Base Course: Aggregate base course.
- D. Section 32 13 13 - Portland Cement Concrete Paving: Concrete curb and gutter and sidewalks.

**1.03 REFERENCES**

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1994, Sixth Edition.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Third Edition.
- C. ASTM D 946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 1982 (Reapproved 1999).

**1.04 PERFORMANCE REQUIREMENTS**

- A. Design paving and subbase at streets and drives for light duty commercial vehicle traffic.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with State of Arkansas Highways standard.
- B. Mixing Plant: Conform to State of Arkansas Highways standard.
- C. Obtain materials from same source throughout.

**1.06 REGULATORY REQUIREMENTS**

- A. Conform to Arkansas Highway and Transportation Department code for paving work on public property.

**1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Asphalt Cement: ASTM D 946.
- B. Aggregate for Wearing Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
  - 1. Graded in accordance with ASTM C 136, within the following limits:
    - a. 2 inch sieve: 100 percent passing.
    - b. 1 inch sieve: 95 percent passing.
    - c. 3/4 inch sieve: 95 to 100 percent passing.
    - d. 5/8 inch sieve: 75 to 100 percent passing.
    - e. 3/8 inch sieve: 55 to 85 percent passing.
    - f. No. 4 sieve: 35 to 60 percent passing.
    - g. No. 16 sieve: 15 to 35 percent passing.
    - h. No. 40: 10 to 25 percent passing.
    - i. No. 200: 5 to 10 percent passing.
- C. Fine Aggregate: In accordance with State of Arkansas Highways standards.
- D. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- E. Primer: In accordance with State of Arkansas Highways standards.
- F. Tack Coat: Homogeneous, medium curing, liquid asphalt.

### **2.02 ASPHALT PAVING MIXES AND MIX DESIGN**

- A. Wearing Course: State of Arkansas Highways standards, ACHM Type III.
- B. Submit proposed mix design of each class of mix for review prior to beginning of work.

### **2.03 SOURCE QUALITY CONTROL**

- A. Test mix design and samples in accordance with Arkansas Highway and Transportation Department Standard Specifications.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that compacted subgrade and aggregate base course are dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of aggregate base course are correct.



### **3.02 PREPARATION - PRIMER**

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base course at uniform rate of 1/3 gal/sq yd.
- C. Apply primer to contact surfaces of curbs, gutters, and concrete drainage structures.
- D. Use clean sand to blot excess primer.

### **3.03 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters, and concrete drainage structures.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

### **3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Install Work in accordance with State of Arkansas Highways standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place compacted thickness as indicated on Drawings.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### **3.05 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

### **3.07 PROTECTION**

- A. Immediately after placement, protect pavement from mechanical injury for 3 days or until surface temperature is less than 140 degrees F.

**END OF SECTION**

**SECTION 32 13 13**  
**PORTLAND CEMENT CONCRETE PAVING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete sidewalks, integral curbs and gutters, aprons, and dumpster pad.

**1.02 RELATED SECTIONS**

- A. Section 00 30 10 - Geotechnical Investigation
- B. Section 32 14 13 - Cast-in-Place Concrete.
- C. Section 33 41 00 - Joint Sealers: Sealant for joints.
- D. Section 31 2323 - Fill and Backfill: Compacted subbase for paving.
- E. Section 31 22 00 - Grading: Preparation of site for paving and base.

**1.03 REFERENCES**

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 1997).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988.
- F. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2001b.
- G. ASTM C 33 - Standard Specification for Concrete Aggregates; 2002a.
- H. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2001.
- I. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- J. ASTM C 150 - Standard Specification for Portland Cement; 2002a.
- K. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2001.
- L. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2001.

- M. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.
- N. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 1999a.
- O. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.
- P. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2001.
- Q. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (non-extruding and Resilient Bituminous Types); 1999.
- R. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction; 1984 (Reapproved 1996).

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Design paving for parking, light duty commercial vehicles, and residential streets.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with ACI 301.
- B. Obtain cementitious materials from same source throughout.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.

#### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

### **PART 2 – PRODUCTS**

#### **2.01 FORM MATERIALS**

- A. Form Materials: Conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
  - 1. Thickness: 1/2 inch.

#### **2.02 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.
- B. Dowels: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.

## **2.03 CONCRETE MATERIALS**

- A. Concrete Materials: As specified in Section 300.

## **2.04 ACCESSORIES**

- A. Curing Compound: ASTM C 309, Type 1, Class A.
- B. Joint Sealer: Self leveling type as specified in Section 07 9000.

## **2.05 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:
  - 1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: as specified on the plans.

## **2.06 MIXING**

- A. Transit Mixers: Comply with ASTM C 94/C 94M.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

### **3.02 SUBBASE**

- A. Prepare the subbase in accordance with State of Arkansas Highways standards.

### **3.03 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- C. Notify Architect a minimum of 36 hours prior to commencement of concrete operations.

### **3.04 FORMING**

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

### **3.05 REINFORCEMENT**

- A. Place reinforcement as indicated.
- B. Place dowels to achieve pavement and curb alignment as detailed.

### **3.06 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
- B. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

### **3.07 JOINTS**

- A. Align curb, gutter, and sidewalk joints.
- B. Provide scored joints:
  - 1. At 6 feet intervals or as indicated on the drawings.
- C. Provide expansion joints:
  - 1. At maximum 20 foot intervals or as indicated on the drawings.

### **3.08 FINISHING**

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.

### **3.09 JOINT SEALING**

- A. See Section 07 9000 for joint sealer requirements.

### **3.10 TOLERANCES**

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation from True Position: 1/4 inch.

### **3.11 FIELD QUALITY CONTROL**

- A. Independent Testing Agency will perform field quality control tests, as specified in Section 01400.
  - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
  - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
  - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed each day.
  - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

### **3.12 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

**END OF SECTION**

**SECTION 32 3119**  
**DECORATIVE METAL FENCES AND GATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Decorative aluminum fences.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 31 2316 - Excavation.

**1.03 REFERENCE STANDARDS**

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- F. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- G. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint; 2002 (Reapproved 2009).
- H. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013.
- I. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008.
- J. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates; 2011.
- K. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2010).
- L. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test; 2009.
- M. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016.
- N. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2017.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings:
  - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.



- D. Samples: Submit two samples of fence panels, slat infill, 12 inch by 12 inch in size illustrating construction and colored finish.
- E. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and etc..
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Manufacturer's Warranty.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Tools: One each of every special tool required for maintenance of \_\_\_\_\_.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

#### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Decorative Metal Fences and Gates: Basis of design: Flat Top - Ascot 3 Rail - Alumi-Guard
  - 1. Alumi-Guard: [www.alumi-guard.com/#sle](http://www.alumi-guard.com/#sle).
  - 2. Ameristar Perimeter Security, USA: [www.ameristarfence.com/#sle](http://www.ameristarfence.com/#sle).
  - 3. Superior Aluminum Products, Inc: [www.superioraluminum.com/#sle](http://www.superioraluminum.com/#sle).
  - 4. Ultra Aluminum Manufacturing Inc: [www.ultrafence.com/#sle](http://www.ultrafence.com/#sle).

#### **2.02 FENCES**

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Aluminum: ASTM B221.
  - 1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
  - 2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
  - 3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.
- C. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
  - 1. Tamper-proof security bolts.
  - 2. Self-drilling hex-head screws.

#### **2.03 ALUMINUM FENCE**

- A. Decorative Aluminum Fence System: Provide fence meeting the Test Load and Coating Performance requirements of ASTM F2408 for Industrial class.
- B. Fence Panels: 3 feet, 6 inches high by 6 feet long.
  - 1. Panel Style: Two rail.
  - 2. Panel Strength: Capable of supporting 270 pounds minimum load applied at midspan without deflection.

3. Attach panels to posts with manufacturer's standard panel brackets and recommended fasteners.
- C. Posts: Aluminum extrusions; 2-1/2 inches square.
  1. Size: 2-1/2 inches square.
  2. Extrusion Wall: 0.080 inch thick.
  3. Internal Reinforcing: 0.080 inch thick.
- D. Rails: Extruded aluminum channels.
  1. Double-walled aluminum U channel; outside cross-section dimensions of 1-3/4 inch square; interior guide channel forms lower limit of raceway for retaining rod.
  2. Effective Wall Thickness:
    - a. Top Wall of Outer Channel: 0.100 inch thick.
    - b. Side Wall: 0.120 inch thick.
- E. Pickets: Extruded aluminum tubes.
  1. Size: 1-1/4 inch square.
  2. Size: 1 inch square.
  3. Spacing: 4.715 inch on center.
  4. Style: Pickets with finial extend above top rail.
- F. Fasteners: Manufacturer's standard stainless steel bolts, screws, and washers; factory finish fasteners to match fence.

## **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.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. When cutting rails immediately seal the exposed surfaces by:
  1. Removing metal shavings from cut area.
  2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
  3. Apply two coats of custom finish spray paint matching fence color.
  4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.

### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
  1. Hole diameter.
  2. Hole depth.

- 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- E. Workmanship: Verify neat installation free of defects.

### **3.06 CLEANING**

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

### **3.07 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

### **3.08 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**

**SECTION 33 11 16**  
**WATER DISTRIBUTION SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. Extent of water distribution system work is indicated on drawings and by requirements of this section. This section includes the following work:
  - 1. Furnish and install new potable water system components.

**1.02 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of pipe, fittings, valves, or accessories for use in potable water systems whose products have been used satisfactorily in similar service.
- B. All materials and workmanship will comply with the latest standards set forth by Central Arkansas Water.
- C. Codes and Standards: Comply with applicable requirements of the latest edition of standards including the following:
  - 1. Arkansas State Plumbing Code.
  - 2. Arkansas Department of Health Regulations.
  - 3. Standards of Central Arkansas Water, Little Rock, Arkansas.
  - 4. ASTM D 2241 "Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe SDR-PR".
  - 5. ASTM D1784 "Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds".
  - 6. AWWA C104 "Standard for Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water".
  - 7. AWWA C110 "Standard for Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids".
  - 8. AWWA C111 "Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings".
  - 9. AWWA C150 "American National Standard for the Thickness Design of Ductile-Iron Pipe".
  - 10. AWWA C151 "Standard for Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids".
  - 11. AWWA C153 "Standard for Ductile-Iron Compacted Fittings, 3 inch through 16 inch, for Water and Other Liquids".
  - 12. AWWA C500 "Standard for Gate Valves for Water and Sewerage Systems".
  - 13. AWWA C502 "Dry-Barrel Fire Hydrants".
  - 14. AWWA C509 "Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems".

15. AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Appurtenances".
16. AWWA C605-94 "Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water".
17. AWWA C651 "Standard for Disinfecting Water Mains". CDA Copper Tube Handbook.
18. AWWA C800 "Standard for Underground Service Line Valves and Fittings".
19. AWWA C900 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution".
20. Abbreviations: ASTM = American Society for Testing and Materials
21. AWWA = American Water Works Association

### **1.03 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, unload and handle pipe, fittings, and other materials in a manner which will prevent damage to materials. Do not drop pipe or other materials and do not allow pipe to collide with other pipe or materials. Do not subject materials to impact or jarring that might crack or otherwise damage materials.
- B. Store pipe and other materials in approved locations and blocked or otherwise stabilized to prevent rolling or falling. Cover or otherwise protect items which can be damaged by weather.

### **1.04 SUBMITTALS**

- A. Submit the following product data for the Engineer's approval prior to ordering materials.
  1. Valves, pipe, hydrants, and accessories.
- B. At project closeout, submit one (1) copy of record drawings which legibly identify and accurately locate capped facilities and new installed work including valves, fittings, bends, etc.

### **1.05 DEFINITIONS**

- A. Remove and Dispose: Remove and legally dispose off-site of items except those indicated to be reinstalled or salvaged.
- B. "City" shall mean the municipal utility department for the City of Little Rock, Arkansas.

## **PART 2 – PRODUCTS**

### **2.01 PIPE AND PIPE FITTINGS**

- A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated.
- B. PVC pipe 2 inch & smaller diameter:
  1. Class 200 psi (SDR 21) similar and equal to Johns-Manville PVC Ring-Tite pipe with rubber ring and integral thickened bell joints.
  2. Pipe shall meet requirements of ASTM D1784 and ASTM D2241; and bearing National Sanitation Foundation seal for potable water.

3. Meet following minimum test criteria:
  - a. Quick burst test: Pass without failure 500 psi applied in 60 to 70 seconds tested per ASTM D1599 and D2241.
  - b. Sustained pressure test: Pass without failure for 1000 hours a pressure of 340 psi tested per ASTM D1598 and referenced in ASTM D2241.
  - c. Acetone immersion test: No visible spalling or cracking after 20 minutes immersion of 1" long sample ring in anhydrous acetone per ASTM D2152.
  - d. Vice test: No evidence of splitting or shattering in a 2" long ring section flattened between two flat parallel plates. Flattening not less than 60% of the outside diameter in 2 to 5 minutes elapsed time.
- C. PVC pipe 4 inch through 8 inch:
  1. Pipe shall comply with requirements of AWWA C900 and shall be DR 14 (pressure class 200 psi) or DR 18 (pressure class 150 psi) unless otherwise shown on the Drawings.
  2. Pipe shall be manufactured from class 12454-A or class 12454-B materials.
- D. Fittings for PVC Pipe:
  1. For 4" and larger pipe, provide MegaLug type ductile iron mechanical joint fittings meeting AWWA standards. Provide transition gaskets where required to fit pipe sizes.
  2. For 3" and smaller pipe, provide PVC fittings manufactured by the pipe manufacturer and meeting requirements of ASTM D 3139.
- E. Ductile Iron Pipe: 6 inch diameter and larger as indicated on drawings. AWWA C151, Class 50. for 6 thru 18 inch, Class 50 for 20 inch diameter.
  1. Lining: AWWA C104, cement mortar.
  2. Gaskets: AWWA C111, rubber.
  3. Joints: AWWA C111
    - a. Except where indicated otherwise: Bell and socket push joint, rubber ring compression type gaskets.
    - b. Where indicated: Restrained joint of approved design with rubber ring compression type gaskets.
    - c. Where indicated: Flanged joint with rubber gaskets.
  4. Fittings:
    - a. Ductile Iron – AWWA C111 Mechanical Joint designed for working pressure of at least 250 psi. All joints shall be fitted with retainer glands.

- b. Where indicated: Flanged joint fittings with rubber gaskets AWWA C115.
  - c. Retainer Glands: Mechanical joint designed for working pressure of at least 200 psi. Glands shall be designed to standard mechanical joint fittings AWWA C111.
- F. Service Fittings: Service line outlets or stubs shall be furnished with caps or plugs secured to withstand test pressure without leakage.
- G. Lubricant: Lubricant furnished for lubricating joints shall be non-toxic, shall not support the growth of bacteria, shall not be deleterious to gasket or pipe material, and shall not impart taste or odor to water. Lubricant containers shall be labeled with the manufacturer's name and shall be NSF approved.

## **2.02 WATER SERVICE LINES**

- A. Copper Tubing:
- 1. Type "K" seamless copper tubing meeting requirements of ASTM B88.
  - 2. Fittings: Provide bronze fittings designed for compressions joints.
- B. HDEP Tubing:
- 1. Drisco brand service line tubing.
  - 2. Fittings: Provide Ford-style bronze fittings.
- C. Service Line Disconnect:
- 1. Valve shall be a 2" ductile gate valve with 2" operating nut.
  - 2. Valves in the meter box shall be 2" brass hand-wheel with non-rising stem gate valve.

## **2.03 VALVES AND VALVE BOXES**

- A. Gate Valves (2 Inches through 12 inch): Provide resilient seat iron bodied, bronze mounted, non-rising stem, double gate designed for 200 psi (minimum) working pressure. Meet AWWA C509 requirements, with "o" ring stem seals and mechanical joints for ductile-iron pipe and push-on joints for PVC pipe. Provide valves by Mueller, Clow, American Valve & Hydrant, Waterous (or approved equal).
- B. Butterfly Valves: 16 inch and larger:
- 1. Provide valves conforming to AWWA C504.
  - 2. Body: ASTM A-126 Class B Cast Iron with mechanical joints. Rated for Class 150B service. Exterior bituminous coated for complete bury service.
  - 3. Shaft – ASTM A276 Type 304 Stainless Steel with "O-Ring" or Split-V seals, replaceable without removing the shaft.
  - 4. Valve Disc – ASTM A536 with 316 edge ductile iron with BUNA-N resilient seats bonded into a self-retaining recess in the body. Seats shall be field replaceable without removing the valve body from the main.
  - 5. Bearings – Teflon-lined and fiberglass backed.
  - 6. Actuators – Manual with totally enclosed mechanism. Traveling-nut type with steel drive

screws and internally threaded bronze nut. 2" x 2" operating nut. No u-joints shall be used on the reach rods.

7. Operator – Worm gears with bronze or ductile iron gears and hardened steel worm. Class 150B Torque requirements and AWWA C504 operator input requirements.
- C. Gate Valves (1 inch): All brass valves.
  - D. Valve Boxes: Provide cast iron or steel valve boxes of two-piece adjustable screw type with cast iron lids for all buried valves and stops. Drop cover marked "WATER".
  - E. Corporation and Curb Stops: AWWA C800 - Provide bronze stop for pressure rating not less than 125 psi with connection designed for application.
  - F. Valve epoxy coating: Coat gate valve and butterfly valve interior surfaces which are not bronze or stainless steel with two-part thermosetting epoxy not less than 8-mil dry film thickness (DFT) & free of holidays. Before application of coating material, all surfaces shall be thoroughly cleaned to remove dirt, grease, oil and any other substances; all sharp angles, protrusions or irregularities which would interfere with proper coating coverage shall be removed; and the entire surface grit blasted to white metal in accordance with SSPC Specifications SP5 resulting in an anchor pattern of at least one (1) mil. Thermo-set epoxy material shall be applied to the sand-blasted surfaces before the white metal begins to oxidize (darken in color). The thermo-set epoxy shall be approved for exposure to fluids for human consumption by the Federal Food and Drug Administration. The disc shall be post-cured for a sufficient period of time to assure full polymerization. Polymerization shall be checked by a direct impact test at 60-in-lb. with no cracking or chipping of the coating. The film thickness shall be checked using an accurate magnetic film thickness gauge. The entire coated surface shall be checked for holidays using a wet sponge type holiday detector. Any areas where the film thickness is found to be less than 8 mils or where holidays were detected, shall be recoated and rechecked. Valves shall be placed for shipment in such manner that the coating is protected from damage.

## **2.04 FIRE HYDRANTS**

- A. General: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6 inch mechanical joint inlet, 200-psi working pressure, Clow 5¼ " fire hydrant, as per City Requirements.
- B. Outlet Threads: NFPA 1963, external hose thread used by the local fire department. Outlets shall have cast-iron caps with steel chains.
- C. Operating and Cap Nuts: Pentagon 1 1/8 inch point to flat.
- D. Direction of Opening: Hydrant valves shall be opened by turning operating nut to the left, or counterclockwise.
- E. Finish: Yellow exterior alkyd gloss enamel paint.
- F. Dry-Barrel Fire Hydrants: AWWA C502, Traffic Model Fire Hydrant, two 2½ and one 4½ inch outlets, 5¼ inch main valve, drain valve, and 6 inch mechanical joint inlet. Four foot bury depth, except where otherwise indicated.

## **2.05 ACCESSORIES**



- A. Provide accessories where indicated on drawings and where required for proper installation. Include clamps, saddles, transition fittings, couplings, bolts, concrete blocking, etc.
- B. Valve Wrenches: Provide two wrenches for each type of valve operator.

## **2.06 PIPE ENCASEMENT FOR HIGHWAY CROSSING**

- A. Provide asphalt coated spiral welded pipe with ¼" minimum thick walls and diameter as indicated on Drawings at highway and crossings. Pipe materials length, size, and installation shall be in accordance with the standards of the Arkansas State Highway and Transportation Department (ASHTD). At locations where an existing highway crossing encasement is to be extended, the encasement pipe shall match the diameter of the existing encasement pipe.

Encasement spacers shall be pre-manufactured stainless-steel spacers that attach to the carrier pipe without the aid of metal bands or straps. The spacers shall be sized & shall be spaced based on the manufacturer's recommendation.

Premanufactured seals shall be used to seal ends of encasement unless otherwise specified by the utility.

## **2.07 TRACE WIRE FOR NON-METALLIC PIPE**

- A. Locator wire shall be placed in the trench along with all plastic water pipe. Locator wire shall be #12 copper wire and shall run continuous along the top of all plastic water pipe.

## **2.08 TAPPING SLEEVES**

- A. Sleeves and bolts shall be two-piece Mueller MJ ductile iron tapping sleeve, designed for a working pressure of at least 200 psi.
- B. Outlets: ANSI B16.1, Class 125 flanges designed to accept tapping valves.

# **PART 3 – EXECUTION**

## **3.01 GENERAL**

- A. Coordinate installation of water distribution system with other work and utility locations.
- B. Maintain drainage at all times. Provide pumps and other equipment as required to dewater trenches.

## **3.02 SELECTIVE DEMOLITION**

- A. Protect items indicated to remain against damage. Contractor shall repair any damage caused by his work at his expense.
- B. Except for items or materials indicated to be reused, salvaged, or reinstalled, demolished materials shall be removed and disposed off-site.
- C. Contractor shall coordinate with the City for shutoff, capping and continuation of water service and shall schedule demolition and removal work to ensure uninterrupted service.

- D. Water lines to be plugged shall be sealed watertight and appropriate thrust restraints installed to prevent blow-off or leakage under normal system operating pressures and surges.

### **3.03 TRENCHING**

- A. Provide trenches for water mains and service lines which are accurately graded for uniform pipe bearing and typical minimum depth of 30 inches cover over main pipes at finish grade and 24 inches cover under ditches unless otherwise shown on the Drawings. Provide 18 inches (minimum) cover at service lines. Excavate trench width as required for proper installation of piping, valves, etc. Increase trench depth where indicated, and/or required for conditions including valve/box height.
- B. Stabilize mucky or unstable trench bottoms by over excavating and bedding pipe in select backfill.
- C. In rock bottom trenches provide 4 inch (minimum) cushion of select backfill for pipe bedding and on each side of pipe, valves and fittings.
- D. Where blasting is required, Contractor shall take proper precautions for protection of persons, the Work, and adjacent property. Any damage done to the Work or property by blasting shall be corrected by the Contractor at his expense.
  - 1. All operations involving the handling, storage and use of explosives shall be performed in accordance with local, State and Federal laws and regulations.

### **3.04 LAYING PIPE**

- A. Lay pipe in prepared trenches carefully grading and bedding bell ends, fittings, and valves.
- B. Clean the inside of bell or coupling and outside of pipe end of all dirt, grease, or other foreign material before jointing pipe.
- C. Joint pipe lengths together as required by manufacturers' recommendations and instructions. Use non-toxic lubricants recommended by pipe manufacturer. Avoid excessive deflections in pipe joints.
- D. Plug ends of pipe using temporary watertight plugs at end of each day's work.
- E. Periodically flush mains for cleansing during laying operations.
- F. Concrete thrust blocking shall be poured at all bends and fittings.
  - 1. Exercise care to avoid over-excavation in trench areas where thrust blocks are to be poured.
  - 2. Remove water from excavation. Pour thrust blocking against undisturbed earth.

### **3.05 BORES**

- A. Bore under highway maintaining minimum depths, and bore length as shown on Drawings. Utilize construction techniques which comply with Highway Department Standards.

### **3.06 PIPE ENCASEMENT**

- A. General: Excavate an area sufficient to allow the installation of the encasement. Use proper precautions to assure that the integrity of the highway bed is not disturbed by the excavation.

**B. Installation of One-Piece Encasement:**

1. Notify Owner before disrupting utility service.
2. Remove tees, bends, valves, or other obstacles to allow free access to the pipe which is to be encased.
3. Make sure that sufficient excavation has been done to allow installation of the encasement without placing undue bending stresses on the carrier pipe.
4. Support the encasement extension to assure a true line from existing encasement to encasement extension. Weld continuously around the perimeter of the joints using approved welding techniques.
5. The construction of encasement structures by tunneling or boring shall be carried out in such manner that settlement of the surface above the structure is minimal. The excavation shall be performed so that voids around the structures are held to a minimum. Voids around the periphery of the structures shall be filled by pressure grouting if required by Engineer and/or Utility. The grout shall be one (1) part Portland cement and two (2) parts sand with water adequate to permit pumping on encasement structures 24-inches in diameter and larger. The grout shall be introduced through suitable fixtures and placed through the structure wall at intervals adequate to completely fill all voids. The fixtures shall have pressure type caps which shall be closed after the grouting operations have been completed. The grouting pressure shall be sufficient to completely fill all voids without causing upheaval of overburden above the encasement structure but shall not exceed five (5) psi. If voids exist around structures smaller than 24-inches in diameter, the Contractor shall introduce grout to completely fill the voids through suitable borings made from the surface.

**3.07 BACKFILL**

- A. After pipe work has been inspected and approved, trenches shall be backfilled with select material as shown on the Drawings and of proper moisture content. Select material shall be fine loose earth free from clods or stones larger than three (3) inches in any dimension. The select material shall be carefully deposited in layers not exceeding four (4) inches in thickness on both sides of the pipe and thoroughly and carefully rammed around the pipe. Additional select material shall be installed to a minimum of twelve (12) inches above the top of pipe.
- B. All trenches and excavations shall be backfilled immediately after inspection and approval using methods which will not disturb the pipe. Material used for backfilling shall consist of the excavation or borrowing of sand, gravel, or other materials approved by the Engineer and shall be free of trash, large rock, lumber, or other debris.
- C. All trenches shall be backfilled, settled and the ground restored to its original condition as soon as possible after pipe is installed. Any unnecessary delay in restoring trenches to original condition shall be cause for stopping all other work until trenches are so restored. The Contractor shall be responsible for all settlement of backfill in trenches and shall refill trenches as often as necessary to bring them back to original grade and during the period when settlement is occurring shall refill them frequently enough to maintain traffic without hazard at all times except when trenches are actually flooded.

- D. All excess excavated material shall be disposed of to the satisfaction of the Engineer. Surfaces

shall be cleaned up, all hummocks and piles smoothed down and the surface left neat and workmanlike. Where existing drainage ditches are disturbed or obstructed with excavated material, such material shall be removed, and the ditch restored to original line and grade.

- E. Backfill through traffic areas shall conform to requirements of the subsection Cutting And Replacing Special Surfaces herein.

### **3.08 VALVES AND VALVE BOXES**

- A. Install valves with operating stems in true vertical position unless otherwise shown on the drawings.
- B. Block valve boxes to provide vertical support using concrete blocks or other approved methods and in a manner that no weight on the box is transferred to the valve or pipe.
- C. Adjust valve boxes to conform to adjacent finished grades.

### **3.09 FIRE HYDRANTS**

- A. Properly locate fire hydrants with respect to property lines and streets and at proper elevations. Do not locate fire hydrants within highway right-of-way.
- B. Support fire hydrants on 4 inches (minimum) thick concrete slab not less than 18 inches square and provide concrete backing and blocking to prevent blow-off of hydrant from lead.
- C. Install retaining glands and restraining rods or bolts.
- D. Paint fire hydrant with two (2) coats of an approved fire hydrant paint.

### **3.10 CUTTING AND REPLACING SPECIAL SURFACES**

- A. When necessary to disturb paved, graveled, or other special surfaces, Contractor shall use care to minimize any such disturbances. Care shall be used in making the backfill to eliminate future settlement and the surface shall be restored using the same type of original surface materials.
- B. Asphalt and Concrete Pavement Surfaces: Edges of pavement shall be cut full depth along straight and true lines along each side of the trench using approved tools and equipment ahead of the trenching operation. All pavement materials shall be removed from the area prior to beginning the trenching work. Subgrade and base material shall match existing on both sides of the trench and all patches shall be made as approved by the Engineer.

Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas.

- C. Gravel Surfaces: Gravel shall be replaced after trenching and backfilling. After the backfill has been so placed that no further appreciable settlement will occur, gravel over the trench shall be replaced to the same compacted thickness as the original surfacing. During construction, the gravel of the remainder of the street not occupied by the trench may be covered with soil from the excavated material. After completion of the backfill, such soil shall be removed, in so far as possible, and additional gravel shall be placed on the street until the surface is as weather resistant and traffic resistant as the original surfacing.
- D. Seeded Areas: After heavy construction work is complete and equipment has been removed, clean all areas disturbed by the Contractor's Work. Seed as specified in Section 02920.

- E. Sodded Lawn Areas: Prepare any sodded areas for proper relaying of any previously removed sod. Remove trench and backfill materials from adjacent lawn areas to permit unhindered growth of grasses and safe operation of mowing equipment. Replace sod as specified in Section 02920. Sod and adjacent lawn areas that do not reestablish at the commencement of the next growing season shall be replaced at the Contractor's expense.
- F. Contractor shall maintain repaired areas as often as necessary to provide a smooth crossing not hazardous to traffic.
- G. Should local regulations pertaining to cutting and replacing special surfaces exist in the project area, they shall be considered to supersede this subsection. The Contractor shall comply with all such local codes or regulations.

### 3.11 SERVICE CONNECTIONS

- A. Service connections shall be furnished and installed as shown on the Drawings.

### 3.12 HYDROSTATIC TESTING

- A. General: Pressure test all water lines in presence of Engineer or Designated Authority. Contractor shall make arrangements for furnishing potable water for testing. Provide all pumps, gages, fittings, and apparatus for testing. Pressure test after backfill is complete.
- B. Test isolated segments of the main as approved by the Engineer. Fill segment being tested with water while bleeding and purging air. Pressurize the main segment being tested using an approved pumping system to a pressure (P) not less than the pressure listed in the table below. Obtain the Engineer's approval of the testing procedure and the pressures to be used before beginning the test. Maintain pressure for period of eight hours, recording (using approved meter(s)) quantity of water required to maintain pressure.

Line segments will be approved as passing the test if no noticeable leaks are present and quantity (Q) required to maintain pressure is less than indicated by Formula

$$Q = \frac{LD(P)^{0.5}}{148,000}$$

as defined by AWWA C605.

Where Q = quantity of makeup water in gallons per hour  
 L = length of pipe sections being tested, in feet  
 D = nominal diameter of the pipe, in inches  
 P = average test pressure during the hydraulic test in PSI (gauge pressure)

- C. Repair all detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.
- D. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.
- E. Test Records:
  - 1. Records shall be made of each piping system component tested. Records shall include:
    - a. Date of test.
    - b. Description and identification of piping tested.
    - c. Test fluid.

- d. Test pressure.
- e. Remarks, including such items as:
  - (1) Leaks - type and location.
  - (2) Repairs made on leaks.
- f. Certification by Contractor and written approval by Engineer.

### **3.13 DISINFECTING**

- A. Disinfect all water lines after tested and approved (but before placing in service) in accordance with AWWA Standard Specification C651. Use liquid chlorine or hypochlorite in such amount as to provide dosage of not less than 50 ppm and to maintain a chlorine residual of not less than 25 ppm for 24 hours.
- B. Flush chlorine solution from lines after contact period of not less than 24 hours.
- C. Sample water from disinfected lines and deliver samples to Arkansas Department of Health for bacteria analysis. Obtain samples as required from selected points with no less than two consecutive samples taken 24 hours apart from each point. Continue sampling and disinfecting process until two consecutive samples (24 hours apart) from each point are approved by the Arkansas Department of Health. Deliver samples to laboratory within 24 hours of sampling.
- D. Submit three (3) copies of Arkansas Department of Health reports to Engineer.
- E. Do not place sterilizing agents in pipes during construction. Install sterilizing agent after pressure testing is complete.

### **3.14 CLEAN UP AND WORK CLOSEOUT**

- A. Clean work areas of all refuse, debris, excess materials, etc. Dispose of "clean-up" items off site.
- B. Grade level areas disturbed during construction.
- C. Completed water system improvements shall be placed in service only upon approval and acceptance of the City.

### **END OF SECTION**

**SECTION 33 31 13**  
**SANITARY SEWER COLLECTION SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. Extent of sanitary sewer collection system work is indicated on drawings and by requirements of this section. This Section includes the following work:
1. Gravity sewer collection lines.
  2. Manholes.
  3. Pressure sewer lines (force mains).
  4. Testing of gravity and pressure sewer lines.
- B. Related Sections:
1. Section 00 3010 – Geotechnical Investigation
  2. Section 02 20 00 – Site Preparation
  3. Section 31 22 00 – Grading
  4. Section 32 23 16 – Excavation
  5. Section 31 23 23 – Fill and Backfill
  6. Section 31 23 17 – Trenching for Site Utilities

**1.02 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipe, fittings, and accessories for use in sanitary sewer collection systems whose products have been used satisfactorily in similar service.
- B. Code and Standards: Comply with applicable requirements of standards including the following:
1. Arkansas State Plumbing Code.
  2. Arkansas Department of Health Regulations.
  3. Standards of the Little Rock Water Reclamation Authority, Little Rock, Arkansas.
  4. ASTM D 2241-80 "Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR)".
  5. ASTM D1784 "Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds".
  6. ASTM A536-84 "Specification for Ductile-Iron Castings".
  7. ASTM A746-86 "Specification for Ductile-Iron Gravity Sewer Pipe.
  8. Abbreviations: ASTM = American Society for Testing and Materials

### **1.03 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, unload and handle pipe, fittings, and other materials in a manner which will prevent damage to materials. Do not drop pipe or other materials and do not allow pipe to collide with other pipe or materials. Do not subject materials to impact or jarring that might crack or otherwise damage materials.
- B. Store pipe and other materials in approved locations and blocked or otherwise stabilized to prevent rolling or falling. Cover or otherwise protect items which can be damaged by weather.

### **1.04 FIELD ENGINEERING**

- A. Owner will provide control staking as required for accurate construction of sewer mains, and services. Contractor will provide construction staking and furnish Engineer with cut sheets at 50 foot stations for approval prior to construction.
- B. For sewer main construction using laser light, maintain elevation and alignment controls at manhole locations and spot check laser light accuracy during construction.
- C. For sewer main construction without laser light, establish offset grade and alignment stakes along main.

### **1.05 SUBMITTALS**

- A. Submit the following product data for Engineer's approval prior to ordering materials:
  - 1. Gravity pipe and joints.
  - 2. Pressure sewer pipe and joints.
  - 3. Pressure sewer services including boxes and valves.
  - 4. Manhole castings.
  - 5. Source, properties and description of bedding and granular fill materials.

### **1.06 DEFINITIONS**

- A. Remove and Dispose: Remove and legally dispose off-site those items as indicated on the Drawings.
- B. "City": Shall mean the municipal utility department for the City of Little Rock, Arkansas.
- C. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable.
- D. Rock excavation, only when specifically listed in the Bid form as a pay item, consists of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or with the use of rippers attached to a Caterpillar brand D-9 bulldozer, a Komatsu brand Model 400 excavator, or equivalent, and all boulders of other detached stones each having a volume of one (1) cubic yard or more.



## E. Project Conditions

1. **Blasting:** Use of explosives is not allowed, without written authorization. Said authorization shall include but not be limited to obtaining any required regulatory permits. Contractor shall perform any blasting with proper precautions for protection of persons, the Work and adjacent property. Any damage done to the Work or property by blasting shall be corrected by the Contractor at his expense.
2. **Protection of Persons and Property:** Barricade open excavations occurring as part of this work and post with warning lights.
  - a Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
  - b Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.
3. **Excavation and Trench Safety:** Occupational Safety and Health Administrative Standard for Excavation and Trenches Safety System, 29 CFR 1926 Subpart P. As required by Arkansas Act 291, 1993 requirements of 29 CFR 1926, Subpart P are specifically incorporated into this specification as if rewritten herein.
4. Submitting a bid on this Section shall mean acceptance of existing conditions.
5. Contractor shall make his own estimate of the kind and extent of the various materials to be excavated in order to accomplish the work.
6. There will be no extra compensation for dewatering.

## **PART 2 – PRODUCTS**

### **2.01 PIPE AND PIPE FITTINGS**

- A. **General:** Provide piping materials and factory fabricated fittings and accessories of sizes and types indicated on drawings or required. To assure uniformity and compatibility of piping systems, pipe, fittings, and couplings shall be furnished by the same manufacturer.
- B. **Gravity Sewer Pipe:**
  1. Polyvinyl chloride (PVC) Sewer Pipe – Meet requirements of ASTM D 3034 for 4” – 15” and F-679 for 18”-21” PVC and shall be SDR 26 or SDR 35 as specified.
  2. Ductile Iron Sewer Pipe - Meet requirements of ASTM A 746 Class 50.
    - a Lining: Corrosion resistant conforming to ANSI A21.4.
    - b Joints: Rubber gasket push-on conforming to ASTM D 3139.
  3. Service Lines – PVC gravity sewer pipe with elastomeric gasketed joints, SDR 26 or SDR 35 as specified.

C. Pressure Sewer Pipe (Force Mains)

1. PVC Pressure Sewer Pipe – Meet requirements of ASTM D 2241, SDR 21, PR 200.
2. Fittings – Ductile iron mechanical joint conforming to ANSI/AWWA C100/A21.10 and C111/A21.11.

D. Service Fittings

Service line outlets or stubs shall be furnished with caps or plugs with same type gasket and joint as service connection pipe. Plug or cap shall be banded or otherwise secured to withstand test pressures without leakage.

E. Encasement Pipe

Smooth wall, welded steel pipe conforming to AASHTO M-190 for Type C coating. Stainless steel casing spacers shall be used to provide the annular space between the encasement pipe and sewer pipe as shown on the Drawings.

F. Special Fittings and Couplings

1. Connections between different types of pipe and for future connections shall be watertight.
2. Connection between plain ends of the same type pipe or transitions between different types of pipe shall be made with Fernco couplings.

**2.02 MANHOLES**

A. Poured in place manholes shall be cast-in-place concrete in accordance with Section 03 30 00 unless otherwise approved.

B. Precast concrete manholes are allowed upon prior approval. Precast concrete ring sections shall be equal in quality to reinforced concrete sewer pipe ASTM C76. Joints shall be rubber gasketed.

C. Manhole Steps:

1. Manhole steps shall not be required in new manholes unless otherwise specified.
2. Where specified, steps shall be cast iron or steel encased in PVC or fiberglass and conforming to OSHA requirements. Steps shall be Neenah Catalog No. R-1982-J or equal.

D. Manhole Frames and Covers:

1. Metal castings shall conform to ASTM A 48, class 35B gray iron with mating surfaces machined for secure bearing.
2. Covers shall be cast with lettering "Sanitary Sewer".
3. Frames and covers shall have a minimum opening and total weight, as shown on the Drawings, and be non-vented with provisions for removal.
4. Acceptable foundries: Deeter and East Jordan Iron Works or approved equal.

## **2.03 SOIL MATERIALS**

- A. Pipe bedding material shall be gravel or crushed stone, maximum diameter 1- $\frac{1}{4}$ ".
- B. Trench Backfill and Fill Materials (not under traffic areas): Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Trench Backfill (under traffic areas): See details on Drawings.

## **2.04 PIPE ENCASEMENT FOR HIGHWAY AND RAILROAD CROSSING**

- A. Where required by state highway, railroad, county or municipalities, furnish and install asphalt coated spiral welded pipe with  $\frac{1}{4}$ " minimum thick walls and diameter as shown on the Drawings. Pipe materials length, size, and installation shall be in accordance with the standards of the applicable authority. At locations where an existing crossing encasement is to be extended, the encasement pipe shall match the diameter of the existing encasement pipe and shall be of sufficient size to install or remove the carrier pipe.

## **PART 3 – EXECUTION**

### **3.01 TRENCHING**

- A. Excavate trenches accurately to grade and alignment shown on Drawings or as established in the field by Engineer. Trench width as shown on the Drawings and not more than 36" at 12 inches above pipe.
- B. When excavation is carried below that required fill space with concrete, bedding, or compacted select material at Contractor's expense.
- C. Trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes.
- D. Where necessary to protect labor, the work, or adjacent property the Contractor shall provide and install shoring. Such shoring shall remain in place until the backfill has proceeded to a point where it can be removed safely, except that, if in the opinion of the Engineer, damage is liable to result from withdrawing shoring, it shall remain in place.
- E. All excavation shall be dewatered before any construction is undertaken therein. Concrete shall be placed only upon dry, firm foundation material and pipe shall be laid only in dry trenches.
- F. In order to avoid superimposed loading in excess of the designed and specified pipe strength and to provide sufficient room for proper installation and bedding of the sewer pipe, the trench widths for the pipe sizes used shall be kept within the limits specified in the following:

| Inside Pipe Diameter | Min. Width of Trench at Center of Pipe | Max. Width of Trench 12" above Outside Top of Pipe |
|----------------------|----------------------------------------|----------------------------------------------------|
| 6" - 8"              | 20"                                    | 36"                                                |
| 10" - 12"            | 24"                                    | 36"                                                |
| 15" - 18"            | 30"                                    | 42"                                                |
| 21" - 24"            | 36"                                    | 48"                                                |

- G. If it becomes necessary to reduce the earth load on the trench banks to prevent sliding and caving, it will be permissible to cut the trench banks back on a slope above an elevation two (2) feet above the outside top of the pipe. Under no circumstances, however, shall the specified maximum width twelve (12) inches above the outside top of the pipe be exceeded, except at points where the combined superimposed earth and live loads on the pipe are sufficiently low to permit an increase in the specified maximum trench width and then only where such an increase in trench width is authorized by the Engineer. All trenches must be undercut as shown on the pipe bedding detail of the Plans. The entire width of the trench shall be backfilled to pipe grade with pipe bedding material prior to laying the pipe.
- H. Where water occurs in trenches, pumps shall be kept operating, taking suction out of a sump below the pipe subgrade, so as to hold the water level well below the bottoms of all bells until the pipe laying operation is complete and ready for backfilling.
- I. The contractor will be required to keep the sides of the excavation vertical, except as hereinbefore provided.
- J. If rock is encountered, it may be excavated with jack hammer or by blasting. However, if the Contractor uses blasting, he must comply with the latest revised U.S. Bureau of Mines Code regarding public safety as well as employee safety. The Contractor shall also comply with all state and local codes for the handling and use of explosives, including the acquisition of any necessary permits or inspections.
- K. When rock is encountered, the trench shall be excavated to the same lines as that for earth excavation as shown on the Plans.
- L. The excavation of trenches shall not advance more than one hundred (100) feet ahead of the completed pipe work and backfill, except by permission of the Engineer.
- M. Trenches for force mains, pressure mains, pressure service line, electrical lines and conduits, and gravity service lines shall be of the width and depth necessary of the proper installation of the pipe according to the Plans. They shall have a minimum of thirty (30) inches cover from finish grade.

### **3.02 SELECTIVE DEMOLITION**

- A. Protect items indicated to remain against damage. Contractor shall repair any damage caused by his work at his expense.
- B. Except for items indicated to be reused, salvaged or reinstalled, demolished materials shall be removed and disposed off-site.
- C. Contractor shall coordinate with the City for shut-off, capping and continuation of sewer service and shall schedule demolition and removal work to ensure uninterrupted service.
- D. Sewer lines to be plugged shall be sealed watertight as noted on the Drawings.

### **3.03 INSTALLATION OF PIPE**

- A. Lay gravity pipe beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert. Place bell ends of pipe facing upstream. Remove all loose material, rocks or other unsuitable material from trenches and place a portion of bedding material below pipe before laying pipe. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.
- B. Clean the end of pipe and insides of bell before making joints. Check gaskets and sealing rings and adjust if displaced or replace if missing. Apply approved lubricant to joint, align pipe, and push pipe into bell distance required to make joint. Follow pipe manufacturers installation instructions.
- C. Cap ends of pipe with temporary mechanical, pneumatic, or other approved positive sealing plugs at end of each day's work. Anchor or apply weight to prevent pipes from floating. Clean pipe interior of dirt and other materials as work progresses.
- D. Remove and re-lay pipe displaced during construction or laid out of grade and alignment unless approved to remain by the Engineer.
- E. Do not backfill pipe until pipe has been inspected and approved.

### **3.04 CONCRETE ENCASEMENT, BACKING BLOCKS, AND COLLARS**

- A. Provide concrete encasement around sewer pipes with less than 2 feet of cover, at points with special hazards and at locations indicated on the drawings.
- B. Provide concrete blocking where required to stabilize branch connections, wyes, and other points.
- C. Provide concrete collars around sewer pipe at locations as directed by the Engineer or indicated on drawings to resist longitudinal movement caused by steep grades, etc.
- D. Concrete thrust blocking shall be poured at all force main bends and fittings.
  - 1. Exercise care to avoid over-excavation in trench areas where thrust blocks are to be poured.
  - 2. Remove water from excavation. Pour thrust blocking against undisturbed earth.
  - 3. Cure thrust blocks a minimum of 5 days before conducting hydrostatic tests.

### **3.05 BACKFILL**

- A. Do not backfill trenches until the pipe has been inspected and approved.
- B. Bed pipe in bedding material as indicated on drawings, carefully placing and tamping material to insure bedding completely around pipes without voids. Apply bedding material in 4" layers.  
  
Service lines under paved areas shall be bedded as required for mains, from the main to the limits of the pavement.
- C. Backfill remainder of trench above bedding material using approved backfill material and compacted to required density. All trenches shall be backfilled, settled, and the ground restored to its original condition as soon as possible after the pipe is installed. Any unnecessary delay in restoring trenches to their original condition shall constitute just cause for stopping all other work until the trenches are restored. The Contractor shall be responsible for all settlement of backfill in trenches occasioned by the work covered herein. He shall refill trenches as often as necessary to bring them back to original grade and during the period when settlement is occurring shall refill them frequently enough to maintain traffic without hazard at all times except when trenches are actually flooded.
- D. Backfill around manholes as soon as concrete has cured sufficiently to resist loads without damage to manholes.
- E. Backfill under paved surfaces as shown on the Drawings. Backfill under paved surfaces shall be compacted with pneumatic tamper in layers not to exceed four (4) inches thick for the entire depth of the trench. Material shall not be deposited by dozer or other equipment when the paved surface is in place at the time of the backfill.
- F. All excavated material which is unsuitable or not needed for backfill shall be wasted or disposed of to the satisfaction of the Engineer. Surfaces shall be cleaned up, all hummocks and piles smoothed down, and the surface left neat and workmanlike. Where existing drainage ditches are disturbed or obstructed with excavated material, such material shall be entirely removed, and the ditch left true to original line and grade.
- G. Unnecessary delays in backfilling, grading, cleaning, and restoring surfaces along trenches constitutes cause for stopping work until trenches are restored.

### **3.06 MANHOLES**

- A. General: Construct manholes in accordance with Drawing details and with Section 03 3000.
- B. Invert channels shall be semi-circular in shape to allow for a smooth transition from one pipe to another. Form inverts directly in manhole concrete base.
- C. Frames shall set in a bed of mortar with mortar carried over flange of ring. Frames and covers shall be installed to prevent infiltration of surface or groundwater into manholes.
- D. Steps, where specified, shall be cast into manhole wall & installed to withstand a force of 350 pounds.

E. Poured in Place Manholes:

1. Manhole forms may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 8 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations and provided curing and protection operations are maintained.
2. Manholes shall not be backfilled until they have cured a minimum of sixty-four (64) hours at 70 degrees F or above.

F. Precast Manholes:

1. All joints between separate precast sections and between the cone and manhole ring shall be gasketed with Ram-Nek or approved equal to ensure watertightness.

### **3.07 CONNECTION TO EXISTING MANHOLES**

- A. Where shown on the Drawings to connect to existing manhole and where no stubout exists or is of insufficient size or alignment, Contractor shall cut in an opening through the manhole wall of sufficient size (no more than 2" larger than the outside diameter of the pipe) to permit installation of new pipe to the indicated line and grade.
- B. Extend new pipe entirely through the wall, fitted with a premolded rubber waterstop. Fill the remaining void with an expansive hydraulic grout.
- C. Bottoms of existing manholes shall be refinished, removing portions of existing invert and re-grouting as necessary to provide a smooth and uniform invert.
- D. Connect to existing manholes only after all other upstream lines and manholes have been completed, cleaned, tested, inspected and approved. Connections shall be made under the supervision of the City.

### **3.08 BORES**

- A. Bore under highways maintaining minimum depths and bore lengths as shown on the Drawings. Utilize construction techniques and comply with the requirements of the regulating authority.
- B. Pipe Encasement:
  1. Excavate an area sufficient to allow the installation of the encasement. Use proper precautions to assure that the integrity of the roadway or railroad bed is not disturbed by the excavation.

### **3.09 CUTTING AND REPLACING SPECIAL SURFACES**

- A. When necessary to disturb paved, graveled, or other special surfaces, Contractor shall use care to minimize any such disturbances. Care shall be used in making the backfill to eliminate future settlement and the surface shall be restored using the same type of original surface materials.
- B. Asphalt and Concrete Pavement Surfaces: Edges of pavement shall be cut full depth along straight and true lines along each side of the trench using approved tools and equipment ahead of the trenching operation. All pavement materials shall be removed from the area prior to beginning

the trenching work. Subgrade and base material shall match existing on both sides of the trench and all patches shall be made as approved by the Engineer.

Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas.

- C. Gravel Surfaces: Gravel shall be replaced after trenching and backfilling. After the backfill has been placed so that no further appreciable settlement will occur, gravel over the trench shall be replaced to the same compacted thickness as the original surfacing. During construction, the gravel of the remainder of the street not occupied by the trench may be covered with soil from the excavated material. After completion of the backfill, such soil shall be removed, in so far as possible, and additional gravel shall be placed on the street until the surface is as weather resistant and traffic resistant as the original surfacing.
- D. Seeded Areas: After heavy construction work is complete and equipment has been removed, clean all areas disturbed by the Contractor's Work.
  - 1. Clean all debris and grade to finish grade allowing for ample drainage away from all structures and to drainage channels.
  - 2. Loosen soil to a minimum depth of 1 ½ inches. Apply 10-20-10 fertilizer to all soil areas at a rate of 200 pounds per acre and seed with hulled Bermuda grass seed at the rate of 20 pounds per acre.
  - 3. After seeding and fertilizing, spread straw over all areas. Straw shall be free of grass and weed seeds.
  - 4. Contractor shall be responsible for watering and maintaining all grass areas until a uniform growth of grass at least 1 ½ inches tall is developed over the entire area. Contractor shall, at his expense, regrade and reseed all areas that may become eroded during this period until the entire area has the required grass cover.
  - 5. If the Work is not ready for seeding prior to August 1 of the year, the Contractor may use rye grass in lieu of Bermuda grass. All other requirements remain unchanged.
- E. Sodded Lawn Areas: Prepare any sodded areas for proper relaying of any previously removed sod. Remove trench and backfill materials from adjacent lawn areas to permit unhindered growth of grasses and safe operation of mowing equipment. Replace sod as specified in Section 02900. Sod and adjacent lawn areas that do not reestablish at the commencement of the next growing season shall be replaced at the Contractor's expense.
- F. Sidewalks:
  - 1. When removal is necessary for pipeline installation, sidewalks shall be saw cut in a neat straight line along existing joints where possible. Finished sidewalk shall extend a minimum of nine (9) inches on either side of trench banks.
  - 2. Thickness of sidewalks shall be a minimum of 4 inches or match existing, whichever is greater. Concrete shall be placed true to grade to ensure that ponding of water will not occur.
  - 3. Place, finish, and cure concrete in accordance with Section 03305. Protect sidewalk from



damage for 7 days minimum.

4. Install 6 x 6 inch #10 welded wire mesh reinforcement.
  5. Repaired sidewalk surfaces shall be finished and tooled to match the existing walk. Install scored contraction joints at no less intervals than equal to the walk width and within 24 hours of concrete placement.
- G. Contractor shall maintain repaired areas as often as necessary to provide a smooth crossing not hazardous to traffic.
- H. Should local regulations pertaining to cutting and replacing special surfaces exist in the project area, they shall be considered to supersede this subsection. The Contractor shall comply with all such local codes or regulations.

### 3.10 TESTING

- A. Gravity Sewer Mains - Leakage Testing:
1. Inspect interior of sewer mains by lamping or other approved methods. Adjust or relay pipe which has been displaced or damaged.
  2. Repair all detected leaks.
  3. Observe sewer mains for infiltration after heavy rainfall. Infiltration shall not exceed 50 gallons per day per inch of pipe diameter per mile. Test and repair in presence of Engineer. Repair infiltration leaks.
  4. Perform low pressure air test on completed sections of gravity mains and services from manhole to manhole. Test shall be conducted with completed backfill in place. Test as required by ASTM C828-78.
    - a Plug ends of lines to withstand internal pressures.
    - b Provide two taps at one plug for connecting air equipment.
    - c Connect air pressure equipment and pressurize section to 3.5 to 4.0 psig. Adjust air supply to maintain 3.5 psig for time required for inside air temperature to stabilize. Check for leaking plugs or noticeable leaks. Repair noticeable leaks or tighten plugs and restart test.
    - d After temperature has stabilized hold pressure at 3.5 psig and shut air supply. Record time required for pressure to drop to 3.0 psig. The minimum time required for the pressure to drop shall be as follows:

| Pipe Size | Time        |
|-----------|-------------|
| 4"        | 2.5 minutes |
| 6"        | 4.0 minutes |
| 8"        | 5.0 minutes |
| 10"       | 6.5 minutes |
|           |             |

|     |             |
|-----|-------------|
| 12" | 7.5 minutes |
| 15" | 9.5 minutes |

- e If section fails to meet time requirements, determine the cause, repair, and retest the line. Repair and retest as required to meet air test requirements.
  - 5. Repair detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.
  - 6. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.
  - 7. All tests shall be conducted in the presence of the Engineer or Designated Authority.
- B. Gravity Sewer Mains - Deflection Testing:
- 1. Perform deflection (reduction in vertical inside diameter) tests between successive man-holes on PVC gravity sewer pipe a minimum of 30 days after installation and backfilling is complete.
  - 2. Perform tests utilizing a sharp edge rigid Mandrel.
  - 3. Deflection shall not exceed 5 percent.

Mandrel dimensions based on 5 percent deflection shall be as follows:

| Pipe Diameter (inches) | Mandrel O.D. (inches) |
|------------------------|-----------------------|
| 6                      | 5.70                  |
| 8                      | 7.60                  |
| 10                     | 9.50                  |
| 12                     | 11.40                 |
| 15                     | 14.25                 |

- C. Sewer Force Mains:
- 1. General: Pressure test all sewer force mains in presence of Engineer or Designated Authority. Contractor shall make arrangements for furnishing potable water or other approved source for testing. Provide all pumps, gages, fittings, and apparatus for testing. Pressure test after backfill is complete.
  - 2. Fill pipe with water while bleeding and purging air. Bleed air at high points of lines and at each service line. Pressurize lines using approved pumping system to a pressure one hundred (100) percent in excess of the normal pressure, but not less than 100 psig at high point of line. Maintain pressure for period of four hours, recording (using approved meter(s)) quantity of water required to maintain pressure. Line segments will be approved as passing

the test if no noticeable leaks are present and quantity (L) required to maintain pressure is less than indicated by the Formula as defined by AWWA C-600-77.

$$L = \frac{ND(P)^{\frac{1}{2}}}{7400}$$

Where L is allowable leakage gallons per hour.

N is number of joints in the segment being tested.

D is the nominal diameter of the pipe in inches.

P is the average test pressure in pounds per square inch gage.

3. Repair all detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.
4. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.

D. Manholes:

1. Visual Testing:

Manhole interiors shall be visually inspected for detection of leaks. All visible leaks shall be corrected.

2. Hydrostatic Testing:

When, in Engineer's opinion, the groundwater table is too low to permit visual detection of leaks, Engineer may require hydrostatic testing of manholes as follows:

- a Plug all inlets and outlets, and fill manhole with water to base of cover ring.
- b Leakage in each manhole shall not exceed 0.1 gallons per hour per foot of head above invert.
- c Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into walls.
- d Repair manholes that do not meet leakage test.

3. Vacuum Testing:

All newly constructed manholes, whether precast or poured in place, shall pass a vacuum test prior to acceptance. A vacuum of 10 inches Hg shall be placed on the manhole. The measured time for a vacuum loss of one (1) inch Hg shall not be less than 60 seconds.

E. Test Records:

1. Records shall be made of each piping system component tested. Records shall include:
  - a Date of test.
  - b Description and identification of piping tested.
  - c Test fluid.
  - d Test pressure.
  - e Remarks, including such items as:
    - (1) Leaks - type and location.
    - (2) Repairs made on leaks.
  - f Certification by Contractor and written approval by Engineer.

**3.11 CLEAN-UP**

- A. Clean construction area of all debris, refuse, excess material, etc. Dispose of off-site.
- B. Clean interior of manholes and sewer mains of all dirt and other materials.

**END OF SECTION**

**SECTION 33 41 00  
STORM DRAINAGE SYSTEM**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. Extent of storm drainage system work is indicated on drawings and by requirements of this section. This section includes the following work:
  - 1. Culverts
- B. Related sections:
  - 1. Section 00 30 10 – Geotechnical Investigation
  - 2. Section 02 20 00 – Site Preparation
  - 3. Section 31 22 00 – Grading
  - 4. Section 31 2316 – Excavation
  - 5. Section 31 23 23 – Fill and Backfill
  - 6. Section 31 23 17 – Trenching for Site Utilities

**1.02 QUALITY ASSURANCE**

- A. Code and Standards: Comply with applicable requirements of standards including the following:
  - 1. American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
    - a AASHTO M252 - Standard Specification for Polyethylene Corrugated Drainage Pipe.
    - b AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12-inch to 24-inch diameter.
  - 2. American Society for Testing and Materials (ASTM), 1961 Race Street, Philadelphia, Pennsylvania 19103.
    - a ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
    - b ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
    - c ASTM C412 - Specification for Concrete Drain Tile.
    - d ASTM C443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
    - e ASTM C444 - Specification for Preformed Concrete Pipe.
    - f ASTM C478 - Specification for Precast Reinforced and Nonreinforced Masonry.
    - g ASTM D1248 - Specification for Polyethylene Plastics Modeling and Extrusion Materials.
    - h ASTM D2321 - Recommended Practice for Underground Installation of Flexible

Thermoplastic Sewer Pipe.

- i ASTM D2412 - Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
  - j ASTM F405 - Standard Specification for Corrugated Polyethylene Pipe and Fittings.
  - k ASTM F667 - Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
3. Arkansas Highway and Transportation Department (AHTD)
- a Standard Specifications for Highway Construction (latest edition).

### **1.03 SUBMITTALS**

- A. Submit the following product data for Engineer's approval prior to ordering materials:
- 1. Pipe and fittings.
  - 2. Flared end sections.

## **PART 2 – PRODUCTS**

### **2.01 PIPE AND PIPE FITTINGS**

- A. General: Provide piping materials and factory fabricated fittings and accessories of sizes and types indicated on drawings or required. Pipe and fittings shall be free of foreign inclusions and visible defects.
- B. Corrugated Polyethylene Pipe:
- 1. Provide pipe and fittings manufactured of polyethylene compounds which meet or exceed the requirements of Type II, Category 4 or 5, Grade P33 or P34, Class C per ASTM D1248. Clean reworked material may be used.
  - 2. Minimum parallel plate pipe stiffness values at 5 per cent deflection (per ASTM D2412) shall be as follows:
    - a 12-inch: 45 psi.
    - b 15-inch: 42 psi.
    - c 18-inch: 40 psi
    - d 24-inch: 34 psi.
    - e 30-inch: 28 psi.
    - f 36-inch: 22 psi.
  - 3. Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.

- 4. Fittings:
  - a Provide molded or fabricated fittings manufactured by pipe supplier. Fittings produced by manufacturer other than pipe supplier shall not be allowed.
  - b Provide split couplings.
    - (1) Corrugated to match pipe corrugations.
    - (2) Engage a minimum of 6 corrugations for 12-inch through 24-inch diameter and 4 corrugations for 30-inch and 36-inch diameter pipe.
  - c Gaskets: Neoprene, where required by Engineer or shown on the Drawings.
  - d Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.
- C. Reinforced Concrete Pipe:
  - 1. Meet requirements of AHTD Section 606.
  - 2. Class III or as shown on the Drawings.
  - 3. Joints shall conform to ASTM C443.
- D. Cast-in-place Concrete:
  - 1. Conform to Section 03305 herein.
  - 2. Design mix to attain 4,000 psi compressive strength at 28 days.

### **PART 3 – EXECUTION**

#### **3.01 TRENCHING**

- A. Excavate trenches accurately to grade and alignment shown on Drawings or as established in the field by Engineer. Provide ample space for storm drain construction. Trench widths as shown on Drawings.
- B. When excavation is carried below that required, fill space with concrete, pipe bedding, or approved compacted select material.
- C. Trenching and bedding shall meet requirements of AHTD Sections 606 and 607.
- D. Where soft, mucky, or otherwise unsuitable material is encountered, excavation shall continue until firm material is reached. The over-excavation shall be filled to grade with pipe bedding or approved compacted select material.

#### **3.02 INSTALLATION OF PIPE AND CULVERTS**

- A. Lay sections on properly compacted granular bedding to lines and grades as shown on Drawings.
- B. Backfill with approved imported granular materials as shown on the Drawings.
- C. Install joint band couplers in accordance with pipe manufacturer's recommendations and AASHTO guidelines. Use Ram Neck gasket material in end corrugation of each pipe end.
- D. Install reinforcing end collar where pipe terminates without protective end treatment such as

headwall, inlet box, or grouted rip rap.

- E. Pipes (storm, sanitary, water) that cross each other with less than 1 foot clearance must have a concrete encased intersection.
- F. Cut pipe ends squarely and clean without rough edges so as not to affect jointing at couplings, structures, and points of termination.

### **3.03 PIPE BEDDING AND BACKFILL**

- A. Install pipe bedding material as shown on the Drawings and in layers not exceeding 4 inches maximum thickness. Thoroughly place bedding material around pipe haunches, shovel slicing as necessary to eliminate all voids.
- B. When flexible drainage pipe is used, the following special requirements apply:
  - 1. Provide minimum 12 inches cover where located under traffic areas.
  - 2. Bedding shall be equal to AHTD Class 7 or Class 8 granular material.
  - 3. Bedding shall be a minimum of 4 inches below bottom of pipe, including bell ends, and shall extend a minimum of 12 inches above the top of pipe.
- C. Backfill remainder of trench above bedding material using approved backfill material and compacted to a minimum of 95 percent of Standard Proctor density.
- D. Backfill for all drainage pipe under paved surfaces with granular material as shown on the Drawings.
- E. Backfill in non-traffic areas for reinforced concrete pipe shall be made from suitable excavated materials.
- F. Backfill and restore trenches as soon as possible after pipe is laid. Unnecessary delays in backfilling, grading, cleaning and restoring disturbed surfaces constitutes cause for stopping work until trenches are restored.

### **3.04 CLEAN-UP**

- A. Clean construction area of all debris, refuse, excess material, etc. Dispose of off-site.
- B. Clean interior of structures of all dirt and other materials.

**END OF SECTION**