# SECTION 22 0001

# GENERAL PLUMBING REQUIREMENTS

## PART 1 GENERAL

### 1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner training, etc., including all incidental and related items, necessary to complete installation and successfully test and start up and operate the Plumbing systems indicated on the drawings, AND as described in each Section of Division 220000 Specifications.

B. All drawings and General Provisions of the Contract, including the General Conditions, Supplementary General Conditions, and Division 1 specification sections, apply to work of all Division 22 sections. The items in this section are not intended to supersede, but are supplementary to, the requirements set forth in other Divisions of the specifications.

C. The Contractor, and his Subcontractors and Suppliers, shall include in his bid all materials, labor, and equipment involved, in accordance with all local customs, codes, rules, regulations; and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

D. The CONTRACTOR shall be responsible for the complete and satisfactory accomplishment of all Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation, and demonstrate that all electrical systems will operate satisfactorily under normal operating conditions.

### 1.02 DRAWINGS

A. The drawings are diagrammatic and show the general location and arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit. The Contractor shall provide/install all plumbing systems, and associated equipment, complete and include all necessary offsets, fittings, and other components required due to interferences, space constraints, code requirements, etc. as required to provide a complete/functional system.

B. The general plumbing requirements are intended to augment the drawings and specifications. Should conflicts occur between the drawings and the specifications, the strictest provision shall govern. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the ARCHITECT and/or ENGINEER for resolution.

C. The CONTRACTOR shall examine the drawings of all other trades in order to verify the conditions governing the work on the job site. Arrange work accordingly, providing all piping, fittings, traps, valves and accessories as may be required to meet such conditions.

D. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the ARCHITECT and/or ENGINEER.

E. The architectural and structural drawings take precedence in all matters pertaining to the building structure, plumbing drawings in all matters pertaining to plumbing trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the ARCHITECT and/or ENGINEER for resolution.

### 1.03 COORDINATION OF WORK

A. The CONTRACTOR and his Subcontractors shall be responsible for all tasks applicable to their work in accordance with the Specifications, Drawings, and code requirements, and shall be

responsible for coordinating locations and arrangements of their work to give best results with all other relevant trades.

1. Coordinate his work to obtain symmetry in ceiling layouts, lights, diffusers, etc. are coordinated and are installed per the Architectural reflected ceiling plan.
2. Coordinate all wall, roof, floor penetrations, equipment pads, etc. with architectural and structural trades.
3. Refer to architectural floor plans for exact locations/heights of fixtures (standard and barrier free), sinks, toilets, lavatories, water coolers, etc. Coordinate with architectural plans for details on casework, furniture, etc.
4. Verify requirements of all equipment with shop drawing submittals prior to installation - notify Architect/Engineer of any conflicts between shop drawings and plans.
5. Coordinate locations of plumbing items that require access (i.e. isolation valves, balance valves, etc.) with reflected ceiling plan. Items located above hard non-accessible ceilings shall be provided with access doors as required.
6. Do not route/locate below grade piping below, or with 45 degrees of the bottom corner of, foundation walls/footings. Coordinate with structural trades prior to installing piping.
7. Verify clearance requirements of all electrical and mechanical equipment/systems prior to the installation of any new work. Plumbing equipment, piping, systems, etc. shall not interfere with electrical equipment spaces. Electrical conduit and equipment clearances shall not interfere with mechanical equipment spaces.

**1.04 INSPECTION OF SITE AND PROJECT DOCUMENTATION**

A. The CONTRACTOR shall visit the site and examine/verify the conditions under which the work must be conducted before submitting proposal. The CONTRACTOR shall examine the drawings and specifications of all other trades including Mechanical, Architectural, Structural and Electrical.

B. The submitting of a proposal implies that the CONTRACTOR has visited the site, examined all contract documents, and understands the conditions under which the work must be conducted.

C. The CONTRACTOR shall notify the ARCHITECT and/or ENGINEER, prior to submitting his bid via Request For Information (RFI), of any potential problems that he has identified during his inspection of the site or from the review of plans/specifications. RFIs must be submitted at least 5 working days prior to bid opening.

**1.05 GENERAL SUPPORT REQUIREMENTS**

A. Provide all necessary angle/brackets, hangers, or supplementary supporting steel as required for adequate support for all piping, ductwork, and equipment. Secure approval from Architect and/or Structural Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure, or cutting/coring thru structural systems

B. Where piping or equipment is supported or suspended from concrete construction, provide approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

C. Install plumbing and mechanical piping systems with adequate anchors, guides, expansion loops, etc. as required to provide for piping expansion/contraction.

**1.06 GUARANTEE**

A. CONTRACTOR shall guarantee that all labor, materials, and equipment are free from defects and agrees to replace or repair any part of this installation which becomes defective within a period of one year from the date of substantial completion following final acceptance. Acceptance date of substantial completion shall be as determined by the ARCHITECT and/or

ENGINEER.

B. The CONTRACTOR shall file with the OWNER any and all guarantees from the equipment manufacturers including the operating conditions and performance capacities they are based on.

**1.07 CODES, PERMITS AND FEES**

A. Refer to Division 1, General Conditions and Supplementary Conditions.

B. Unless otherwise indicated, all required permits, plan reviews, licenses, inspections, approvals and fees for mechanical work shall be secured and paid for by the CONTRACTOR.

C. All work shall be executed in accordance with the latest enforceable rules and regulations set forth in local and state codes.

1. Mechanical and Plumbing systems shall be installed per current jurisdictional codes (Michigan Mechanical Code, Michigan Plumbing Code, International Fuel Gas Code, etc.), current NFPA codes (NFPA 101, NPFA 90, etc.), and applicable sections of the Michigan Building Code.

D. In the event that the plans and specifications conflict with any rules, regulations, or codes applying, said rules, regulations and codes shall govern.

E. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

**1.08 UTILITIES**

A. The CONTRACTOR shall be responsible for coordinating, obtaining service, and advising the ENGINEER, and approval agencies (i.e. health dept.) for the on-site domestic water, and sanitary sewer systems.

B. In the event that the plans and specifications conflict with any agency rules, regulations, or codes applying, said rules, regulations and codes shall govern.

**1.09 SUBSTITUTION ITEMS REQUIRING PRIOR APPROVAL**

A. All items that the CONTRACTOR proposes to use in the work that are not specifically named in the contract documents must be submitted for review. Such items must be submitted to the ARCHITECT and/or ENGINEER for approval a minimum of ten (10) days prior to bid opening. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

**1.10 MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment of product provided shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Substitution Items Requiring Prior Approval specified in this Section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original bid.

C. All package unit skid mounted equipment that are factory assembled shall meet, in detail, the products named and specified within each section of the detailed mechanical and electrical specifications.

**1.11 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

A. Provide compete maintenance and operating instructional manuals covering all plumbing equipment as specified herein, Division 1 requirements, and individual equipment specification sections.

B. The O&M data shall be bound in a suitable number of 3" or 4", 3-ring, hard cover binders. Permanently imprinted on the cover shall be the words, "Manufacturer's Operation and Maintenance Data", project title, location of project, and the date. A table of contents shall be provided in the front of each binder.

C. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Each piece of equipment in the O&M manual shall be identified as identified on the project drawings (i.e. Domestic Water Heater DWH-1, etc.).

D. Internally subdivide the binder contents with permanent page dividers, organized by major equipment/systems (i.e. Plumbing Equipment, Plumbing Fixtures, Plumbing Specialties, etc.)

E. Contents: Each volume of O&M manual shall have three parts:

1. Part 1: A directory listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: O&M data, arranged and subdivided by major equipment/systems. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers:

   a. List of equipment.

   b. Copies of Shop drawings and product data, approved by Architect/Engineer.

   c. Installation and operational procedures.

   d. Routine maintenance procedures.

   e. Trouble shooting procedures.

   f. Complete parts lists by nomenclature, manufacturer's part number and use.

   g. Recommended spare parts lists.

   h. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

   i. Complete wiring and schematic diagrams.

   j. Elevations and/or sections cut through all of the major equipment and sub-assemblies.

3. Part 3: Project documents and certificates, including the following:

   a. Warranty Certificates.

   b. Copies of approved construction permits.

F. Maintenance and Operating manuals shall be provided to the ARCHITECT and/or ENGINEER for review when construction is 75% complete.

G. A minimum of two (2) copies of all approved Operation and Maintenance literature shall be furnished to the OWNER within 10 days after final inspection. O&M manuals must be completed prior to start of OWNER training as the manuals shall be used as the basis of the training.

### 1.12 SHOP DRAWINGS/SUBMITTALS

A. Refer to General Conditions and Supplementary General Conditions.

B. All shop drawings shall be submitted in groupings of similar and/or related items. Incomplete submittal groupings will be returned unchecked.

C. Submit fire protection system shop drawings, product data and hydraulic calculations to local authorities having jurisdiction, the OWNER'S insuring agency, and the ARCHITECT and/or ENGINEER for approval prior to fabrication or installation. Submit proof of approval to ARCHITECT and/or ENGINEER.

D. Unless noted otherwise, submit digital (.pdf format) copies of complete manufacturer's shop drawings for all plumbing equipment, valves, specialties, wiring diagrams and control diagrams including, but not limited to the items listed below. Where items are referred to by symbolic designation on the drawings and specifications, all submittals shall bear the same designation. Refer to other Sections of the plumbing specifications for additional requirements.

1. Expansion Tanks
2. Plumbing Specialties
3. Plumbing Equipment
4. Plumbing Fixtures
5. Water Heaters

### 1.13 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection the CONTRACTOR shall instruct OWNER's designated personnel in operation, adjustment and maintenance of plumbing equipment and systems at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use Operation and Maintenance Manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

### 1.14 RECORD DRAWINGS

A. The CONTRACTOR shall keep accurate notes of all deviations from the construction documents and discrepancies of construction on field drawings as they occur. The marked up field documents shall be available for review by the ARCHITECT and/or ENGINEER, and OWNER at their request.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 INSTALLATION OF EQUIPMENT

A. Install equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the ARCHITECT and/or ENGINEER for resolution.

### 3.02 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Plumbing Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor

and shall include the full cost for same in his bid.

**3.03 COORDINATION**

A. Install work to avoid interference with work of other trades including, but not limited to, architectural and electrical trades. Remove and relocate any work that causes an interference at CONTRACTOR's expense. Disputes regarding the cause of an interference shall be resolved by the ARCHITECT and/or ENGINEER.

**3.04 SLEEVES**

A. Provide and install Schedule 40 black steel pipe sleeves, cut to length, wherever pipes pass through above grade walls and floors. Provide and install galvanized steel pipe sleeves, cut to length, wherever pipes pass through below grade foundation walls and slab on grade floors. Sleeves shall terminate flush with walls in finished areas. All sleeves through the floor are to extend two (2) inches above finish floor.

B. Provide escutcheons at each penetration through walls, floors, and ceilings in exposed areas.

C. Patch sleeves to match building material.

**3.05 SEALING OF PLUMBING OPENINGS**

A. Seal the space around pipes and sleeves through walls, floors and ceilings.

B. Provide adequate clearance to allow for proper pipe movement and sealing.

C. Provide/install fireproof wall and floor sleeves as required by applicable building codes at all applicable wall, ceiling, and floor penetrations. Refer to Architectural plans for wall assembly ratings.

D. Sleeves placed in floors shall be flush with the underside of the floor construction and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise noted or detailed.

E. Where sleeves pass through reinforced concrete floors, they shall be properly set in position prior to concrete pouring in such a way that they will be maintained in position until the concrete is set.

F. Pipes passing through below grade perimeter walls or slabs on grade shall have the space between the pipe and sleeve sealed watertight with a mechanically expandable elastomer seal device.

**3.09 CUTTING, CORING AND PATCHING**

A. Refer to General Conditions

B. The CONTRACTOR shall perform all cutting, coring, and patching that may be necessary for the installation of their Work. All cutting, coring, patching and repair work shall be performed by the CONTRACTOR through qualified Subcontractors. CONTRACTOR shall include full cost of same in his bid.

C. Secure approval form Architect and/or Structural Engineer, in writing, before cutting, welding/bolting to, or anchoring from any structural building components (i.e. structural steel, load bearing walls, footings/foundations, concrete floors/ceilings, etc.).

**3.10 EXCAVATION AND BACKFILLING**

A. Provide all excavation, trenching, tunneling and backfilling required for the plumbing work.

B. Provide all pumping and/or well pointing required for the plumbing work.

C. Provide foundations if required to support underground piping.

D. Refer to Architectural/Structural specification sections for excavation and backfilling details.

### 3.11 EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Shall be as required or as shown on plans or specified.

B. Provide concrete housekeeping pads for all floor mounted plumbing equipment (i.e. hydromatic tanks). Concrete housekeeping pads shall be installed by qualified concrete trade subcontractors. Concrete housekeeping pads shall be poured before equipment is installed, minimum 4" tall, with anchor bolts and sleeves to fit machine base. Contractor shall include full cost of concrete housekeeping pads in his bid.

C. For equipment suspended form ceiling or walls, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of ARCHITECT and/or ENGINEER for same including loads, locations, and methods of attachment.

### 3.12 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures and other items included in the work in accordance with the approved shop drawings and rough-in measurements furnished by the manufactures of the particular equipment furnished.

B. All piping connections to equipment shall be flanged or shall be made with unions to facilitate equipment removal.

C. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment.

D. Brass unions for connections of 2 inch and less and flanged union with dielectric gasket and bolt sleeves for 2-1/2 inch and greater shall be used for equipment connections of dissimilar metals.

### 3.13 ACCESSIBILITY

A. All equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, as required by the equipment manufacturer and as subject to the approval of the ENGINEER.

### 3.14 CLEANING

A. Each trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment and systems have been completed and tested, each entire system shall be cleaned and flushed.

C. Prior to connection of new piping to existing piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

### 3.15 PAINTING

A. All plumbing systems, equipment, piping, etc. exposed in finished areas shall be painted to match the surrounding finishes. Refer to specification section 09900 - Coordinate color with Architect.

### 3.16 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Electrical equipment furnished by Plumbing Trades and installed by Electrical Trades shall be turned over to Electrical Trades in good condition.

B. Equipment and materials shall be protected from theft, injury or damage.

C. Materials with enamel or glaze surface, shall be protected from damage by covering and/or coating as recommended in bulletin, "Handling and Care of Enameled Cast Iron Plumbing Fixtures," issued by the Plumbing Fixtures Manufacturers Association, and as approved.

D. Coat polished or plated metal parts with white petroleum jelly immediately after installation.

E. Protect equipment outlets, pipe openings with temporary plugs or caps.

F. Provide adequate storage for all equipment and materials delivered to the job site. Equipment set in place in unprotected areas must be provided with temporary protection.

**3.17 GENERAL SUPPORT REQUIREMENTS**

A. Each trade shall provide all required supporting components to properly support their work. Supporting components/systems shall be in accordance with Code and as specified.

B. Provide all necessary angle/brackets or supplementary steel as required for adequate support for all piping, ductwork, specialties, and equipment. Secure approval form ARCHITECT and/or Structural ENGINEER, in writing, before welding or bolting to steel framing or anchoring to concrete structure.

C. Where piping, specialties, or equipment is supported or suspended from concrete construction, provide approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

**3.18 DRAWINGS AND MEASUREMENTS**

A. These specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either the drawings or specifications shall be as binding as if call for by both. The work herein described shall be complete in every detail.

B. The Drawings are not intended to be scaled for rough-in measurements, nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement shall be taken by the Contractor. The Contractor shall check latest architectural drawings to locate equipment/fixtures/etc., check latest structural drawings for interferences, etc.

**3.19 PIPING SYSTEMS TESTING**

A. Test drainage piping systems in accordance with their respective and applicable governing codes. Test drainage and waste piping hydraulically by filling the system to its highest point or at a static head of 10 feet, whichever is higher.

B. Pressure test plumbing piping (domestic cold water, domestic hot water, etc.) in accordance with governing and applicable codes. At minimum, test with water at 225 PSIG - permissible pressure drop shall be 0 PSIG over 2 hour period.

**3.20 EXTRA WORK**

A. For any extra work which may be proposed, the Contractor shall furnish to the General Contractor/Construction Manager, an itemized breakdown of the estimated cost of all materials and labor required to complete this work. The estimate cost breakdown shall include unit prices (same prices for increase/decrease of work) for all materials (i.e. duct, piping, valves, equipment, equipment rental, etc.) and all labor (i.e. manhours, overtime, etc.) which may be required for any proposed extra work. The Contractor shall not proceed until receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

# END OF SECTION

# SECTION 22 0719

# PLUMBING PIPING INSULATION

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

### 1.02 REFERENCE STANDARDS

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].

C. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

D. ASTM C 195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

E. ASTM C 449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

F. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

G. ASTM C 533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

H. ASTM C 534/C 534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

I. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation.

J. ASTM C 795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

K. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

L. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials.

M. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

### 1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than 10 years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 10 years of experience.

C. Where insulation and covering is specified or required to include a vapor barrier, it is critical that the integrity of the vapor barrier is maintained. Do not use fasteners that may unintentionally penetrate the vapor barrier. Where fasteners must penetrate the vapor barrier, the vapor barrier shall be repaired with a patch or tape of the same material.

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

B. Store insulation in original wrapping and protect from weather, dirt, chemicals, and damage.

### 1.06 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.

### 1.07 INSULATION OF EXISTING SYSTEMS

A. On renovation/addition projects where existing piping systems are being modified the existing piping systems shall be reinsulated as required to maintain sealed insulation/vapor barrier.

B. After completion of any required asbestos abatement, reinsulate all existing systems.

## PART 2 PRODUCTS

### 2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

B. Where insulation and covering is specified or required to include a vapor barrier, it is critical that the integrity of the vapor barrier is continuously maintained. Fasteners or other securing devices that may unintentionally penetrate, or damage, the vapor barrier are prohibited. Where fasteners must penetrate the vapor barrier, the vapor barrier shall be repaired.

### 2.02 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation: www.knaufusa.com.
2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C 547 and ASTM C 795; rigid molded, noncombustible.

1. 'K' value: ASTM C 177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.
4. Density: 3.5 lb./cu. ft.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E 96 of 0.02 perm-inches. Secure with self-sealing longitudinal laps and butt strips.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive:

1. Compatible with insulation as recommended by insulation manufacturer.

F. Insulating Cement/Mastic:

1. ASTM C 195; 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.

H. Indoor Vapor Barrier Finish:

1. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Outdoor Breather Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Insulating Cement:

1. ASTM C 449/C 449M.

**2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION (CELLULAR FOAM)**

A. Manufacturer:

1. Armacell International: www.armacell.com.
2. Armstrong "AP Armaflex".
3. Rubatex Corp.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3; use molded tubular material wherever possible. Insulation shall not be used on stainless steel.

1. K Value: ASTM C177 or C518; 0.27 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Maximum Service Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
5. Maximum Vapor Transmission: ASTM E96; 0.20 perm inches.
6. Maximum Flame Spread: ASTM E84; 25.
7. Maximum Smoke Developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

**2.04 JACKETS**

A. PVC Plastic.

1. Manufacturers:
   a. Johns Manville Corporation: www.jm.com.
   b. Knauf.
   c. Ceel-Co.

d. Certain Teed.

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 E 96/E 96M.

d. Maximum Flame Spread: ASTM E84; 25.

e. Maximum Smoke Developed: ASTM E84; 50.

f. Thickness: 15 mil.

g. Connections: Pressure sensitive color matching vinyl tape.

h. Jacket shall be ultraviolet-resistant.

i. Jackets shall meet USDA and FDA requirements where applicable.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

# 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.

C. Equipment nameplates, identification tags, etc. shall not be covered by insulation.

## 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. 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. Vapor barrier shall be continuous.

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.

3. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints. Bevel and seal ends of insulation. Provide removable insulation access sections to permit access and removal of unions, flanges, and strainer baskets. Access sections shall be capable of removal and replacement with no damage to adjacent insulation.

C. Insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with 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.

3. Finish with tape and white paintable vapor barrier jacket.

4. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible

connections, pump bodies, and expansion joints. Bevel and seal ends of insulation.

D. Provide removable insulation covers for providing access/removal of unions, flanges, strainer baskets, etc. Access sections shall be capable of removal and replacement with no damage to adjacent insulation.

E. Shields:

1. Application: Piping 1 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts. All piping, all sizes, shall have shields installed between the pipe hangers and insulation or inserts.

F. Continue insulation through walls, sleeves, pipe hangers/rollers, and other pipe penetrations. Install steel sleeves at all wall and floor penetrations. Finish at supports, protrusions, and interruptions. At fire separations, fire caulk per building code requirements.

G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

H. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

I. Ends of insulation shall be sealed off. Spray paint is not acceptable. There shall be no exposed ends.

J. Insulation not properly installed shall be removed and replaced or repaired as necessary.

K. Insulation on hot surfaces shall be applied while the surfaces are hot to avoid breaking of insulation during expansion of piping.

**3.03 SCHEDULES**

A. Plumbing Systems:

1. Domestic Hot Water Supply:

a. Glass Fiber Insulation:

1) Pipe Size Range: 2 inch and smaller.

a) Thickness: 1.0 inch.

b. Cellular Foam Insulation:

1) Pipe Size Range: 2 inch and smaller.

a) Thickness: 1.0 inch.

2. Domestic Cold Water:

a. Glass Fiber Insulation:

1) Pipe Size Range: All Sizes.

a) Thickness: 1.0 inch.

b. Cellular Foam Insulation:

1) Pipe Size Range: All sizes.

a) Thickness: 1.0 inch.

## END OF SECTION

# SECTION 22 0721

# PIPING SAFETY COVERS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Lavatory Piping Enclosure.

### 1.02 REFERENCES

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council.

B. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

D. ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness.

### 1.03 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for products specified in this section.

B. Shop Drawings: Indicate locations and configurations of piping insulation for indicated plumbing configurations.

### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products of this section in manufacturer's unopened packaging until installation; maintain storage conditions for products in accordance with manufacturer's recommendations.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Acceptable Manufacturer: Truebro, Inc.; 7 Main Street, P.O. Box 440, Ellington, CT 06029. ASD. Tel: (800) 340-5969 (outside CT), (860) 875-2868 (inside CT). Fax: (860) 872-0300. Email: info@truebro.com. www.truebro.com.

B. McGuire Manufacturing.

### 2.02 PIPING INSULATION ACCESSORIES

A. Provide products that comply with the following:

1. Americans With Disabilities Act (ADA), Article 4.19.4.
2. ANSI/ICC A117.1, American National Standard for Accessible Buildings and Facilities.
3. BOCA Basic Building Code.
4. Requirements of applicable building code.

B. Lavatory Piping Enclosure: Truebro Lav-Shield.

1. Characteristics: One-piece rigid molded vinyl enclosure, minimum 1/8 inch wall thickness, factory-punched for manufacturer's wall fasteners.
2. Vinyl Material: Impact-resistant and stain-resistant molded closed-cell vinyl, having the following performance characteristics:

a. Burning Characteristics: 0 seconds Average Time of Burning (ATB), 0 mm Area of

Burning (AEB), when tested in accordance with ASTM D 635.

b. Indentation Hardness: 69, minimum, when tested in accordance with ASTM D 2240, using Type A durometer.

3. Vinyl Color: China White, fine-textured finish; paintable.

4. Fasteners: Manufacturer's standard stainless steel wall fasteners with tamper-resistant heads.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that piping configurations are correct type for piping cover component configurations specified.

### 3.02 INSTALLATION

A. Install products of this section in accordance with manufacturer's printed installation instructions.

B. Install "Lav-Shields" below wall mounted lavatories/sinks to completely conceal exposed piping/traps/mixing valves/etc.

### 3.03 PROTECTION OF INSTALLED PRODUCTS

A. Do not allow damage to installed products by subsequent construction activities; protect products until Substantial Completion.

## END OF SECTION

# SECTION 22 1005

# PLUMBING PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.

### 1.02 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers (ANSI B16.18).

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.

E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers.

F. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.1).

G. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).

H. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers.

I. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

J. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

K. ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

L. ASTM B 32 - Standard Specification for Solder Metal.

M. ASTM B 88 - Standard Specification for Seamless Copper Water Tube.

N. ASTM B 88M - Standard Specification for Seamless Copper Water Tube (Metric).

O. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

P. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

Q. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

R. ASTM D 2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

S. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

T. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

U. ASTM F 679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

V. AWS D10.9 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.

W. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).

X. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).

Y. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association (ANSI/AWWA C151/A21.51).

Z. AWWA C651 - Disinfecting Water Mains; American Water Works Association (ANSI/AWWA C651).

AA. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute.

BB. 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; Cast Iron Soil Pipe Institute.

CC. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

DD. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.

EE. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

FF. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

GG. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

HH. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

II. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

JJ. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

KK. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

LL. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

MM. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

NN. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

OO. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

**1.03 QUALITY ASSURANCE**

A. Perform Work in accordance with State of Michigan, standards.

B. Valves: Bear UL and FMRC label or marking. Manufacturer's name and pressure rating marked on valve body.

C. Solder containing lead may not be used for any systems.

D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Test drainage piping systems in accordance with their respective and applicable governing codes. Test drainage and waste piping hydraulically by filling the system to its highest point or at a static head of 10 feet, whichever is higher.

F. Pressure test plumbing piping (domestic cold water, domestic hot water, hot water recirculation, etc.) and hydronic piping (i.e. heating water, chilled water, heat pump water, condenser water, etc.) in accordance with governing and applicable codes. At minimum, test with water at 225 PSIG - permissible pressure drop shall be 0 PSIG over 2 hour period.

### 1.04 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and local plumbing and mechanical codes.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

### 1.05 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.

### 1.06 FIELD CONDITIONS

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

## PART 2 PRODUCTS

### 2.01 SANITARY SEWER WASTE AND VENT PIPING (SAN, V), BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A 74 extra heavy weight.

1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C 564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. PVC Pipe: ASTM D 2665 or ASTM D 3034.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

3. Note: All pipes passing under footings, or through foundation walls, shall be cast iron (hubless, service weight piping) or sleeved through a steel pipe sleeve.

**2.02 SANITARY WASTE AND VENT PIPING (SAN, V), ABOVE GRADE**

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. PVC Pipe: ASTM D 2665.

1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D 2564 solvent cement.
3. Note: Only use PVC piping where allowed by Building Codes - do not use PVC piping in return air plenums.
4. Note: PVC piping is not approved for use where exposed to damage (i.e. surface mounted in a storage room, utility/mechanical room, occupied spaces, etc.).

**2.03 DOMESTIC COLD WATER PIPING (CW), BURIED WITHIN 5 FEET OF BUILDING**

A. Soft Copper Tubing: Type K, ASTM B88, seamless and jointless soft copper tubing may be used for sizes 3 inch and smaller. No solder joints shall be permitted on below grade copper tubing.

B. Minimum System Pressure Rating: 160 psig.

**2.04 DOMESTIC HOT WATER (HW), DOMESTIC COLD WATER (CW), ABOVE GRADE**

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B 32, solder, Grade 95TA. Solder containing lead will not be permitted.

B. Minimum System Pressure Rating: 125 psig.

C. Isolation Valves: Ball valves for sizes 2 inch and smaller, ball or butterfly valves for sizes 2-1/2 inch and larger.

D. Exposed piping for sinks, toilets, urinals, etc. shall be chrome plated. Refer to fixture specifications for details.

**2.05 FLANGES, UNIONS, AND COUPLINGS**

A. Unions for Pipe Sizes 2-1/2 inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Dielectric Connections: Union or waterway fitting with galvanized or plated steel threaded end, grooved end, copper solder end, water impervious isolation barrier. Victaulic Style 47 (or approved equal).

**2.06 PIPE HANGERS AND SUPPORTS**

A. Plumbing Piping - Drain, Waste, and Vent:

1. Conform to MSS SP-58.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Vertical Support: Steel riser clamp.
7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Plumbing Piping - Water:

1. Conform to MSS SP-58.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
5. Vertical Support: Steel riser clamp.
6. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. 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.

**2.07 BALL VALVES**

A. Manufacturers:

1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc.: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Victaulic Company: www.victaulic.com

B. Construction, 2 Inches and Smaller: 300 psi CWP, forged brass two piece body, chrome plated brass ball and stem, regular port, TFE seats and seals, blow-out proof stem, lever handle, with Vic-Press 304™ ends. Victaulic Series 589 (or approved equal).

**2.08 SWING CHECK VALVES**

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc.: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Victaulic Company (for all grooved end valves): www.victaulic.com

B. Up to 2 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

## 2.09 SPRING LOADED (SILENT) CHECK VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Nibco.
5. Victaulic Company (for all grooved end valves): www.victaulic.com

B. Valve minimum pressure rating shall match or exceed system pressure rating, iron body, bronze or stainless steel trim, stainless steel springs, aluminum-bronze disc, EPDM, Nitrile, or Buna N seals, wafer style ends in 2 inches and smaller, flanged or grooved ends in sizes greater than 2 inches.

## 2.10 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:
   a. Cla-Val Co: www.cla-val.com.
   b. Henry Technologies: www.henrytech.com.
   c. Watts Regulator Company: www.wattsregulator.com.
2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:

1. Manufacturers:
   a. Cla-Val Co: www.cla-val.com.
   b. Henry Technologies: www.henrytech.com.
   c. Watts Regulator Company: www.wattsregulator.com.
2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labeled.

## 2.11 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.: www.armstronginternational.com.
2. Green Country Filtration: greencountryfiltration.com.
3. WEAMCO: www.weamco.com.
4. Victaulic Company (for all grooved end strainers): www.victaulic.com

B. Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. Provide with integral blowdown valve and hose end fitting.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. Provide with integral blowdown valve and hose end fitting.

C. Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen. Provide with integral blowdown valve and hose end fitting.
2. 300 psi CWP, grooved ductile iron body, Y pattern with 1/16 or 1/8 inch stainless steel perforated screen. Provide with integral blowdown connection. Victaulic Series 732 (or approved equal).

### 2.12 PIPING TRANSITIONS

A. Manufacturers:

1. Can-Tex Industries Div. of Harsco Corp.; Model CT-Adapters:
2. Fernco Joint Sealer Co.; Model PVC Donut
3. Joint, Inc.; Model Caulder.

B. Provide transitions for jointing two different types of pipe materials such as cast iron, clay, steel, plastic, or copper. Fabricate transitions with bushings capable of resisting normal moisture corrosion.

## 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 grooved couplings, flanges or unions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 4' of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Install concrete thrust blocks at elbows of underground domestic water service piping.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9000.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

P. Install water piping to ASME B31.9.

Q. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.

R. Sleeve pipes passing through partitions, walls and floors.

S. Each fixture shall have isolation valves provided. All run-outs from piping mains to fixtures shall have isolation valves installed near the main take-off, whether shown on the plans or not. All isolation valves shall be located in accessible locations.

T. Minimum underground sanitary pipe size shall be 3".

U. All fixtures shall be vented in accordance with a venting method approved by the ruling Plumbing Code.

V. All plumbing vents through the roof shall be located a minimum of 24" from the edge of the parapet or edge of roof.

W. All plumbing vents through the roof shall be located a minimum of 10 feet from any building outdoor air intake (i.e. louvers, windows, etc.).

X. Do not route/locate below grade piping below, or with 45 degrees of the bottom corner of, foundation walls/footings. Coordinate with structural trades prior to installing piping.

Y. 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. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

Z. Pipe Hangers and Supports:

1. Install in accordance with MSS SP-89.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 9000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Support cast iron drainage piping at every joint.

**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 spring loaded check valves on discharge of water pumps (including well pumps).

**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, for pipes 3 inches - 6 inches in diameter. Pipes smaller than 3 inches in diameter shall drain at minimum 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

**3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. 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. Coordinate new on-site sanitary service with Site/Civil trades. 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. Coordinate new on-site water service with well contractor.

1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

**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:

1) Maximum hanger spacing: 10 ft.

2) Hanger rod diameter: 5/8 inch.

2. Plastic Piping:

a. All Sizes:

1) Maximum hanger spacing: 6 ft.

2) Hanger rod diameter: 3/8 inch.

## END OF SECTION

# SECTION 22 1006

# PLUMBING PIPING SPECIALTIES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Trap Primers.

B. Cleanouts.

C. Hydrants.

D. Water hammer arrestors.

E. Thermostatic mixing valves.

### 1.02 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.

B. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering (ANSI/ASSE 1011).

C. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering (ANSI/ASSE 1019).

D. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute.

### 1.03 SUBMITTALS

A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1. Provide pressure loss figures for backflow preventers and double check valves.

C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

D. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than 10 years documented experience.

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

### 1.06 EXTRA MATERIALS

A. Supply for OWNER's use in maintenance of project:

1. Two loose keys for outside wall hydrants.

2. Two service kits for thermostatic mixing valves.

3. Two spare trap seal primers.

## PART 2 PRODUCTS

### 2.01 DRAINS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Zurn Industries, Inc.: www.zurn.com.
3. Wade.

B. Floor Drain (FD-1):

1. ASME A112.21.1M; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, trap primer connection, and adjustable round nickel-bronze strainer.
2. Lacquered finish is standard. Use clamping collar on floors above grade. This is a standard floor drain used in toilet rooms, janitor's closets, showers, etc.
3. Zurn model # Z-415 (with type B-strainer), JR Smith model # 2005, or equal.

**2.02 TRAP PRIMERS**

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Zurn Industries, Inc.: www.zurn.com.
3. Precision Plumbing Products, Inc. (PPP Inc.).

B. For single trap primer installations:

1. Install JR smith "PRIME-ESE" P-trap trap primer on the sanitary outlet of lavatories or drinking fountains.
2. Install PPP Inc. model P1 or P2 trap primer valve on domestic cold water supply pipe (maximum 1-1/2") feeding nearby sink, lavatory, water cooler, etc.

C. For multiple trap primer installations:

1. Install PPP Inc. model P1 or P2 trap primer valve and PPP Inc. trap primer distribution unit with up to 4 outlets to up to 8 floor drains.

**2.03 CLEANOUTS**

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com.
3. Zurn Industries, Inc.: www.zurn.com.
4. Wade.

B. Cleanouts at Exterior Surfaced Areas (CO-1):

1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas (CO-2):

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas (CO-3):

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 (CO-4):

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 (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

### 2.04 HYDRANTS

A. Manufacturers:

1. Arrowhead Brass Company: www.arrowheadbrass.com.
2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
3. Zurn Industries, Inc.: www.zurn.com.
4. Wade.
5. Woodford.

B. Wall Hydrants with recessed box (WH-1):

1. ASSE 1019; freeze resistant, self-draining type with chrome plated lockable recessed box hose thread spout, lockshield and removable key, and integral vacuum breaker.
2. Product: Woodford model B65 or equal.

### 2.05 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Zurn Industries, Inc.: www.zurn.com.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 150 psi working pressure.

### 2.06 MIXING VALVES

A. Thermostatic Mixing Valves; Point of Use:

1. Manufacturers:
   a. ESBE: www.esbe.se.
   b. Leonard Valve Company: www.leonardvalve.com
   c. Lawler.
   d. Watts: Model MMV-M1.
2. Valve: Bronze body, stainless steel disc and spring, integral temperature adjustment cap with locking feature. Copper thermostat assembly. Buna-N; EPDM O'rings. Integral filter washers and check valves on hot and cold water inlets. ASSE 1070 listed.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Cleanouts:

1. Cleanouts shall be installed in accessible locations and provided in any horizontal drainage

line which changes direction more than 45 degrees, at the ends of main and branch runs, base of stacks, and at all traps

2. Cleanouts in horizontal drainage lines located inside the building shall be provided at maximum spacing of 50 feet for drains 4 inches and smaller. All horizontal drainage lines inside the building larger than 4 inches shall have cleanouts spaced at a maximum of 100 feet.
3. Provide cleanouts in any drainage line that penetrates building exterior walls. Cleanouts shall be either inside or outside of the building.
4. 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.
5. Encase exterior cleanouts in concrete flush with grade.
6. Install floor cleanouts at elevation to accommodate finished floor.
7. Provide code required clearances for all cleanouts.

C. Floor drains:

1. Coordinate installation of floor drains with the work of placing concrete to assure proper drain elevation and floor slope.
2. Cast floor drains into the concrete at the time the floors are placed and make watertight.
3. Floor drains in above ground slabs shall be flashed with separate finish with square lead sheet pans. Floor drains in slabs on grade provided with membrane or metal pan waterproofing do not require lead flashing, but shall have two additional layers of the waterproofing at the floor drains. Flashing shall not obstruct the weepholes.
4. Floor drain trap size shall match the outlet size of the drain and the size shown on the plans. Minimum floor drain outlet/piping size shall be 3".
5. Floor drain traps subject to loss by evaporation (i.e. storage rooms, mechanical rooms, bathrooms, etc.) shall have a deep seal trap consisting of at least a 4 inch seal, a trap primer connection, and be protected by a trap primer valve.
    a. Trap Primers:
        1) Trap primer shall be provided for all floor drains subject to loss of seal by evaporation (i.e. storage rooms, bathrooms, mechanical rooms, etc.).
        2) Tap off top of domestic cold water main pipe feeding nearby plumbing fixture.
        3) Trap primer valves shall be installed in concealed but accessible locations for maintenance.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, washing machine outlets, water closets, urinals, dishwashers, bathtubs/showers, and other applicable fixture locations with quick closing valves.

E. Install ASSE 1070 listed "point of use" thermostatic mixing valves at all accessible fixtures (lavatories, sinks, etc.). Provide Lav-Shields under lavatories to conceal mixing valves.

## END OF SECTION

# SECTION 22 3000

# PLUMBING EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Water Heaters.

### 1.02 REFERENCE STANDARDS

A. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc..

### 1.03 SUBMITTALS

A. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Provide electrical characteristics and connection requirements.

B. Shop Drawings:

1. Indicate heat exchanger dimensions, size of tappings, and performance data.

2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

C. Project Record Documents: Record actual locations of components.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed 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 10 years of documented experience.

B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

C. 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.

### 1.05 CERTIFICATIONS

A. Water Heaters: NSF approved.

B. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.

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

## PART 2 PRODUCTS

### 2.01 WATER HEATER MANUFACTURERS

A. A.O. Smith Water Products Co: www.hotwater.com.

B. Rheem Manufacturing Company: www.rheem.com.

C. Lochinvar.

D. Bradford White.

### 2.02 RESIDENTIAL ELECTRIC WATER HEATERS

A. Type: Automatic, electric, vertical storage.

B. Tank: Glass lined welded steel, thermally insulated with one inch thick glass fiber; encased in corrosion-resistant steel jacket; baked-on enamel finish.

C. Controls: Automatic water thermostat with externally adjustable temperature range from 120 to 170 degrees F, flanged or screw-in chrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.

D. Accessories: Provide:

1. Water Connections: Brass.
2. Dip tube: Brass.
3. Drain Valve.
4. Anode: Magnesium
5. Temperature and Pressure Relief Valve: ASME labeled.

### 2.03 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:

1. Amtrol Inc.: www.amtrol.com.
2. ITT Bell & Gossett: www.bellgossett.com.
3. Taco, Inc.: www.taco-hvac.com.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV 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 gage and air-charging fitting, tank drain; precharge to 12 psig.

## 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.

## END OF SECTION

# SECTION 22 4000

# PLUMBING FIXTURES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

Water closets.

Lavatories.

Service sinks.

Drinking fountains.

### 1.02 REFERENCE STANDARDS

A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment.

B. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers.

C. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers.

D. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers.

### 1.03 SUBMITTALS

A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Maintenance Data: Include installation instructions, operation, maintenance data, spare and replacement parts lists, exploded assembly views, and fixture trim exploded view.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed 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 10 years of documented experience.

### 1.05 REGULATORY REQUIREMENTS

A. 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. 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 FIELD MEASUREMENTS

A. Confirm that millwork/casework is constructed with adequate provision for the installation of countertop lavatories and sinks.

# PART 2 PRODUCTS

## 2.01 TANK TYPE WATER CLOSETS

A. Tank Type Water Closet Manufacturers:

1. American Standard Inc.: www.americanstandard.com.
2. Eljer.
3. Kohler Company: www.kohler.com.
4. Zurn.

B. Refer to plumbing fixture schedule.

C. Seat Manufacturers:

1. Bemis Manufacturing Company: www.bemismfg.com.
2. Olsonite: www.olsonite.com.
3. Centoco.

D. Seat:

1. Solid white plastic, open front, extended back, less cover, complete with self-sustaining hinge.

## 2.02 LAVATORIES

A. Lavatory Manufacturers:

1. American Standard Inc.: www.americanstandard.com.
2. Eljer.
3. Kohler Company: www.kohler.com.
4. Zurn.

B. Refer to plumbing fixture schedule.

C. Supply Faucet Manufacturers:

1. American Standard Inc.: www.americanstandard.com.
2. Kohler Company: www.kohler.com.
3. Chicago Faucet.
4. Delta.
5. Zurn.
6. Sloan.

D. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
2. Offset waste with perforated open strainer.
3. Screwdriver stops.
4. Rigid supplies.
5. Wall Mounted Lavatory Carrier:
   a. Manufacturers:

1) JOSAM Company: www.josam.com.
2) Sloan Valve Company.
3) Zurn Industries, Inc.: www.zurn.com.
4) JR Smith.

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.

### 2.03 DRINKING FOUNTAINS

A. Drinking Fountain Manufacturers:
1. Elkay Manufacturing Company: www.elkay.com.
2. Halsey Taylor: www.halseytaylor.com.
3. Haws Corporation: www.hawsco.com.

B. Refer to plumbing fixture schedule.

### 2.04 SERVICE SINKS

A. Service Sink Manufacturers:
1. Elkay Manufacturing Company: www.elkay.com.
2. Just Manufacturing Company: www.justmfg.com.
3. EL Mustee.
4. Kohler.
5. American Standard.
6. Fiat.
7. Acorn.
8. Floorstone.

B. Refer to plumbing fixture schedule.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

### 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 in accordance with manufacturer's instructions.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

G. Furnish and install all plumbing fixtures complete with all supply, soil, waste and vent piping connections; together with all fittings, supports, fastening devices, cocks, valves and appurtenances required to complete installations.

H. All faucets and exposed traps, fittings, trim, connections, etc. shall be of polished chromium plated brass unless otherwise specified.

I. Chrome plated pipe, valves and fittings shall be installed with strap wrenches and padded tools to avoid damage to chrome plated surfaces.

J. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

K. Install "Lav-Shields" below wall mounted lavatories/sinks to completely conceal exposed piping/traps/mixing valves/etc.

**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.

B. Coordinate fixture heights and installation with architectural plans, details, sections, and elevations.

**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 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. Lavatory:
    a. Standard: 31 inches to top of basin rim.
    b. Accessible: 34 inches to top of basin rim.
3. Drinking Fountain:
    a. Accessible: 36 inches to top of spout.

B. Coordinate fixture heights and installation with architectural plans, details, sections, and elevations.

C. Fixture Rough-In

1. Water Closet (Tank Type):
    a. Cold Water: 1/2 Inch.
    b. Waste: 4 Inch.
    c. Vent: 2 Inch.
2. Lavatory:
    a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 1-1/2 Inch.

d. Vent: 1-1/4 Inch.

3. Service Sink:

a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 3 Inch.

d. Vent: 1-1/2 Inch.

4. Drinking Fountain:

a. Cold Water: 1/2 Inch.

b. Waste: 1-1/4 Inch.

c. Vent: 1-1/4 Inch.

5. Hose Bibs and Wall Hydrants:

a. Cold Water: 3/4 Inch.

## END OF SECTION

# SECTION 23 0001

# GENERAL MECHANICAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner training, etc., including all incidental and related items, necessary to complete installation and successfully test and start up and operate the mechanical systems indicated on the drawings, AND as described in each Section of Division 230000 Specifications.

B. All drawings and General Provisions of the Contract, including the General Conditions, Supplementary General Conditions, and Division 1 specification sections, apply to work of all Division 230000 sections. The items in this section are not intended to supersede, but are supplementary to, the requirements set forth in other Divisions of the specifications.

C. The Contractor, and his Subcontractors and Suppliers, shall include in his bid all materials, labor, and equipment involved, in accordance with all local customs, codes, rules, regulations; and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

D. The Contractor shall be held responsible for the complete and satisfactory accomplishment of all Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation, and demonstrate that all electrical systems will operate satisfactorily under normal operating conditions.

### 1.02 DRAWINGS

A. The drawings are diagrammatic and show the general location and arrangement of equipment, piping, ductwork and related items. They shall be followed as closely as elements of the construction will permit. The Contractor shall provide/install all mechanical systems, and associated equipment, complete and include all necessary offsets, fittings, and other components required due to interferences, space constraints, code requirements, etc. as required to provide a complete/functional system.

B. The general mechanical requirements are intended to augment the drawings and specifications. Should conflicts occur between the drawings and the specifications, the strictest provision shall govern. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect and/or Engineer for resolution.

C. The Contractor shall examine the drawings of all other trades in order to verify the conditions governing the work on the job site. Arrange work accordingly, providing all ductwork, piping, fittings, traps, valves and accessories as may be required to meet such conditions.

D. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect and/or Engineer.

E. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect and/or Engineer for resolution.

### 1.03 COORDINATION OF WORK

A. The Contractor shall verify clearance requirements of all electrical and mechanical equipment/systems prior to the installation of any new work. Mechanical equipment,

ductwork, systems, etc. shall not interfere with mechanical equipment spaces or electrical clearances. The Contractor shall coordinate his work to obtain symmetry in ceiling layouts, so that lights, grills, etc. are coordinated and are installed per the Architectural reflected ceiling plan.

B. The Contractor and his Subcontractors shall be responsible for all tasks applicable to their work in accordance with the Specifications, Drawings, and code requirements, and shall be responsible for coordinating locations and arrangements of their work to give best results with all other relevant trades.

1. Coordinate all wall, roof, floor penetrations, equipment pads, equipment locations, system routings, etc. with architectural and structural trades.
2. Verify requirements of all equipment with shop drawing submittals prior to installation - notify Architect and/or Engineer of any conflicts between shop drawings and plans.
3. Coordinate locations of mechanical items that require access (i.e. damper actuators, exhaust fans,etc.) with reflected ceiling plan. Items located above hard non-accessible ceilings shall be provided with access doors as required.
4. Verify clearance requirements of all electrical and mechanical equipment/systems prior to the installation of any new work. Mechanical equipment, piping, ductwork, systems, etc. shall not interfere with electrical equipment spaces. Electrical conduit and equipment clearances shall not interfere with mechanical equipment spaces.

**1.04 INSPECTION OF SITE AND PROJECT DOCUMENTATION**

A. The Contractor shall visit the site and examine/verify the conditions under which the work must be conducted before submitting proposal. The Contractor shall examine the drawings and specifications of all other trades including Mechanical, Architectural, Structural and Electrical.

B. The submitting of a proposal implies that the Contractor has visited the site, examined all contract documents, and understands the conditions under which the work must be conducted.

C. The Contractor shall notify the Architect and/or Engineer, prior to submitting his bid via Request For Information (RFI), of any potential problems that he has identified during his inspection of the site or from the review of plans/specifications. RFIs must be submitted at least 5 working days prior to bid opening.

**1.05 GENERAL SUPPORT REQUIREMENTS**

A. Provide all necessary angle/brackets, hangers, or supplementary supporting steel as required for adequate support for all piping, ductwork, and equipment. Secure approval form Architect and/or Structural Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure, or cutting/coring thru structural systems.

B. Where piping, ductwork, or equipment is supported or suspended from concrete construction, provide approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

C. Install mechanical piping systems with adequate anchors, guides, expansion loops, etc. as required to provide for piping expansion/contraction.

**1.06 GUARANTEE**

A. Contractor shall guarantee that all labor, materials, and equipment are free from defects and agrees to replace or repair any part of this installation which becomes defective within a period of one year from the date of substantial completion following final acceptance. Acceptance date of substantial completion shall be as determined by the Architect and/or Engineer.

B. The Contractor shall file with the Owner any and all guarantees from the equipment manufacturers including the operating conditions and performance capacities they are based on.

**1.07 CODES, PERMITS AND FEES**

A. Refer to Division 1, General Conditions and Supplementary Conditions.

B. Unless otherwise indicated, all required permits, plan reviews, licenses, inspections, approvals and fees for mechanical work shall be secured and paid for by the Contractor.

C. All work shall be executed in accordance with the most current rules and regulations set forth in local and state codes.

1. Mechanical and Plumbing systems shall be installed per current jurisdictional codes (Michigan Mechanical Code, Michigan Plumbing Code, International Fuel Gas Code, Michigan Building Code, etc.), current NFPA codes (NFPA 101, NPFA 90, etc.), and applicable sections of the Michigan Building Code.

D. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. In the event that the plans and specifications conflict with any rules, regulations, or codes applying, said rules, regulations and codes shall govern.

**1.08 SUBSTITUTION ITEMS REQUIRING PRIOR APPROVAL**

A. All items that the Contractor proposed to use in the work that are not specifically named in the contract documents must be submitted for review. Such items must be submitted in duplicate to the Architect and/or Engineer for approval a minimum of ten (10) days prior to bid opening. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

**1.09 MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment of product provided shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Substitution Items Requiring Prior Approval specified in this Section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original bid.

**1.10 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

A. Provide compete maintenance and operating instructional manuals covering all mechanical equipment as specified herein, Division 1 requirements, and individual equipment specification sections.

B. The O&M data shall be bound in a suitable number of 3" or 4", 3-ring, hard cover binders. Permanently imprinted on the cover shall be the words, "Manufacturer's Operation and Maintenance Data", project title, location of project, and the date. A table of contents shall be provided in the front of each binder.

C. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Each piece of equipment in the O&M manual shall be identified as identified on the project drawings (i.e. Exhaust Fan EF-1, etc.).

D. Internally subdivide the binder contents with permanent page dividers, organized by major

equipment/systems (i.e. Fans, etc.)

E. Contents: Each volume of O&M manual shall have three parts:

1. Part 1: A directory listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: O&M data, arranged and subdivided by major equipment/systems. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers:

   a. List of equipment.

   b. Copies of Shop drawings and product data, approved by Architect/Engineer.

   c. Installation and operational procedures.

   d. Routine maintenance procedures.

   e. Trouble shooting procedures.

   f. Complete parts lists by nomenclature, manufacturer's part number and use.

   g. Recommended spare parts lists.

   h. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

   i. Complete wiring and schematic diagrams.

   j. Elevations and/or sections cut through all of the major equipment and sub-assemblies.

   k. At the end of each section, a maintenance schedule shall be provided for each piece of equipment. The schedule shall display the daily, weekly, monthly, semi-annual, and annual lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimal performance and life of the equipment. Photos or reproduction of the manufacturer's literature will not be accepted.

3. Part 3: Project documents and certificates, including the following:

   a. Warranty Certificates.

   b. Copies of approved construction permits.

F. A minimum of two (2) copies of all approved Operation and Maintenance literature shall be furnished to the Owner within 10 days after final inspection. O&M manuals must be completed prior to start of Owner training as the manuals shall be used as the basis of the training.

**1.11 SHOP DRAWINGS/SUBMITTALS**

A. Refer to General Conditions and Supplementary General Conditions.

B. All shop drawings shall be submitted in groupings of similar and/or related items. Incomplete submittal groupings will be returned unchecked.

C. Unless noted otherwise, submit digital (.pdf format) copies of complete manufacturer's shop drawings for all equipment, valves, plumbing and heating specialties, refrigeration specialties, pipe hangers, wiring diagrams and control diagrams including, but not limited to the items listed below. Where items are referred to by symbolic designation on the drawings and specifications, all submittals shall bear the same designation. Refer to other Sections of the mechanical specifications for additional requirements.

1. Fans

### 1.12 RECORD DRAWINGS

A. Contractor shall submit to the Architect and/or Engineer, record drawings which have been neatly marked to represent as-built conditions for all new mechanical work.

B. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect and/or Engineer, and Owner at their request.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 INSTALLATION OF EQUIPMENT

A. Install equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the Architect and/or Engineer for resolution.

### 3.02 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in his bid.

### 3.03 COORDINATION

A. Install work to avoid interference with work of other trades including, but not limited to, architectural and electrical trades. Remove and relocate any work that causes an interference at Contractor's expense. Disputes regarding the cause of an interference shall be resolved by the Architect and/or Engineer.

### 3.04 SEALING OF MECHANICAL OPENINGS

A. Seal the space around pipes in sleeves and around duct openings through walls, floors and ceilings.

B. Provide adequate clearance to allow for proper duct/pipe movement and sealing.

C. Provide/install fireproof wall and floor sleeves as required by applicable building codes at all applicable wall, ceiling, and floor penetrations. Refer to Architectural plans for wall assembly ratings.

### 3.05 CUTTING, CORING AND PATCHING

A. Refer to General Conditions.

B. Unless specifically noted otherwise, the Contractor shall perform all cutting, coring, and patching that may be necessary for the installation of their Work. All cutting, coring, patching and repair work shall be performed by the Contractor through qualified Subcontractors. Contractor shall include full cost of same in his bid.

C. Secure approval form Architect and/or Structural Engineer, in writing, before cutting, welding/bolting to, or anchoring from any structural building components (i.e. structural steel, load bearing walls, footings/foundations, concrete floors/ceilings, etc.).

### 3.06 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures and other items included in the work in accordance with the approved shop drawings and rough-in measurements furnished by the manufactures of the particular equipment furnished.

### 3.07 ACCESSIBILITY

A. All equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, as required by the equipment manufacturer and as subject to the approval of the Engineer.

### 3.08 CLEANING

A. Each trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

### 3.09 PAINTING

A. All mechanical systems, equipment, piping, ductwork, etc. exposed in finished areas shall be painted to match the surrounding finishes. Refer to specification section 09900 - Coordinate color with Architect.

### 3.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Electrical equipment furnished by Mechanical Trades and installed by Electrical Trades shall be turned over to Electrical Trades in good condition.

B. Equipment and materials shall be protected from theft, injury or damage.

C. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.

D. Provide adequate storage for all equipment and materials delivered to the job site. Equipment set in place in unprotected areas must be provided with temporary protection.

### 3.11 GENERAL SUPPORT REQUIREMENTS

A. Each mechanical trade shall provide all required supporting components to properly support their work. Supporting components/systems shall be in accordance with Code and as specified.

B. Provide all necessary angle/brackets or supplementary steel as required for adequate support for all piping, ductwork, specialties, and equipment. Secure approval form Architect and/or Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure.

### 3.12 DRAWINGS AND MEASUREMENTS

A. These specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either the drawings or specifications shall be as binding as if call for by both. The work herein described shall be complete in every detail.

B. The Drawings are not intended to be scaled for rough-in measurements, nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement shall be taken by the Contractor. The Contractor shall check latest architectural drawings to locate equipment/fixtures/etc., check latest structural drawings for interferences, etc..

### 3.13 EXTRA WORK

A. For any extra work which may be proposed, the Contractor shall furnish to the General Contractor/Construction Manager, an itemized breakdown of the estimated cost of all materials and labor required to complete this work. The estimate cost breakdown shall include unit prices (same prices for increase/decrease of work) for all materials (i.e. duct, piping, valves, equipment, equipment rental, etc.) and all labor (i.e. manhours, overtime, etc.) which may be required for any proposed extra work. The Contractor shall not proceed until receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

## END OF SECTION

# SECTION 23 3100

# HVAC DUCTS AND CASINGS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Metal ductwork.

### 1.02 REFERENCE STANDARDS

A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.

E. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.

F. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.

G. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.

### 1.03 SUBMITTALS

A. Product Data: Provide data for duct materials and duct connections.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 10 years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 10 years of documented experience.

### 1.05 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

### 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.

### 1.07 COORDINATION REQUIREMENTS

A. Sheet metal trades shall coordinate all design, construction, and installation with all other trades.

B. Coordinate painting requirements of exposed ductwork in finished areas with specification section 09900 and color with Architect.

### 1.08 DESIGN REQUIREMENTS

A. Duct sizes shown on drawings are inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

C. Use material, weight, thickness, gauge, construction and installation methods as outlined in the latest addition of the following SMACNA publications, unless noted otherwise:

1. HVAC Duct Construction Standards, Metal and Flexible
2. HVAC Air Duct Leakage Test Manual
3. HVAC Systems - Duct Design
4. Rectangular Industrial Duct Construction
5. Round Industrial Duct Construction

D. Use products which conform to NFPA 90A, possessing a flame spread rating of less than 25 and a smoke developed rating of less than 50.

### 1.09 PRESSURE DEFINITIONS

A. Low Pressure Ductwork: Up to 2 inches WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive and negative or positive static pressures.

## PART 2 PRODUCTS

### 2.01 DUCT ASSEMBLIES

A. All Ducts: Galvanized steel, unless otherwise indicated.

B. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

### 2.02 MATERIALS

A. General: Non-combustible ducts, conforming to Class 1 air duct materials, or UL 181.

B. Galvanized Steel Ducts: ASTM A 653/A 653M galvanized steel sheet, Forming Steel (FS) designation, with G90/Z275 zinc coating.

1. Gaskets: Chloroprene elastomer, 40 Durometer, 1/8 inch thick, full face, one piece vulcanized or dovetail at joints.
2. All reinforcement for ducts having a side dimension 48" or less shall be external. Internal reinforcement shall be acceptable only for ducts having a side dimension greater than 48 inches. Reinforcement shall be provided per SMACNA standards.

C. Steel Ducts - Galvanized Round and Flat Oval Spiral: Galvanized sheet steel duct and fittings, lock forming quality per ASTM A527, Coating Designation G-90, factory fabricated, lock seam or welded design in accordance with SMACNA HVAC Duct Construction Standards or SMACNA Industrial Duct Construction Standards as required based on pressure class. Flat oval and round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

1. Manufacturers:
   a. Dixi-Bilt.
   b. Semco.
   c. LaPine Metal Products.
   d. United-McGill.

e. Univarsal Spiral Air.

D. Caulk: Elastomer caulk, UL listed and per NFPA 90A.

E. Sealant: Indoor/outdoor water based duct sealant. UL listed, non-toxic, water resistant, 0 smoke/flame spread, compatible with mating materials, for use on all SMACNA seal Class A, B, and C joints, for use on 1/2 - 10" wg SMACNA pressure classes. Use PCD duct sealer on PVC coated steel ductwork.

1. Manufacturers:

a. Hardcast "Duct-Seal #321"

b. Foremost "PCD Duct Sealer"

### 2.03 DUCTWORK FABRICATION

A. Low Pressure Ductwork (+/- 2 " W.G. Static Pressure Class)

1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, 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. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1. Use double nuts and lock washers on threaded rod supports.

2. 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.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

H. Provide flexible duct connections where ductwork connects to fans, air handling equipment, and other rotating equipment and/or where indicated on the drawings.

### 3.02 DUCTWORK FABRICATION

A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect and/or Engineer in the event of any interferences.

B. Fabricate necessary offsets and transitions to avoid interference with building construction, piping, equipment, etc. Make changes, offsets, etc. for duct obstructions per SMACNA HVAC Duct Construction Standards or SMACNA Industrial Duct Construction Standards as required based upon pressure class. However, do not reduce duct to less than 6 inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes, beams, or other similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards or SMACNA Industrial Duct Construction Standards. In all cases, seal to prevent air leakage.

C. Fabricate ductwork to prevent failure under pressure or vacuum created by fast closure of ductwork devices. Provide leaktight automatic relief devices where required.

D. Ducts or plenums of masonry construction are not acceptable.

E. Repair galvanized surfaces damaged by the application of zinc rich paint per manufacturer's instructions.

**3.03 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

# SECTION 23 3423

# HVAC POWER VENTILATORS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Ceiling exhaust fans.

### 1.02 REFERENCE STANDARDS

A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc..

B. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc. (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

C. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; Air Movement and Control Association International, Inc..

D. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc..

E. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc..

F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.

G. UL 705 - Power Ventilators; Underwriters Laboratories Inc..

### 1.03 SUBMITTALS

A. 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.

B. Manufacturer's Instructions: Indicate installation instructions.

C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 10 years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Greenheck: www.greenheck.com.

B. Loren Cook Company: www.lorencook.com.

C. S&P.

D. Broan.

E. Carnes Company.

### 2.04 CABINET AND CEILING EXHAUST FANS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

B. Grille: Aluminum or Steel with baked white enamel finish.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

## END OF SECTION

# SECTION 26 0001

# GENERAL ELECTRICAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner's Instructions, including all incidental and related items necessary to complete installation and successfully test and start up and operate the Electrical Systems indicated on Drawings and described in each Section of Division 26 Specifications, and conforming with ALL other Contract Documents.

B. The Drawings and General Provisions of the Contract, including the General Conditions, Supplementary General Conditions, and Division 1 specification sections, apply to work of Division 26 sections. The items in this section are not intended to supersede, but are supplementary to, the requirements set forth in other Divisions of the specifications.

C. The Contractor, and his Subcontractors and Suppliers, shall include in his bid all materials, labor, and equipment involved, in accordance with all local customs, codes, rules, regulations; and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

D. The Contractor shall be held responsible for the complete and satisfactory accomplishment of all Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation, and demonstrate that all electrical systems will operate satisfactorily under normal operating conditions.

### 1.02 DRAWINGS & SPECIFICATIONS

A. The drawings are diagrammatic and show the general location and arrangement of equipment, outlets, lights and related electrical items. They shall be followed as closely as elements of the construction will permit. The Contractor shall provide/install all electrical systems, and associated equipment, complete and include all necessary wire/conduit, pull boxes, and other components required due to interferences, space constraints, code requirements, etc. as required to provide a complete/functional system.

B. These General Electrical Requirements are intended to augment the drawings and specifications. Should conflicts occur between the drawings and the specifications, the strictest provision shall govern. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect and/or Engineer for resolution.

C. The Contractor shall examine the drawings of all other trades in order to verify the conditions governing the work on the job site. Arrange work accordingly, providing all wiring, conduit, fittings, boxes, etc. as may be required to meet such conditions.

D. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect and/or Engineer.

E. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect and/or Engineer for resolution.

### 1.03 COORDINATION OF WORK

A. The Contractor shall verify clearance requirements of all electrical and mechanical

equipment/systems prior to the installation of any new work. Electrical equipment, wiring, systems, etc. shall not interfere with mechanical equipment spaces. The Contractor shall coordinate his work to obtain symmetry in ceiling layouts, lights, grills, etc. are coordinated and are installed per the Architectural reflected ceiling plan.

B. The Contractor, and his Subcontractors, shall be responsible for all tasks applicable to their work in accordance with the Specifications, Drawings, and code requirements, and shall be responsible for coordinating locations and arrangements of their work to give best results with all other relevant trades.

1. Coordinate all wall, roof, floor penetrations, equipment pads, equipment locations, system routings, etc. with architectural and structural trades.
2. Verify requirements of all equipment with shop drawing submittals prior to installation - notify Architect/Engineer of any conflicts between shop drawings and plans.
3. Coordinate rough-in locations and mounting heights of all devices with locations/heights of countertops/sinks/furniture/cabinets/etc. with Architectural Elevations and other trades prior to rough-in.
4. Coordinate rough-in locations of mechanical control devices (i.e. thermostats, sensors, etc.) with mechanical trades. E.C shall provide rough-in of box for T-stat/Sensor and conduit pathway from box to mechanical unit's control box, for wiring by M.C and/or T.C.. T-stats shall be located @ 48" AFF unless noted otherwise.
5. Coordinate locations of electrical items that require access (i.e. panelboards, starters, pull boxes, etc.) with reflected ceiling plan. Items located above hard non-accessible ceilings shall be provided with access doors as required.
6. Do not route/locate below grade conduits below, or with 45 degrees of the bottom corner of, foundation walls/footings. Coordinate with structural trades prior to rough-in.
7. Verify clearance requirements of all electrical and mechanical equipment/systems prior to the installation of any new work. Electrical equipment, lighting, conduit, systems, etc. shall not interfere with mechanical equipment spaces. Mechanical equipment, piping, ductwork, systems, etc. shall not interfere with electrical equipment spaces.

**1.04 INSPECTION OF SITE AND PROJECT DOCUMENTATION**

A. The Contractor shall visit the site and examine/verify the conditions under which the work must be conducted before submitting proposal. The Contractor shall examine the drawings and specifications of all other trades including Mechanical, Architectural, Structural, Plumbing, and Electrical.

B. The submitting of a proposal implies that the Contractor has visited the site, examined all contract documents, and understands the conditions under which the work must be conducted.

C. The Contractor shall notify the Architect and/or Engineer, via written RFI prior to submitting his bid, of any potential conflicts/problems with the plans that he has identified during his inspection of the site and/or from the review of plans/specifications. RFIs must be submitted at least 5 working days prior to bid opening.

**1.05 GENERAL SUPPORT REQUIREMENTS**

A. Provide all necessary angle/brackets or supplementary steel as required for adequate support for all conduit, lighting, specialties, and equipment. Secure approval form Architect and/or Structural Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure, or cutting/coring thru structural systems.

B. Where conduit or equipment is supported or suspended from concrete construction, provide approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

**1.06 GUARANTEE**

A. Contractor shall guarantee that all labor, materials, and equipment are free from defects and agrees to replace or repair any part of this installation which becomes defective within a period of one year from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material or installation. Acceptance date of substantial completion shall be Owner occupancy as determined by the Architect and/or Engineer.

B. The Contractor shall file with the Owner one set of guarantees from the equipment manufacturers including the operating conditions and performance capacities they are based on.

**1.07 CODES, PERMITS AND FEES**

A. Refer to Division 1, General Requirements and Supplementary Conditions.

B. Unless otherwise indicated, all required permits, plan reviews, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor.

C. All work shall be executed in accordance with the latest enforceable rules and regulations set forth in local and state codes.

1. Electrical systems shall be installed per current jurisdictional codes (Michigan Electrical Code, Michigan Energy Code, etc.), current NFPA codes (NFPA 101, NPFA 90, NFPA 72, etc.), and applicable sections of the Michigan Building Code.

D. In the event that the plans and specifications conflict with any rules, regulations, or codes applying, said rules, regulations and codes shall govern.

E. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

**1.08 UTILITIES**

A. The Contractor shall be responsible for coordinating, obtaining service, and advising the Engineer, and utility company(s) for the electrical and telephone service installations.

B. Rules of local utility companies shall be complied with. The Contractor shall check with each utility company supplying service to the installation (i.e. power) and coordinate service requirements including, but not limited to, all transformers, meter boxes and meters which will be required.

C. In the event that the plans and specifications conflict with any utility rules applying, said utility rules and regulations shall govern.

**1.09 SUBSTITUTION ITEMS REQUIRING PRIOR APPROVAL**

A. All items that the Contractor proposes to use in the work, that are not specifically named in the contract documents, must be submitted for review/approval. Such items must be submitted in duplicate to the Architect and/or Engineer for approval a minimum of ten (10) days prior to bid opening. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

B. Lighting Substitutions:

1. Furnish lighting fixtures as scheduled on drawings.

2. Lighting fixture substitutions may be considered for approval by the Architect and/or Engineer only if all of the following criteria are met:

a. Provide specification cut sheets marked-up to clearly identify the proposed luminaire

including features, options, accessories, etc. required to match products indicated in the schedules.

b. Submit all cut sheets, etc. to the Architect and/or Engineer no less than 7 days prior to bid date. Substitutions submitted after this date will not be considered.

**1.10 MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be the manufacturer's latest design.

B. If equipment by an approved manufacture is other than the equipment specified as the basis of design the substituted equipment shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Substitution Items Requiring Prior Approval specified in this Section of the Specifications. All costs to make these items of equipment comply with original requirements including, but not limited to, conduit, wiring, bus work, enclosures, and building alterations shall be included in the original bid.

**1.11 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

A. Refer to Division 1, General Requirements.

B. Provide compete maintenance and operating instructional manuals covering all electrical equipment as specified herein, and individual equipment specification sections.

C. The O&M data shall be bound in a suitable number of 3" or 4", 3-ring, hard cover binders. Permanently imprinted on the cover shall be the words, "Manufacturer's Operation and Maintenance Data", project title, location of project, and the date. A table of contents shall be provided in the front of each binder.

D. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Each piece of equipment in the O&M manual shall be identified as identified on the project drawings (i.e. Panel A, etc.).

E. Internally subdivide the binder contents with permanent page dividers, organized by major equipment/systems (i.e. Distribution Equipment, Wiring Devices, etc.)

F. Contents: Each volume of O&M manual shall have three parts:

1. Part 1: A directory listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: O&M data, arranged and subdivided by major equipment/systems. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers:

   a. List of equipment.

   b. Copies of Shop drawings and product data, approved by Architect/Engineer.

   c. Installation and operational procedures.

   d. Routine maintenance procedures.

   e. Trouble shooting procedures.

   f. Complete parts lists by nomenclature, manufacturer's part number and use.

   g. Recommended spare parts lists.

h. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

i. Complete wiring and schematic diagrams.

j. Elevations and/or sections cut through all of the major equipment and sub-assemblies.

3. Part 3: Project documents and certificates, including the following: Shop drawings.

a. Warranty certificates.

b. Copies of approved construction permits.

c. Contractor's and equipment manufacturer's telephone numbers for warranty repair services.

G. A minimum of two (2) copies of all approved Operation and Maintenance literature shall be furnished to the Owner within 10 days after final inspection. O&M manuals must be completed prior to start of Owner training as the manuals shall be used as the basis of the training.

### 1.12 SHOP DRAWINGS

A. Refer to Division 1, General Requirements.

B. All shop drawings shall be submitted in groupings of similar and/or related items. Incomplete submittal groupings will be returned unchecked.

C. Unless noted otherwise, submit electronically in digital .pdf form, copies of complete manufacturer's shop drawings for all electrical equipment, or systems, including but not limited to, the items listed below. Where items are referred to by symbolic designation on the drawings and specifications, all submittals shall bear the same designation. Refer to other Sections of the electrical specifications for additional requirements.

1. Panelboards
2. Disconnect Switches
3. Wiring Devices
4. Lighting Fixtures
5. Lighting Control Equipment

### 1.13 RECORD DRAWINGS

A. Contractor shall submit to the Architect and/or Engineer, record drawings which have been neatly marked to represent as-built conditions for all new electrical work.

B. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the concealed conditions and other items of construction on field drawings as they occur. Proper circuiting, conduit runs, location and number of electrical devices shall be indicated on the "as-built" drawings. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. All material and equipment furnished and installed by the Contractor for the permanent Work shall be new, unused, of the best quality of make specified, shall be free from defects of any character, and shall be listed as approved by the UL and/or FM.

B. Outdoor electrical equipment shall be weatherproof, NEMA 4X (stainless steel), unless otherwise indicated.

C. Unless otherwise specified in other Division 26 sections, the sheet metal surfaces of equipment

enclosures shall be coated with a rust resisting primer. Over the primer, a corrosion resistant baked enamel finish shall be applied. The color shall be ASA No. 49, medium light gray.

# PART 3 EXECUTION

## 3.01 INSTALLATION OF EQUIPMENT

A. Install equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the Architect and/or Engineer for resolution.

## 3.02 CHASE, SHAFTS AND RECESSES

A. Coordinate with architectural and other trades to ensure accurate location and size of chases, shafts and recesses.

## 3.03 CUTTING, CORING AND PATCHING

A. Refer to General Conditions

B. The Contractor shall perform all cutting, coring, and patching that may be necessary for the installation of their Work. All cutting, coring, patching and repair work shall be performed by the Contractor through qualified Subcontractors. Contractor shall include full cost of same in his bid.

C. Secure approval form Architect and/or Structural Engineer, in writing, before cutting, welding/bolting to, or anchoring from any structural building components (i.e. structural steel, load bearing walls, footings/foundations, concrete floors/ceilings, etc.).

## 3.04 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling and backfilling required for the electrical work.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical drawings.

C. Install warning tape for all buried circuits.

D. Refer to Architectural, Structural, and Site/Civil Specification sections for excavation and backfilling details.

## 3.05 EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Shall be as required for equipment mounting or as shown on plans.

B. Provide concrete housekeeping pads for floor mounted electrical equipment through approved, qualified concrete subcontractors. Concrete housekeeping pads shall be poured before equipment is installed, with anchor bolts and sleeves to fit machine base. Refer to structural plans/specifications for pad details. Contractor shall include full cost of concrete housekeeping pads in his bid.

C. Coordinate concrete housekeeping pads to insure correct size, location, anchor bolts and sleeves.

D. For equipment suspended from ceiling or walls, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect and/or Structural Engineer for same including loads, locations, and methods of attachment.

## 3.06 SLEEVES

A. Provide and install Schedule 40 black steel pipe sleeves, cut to length, wherever conduits pass through above grade walls and floors. Provide and install galvanized steel pipe sleeves, cut to length, wherever conduits pass through below grade foundation walls and slab on grade floors. Sleeves shall terminate flush with walls in finished areas. All sleeves through the floor are to extend two (2) inches above finish floor.

B. Provide escutcheons at each penetration through walls, floors, and ceilings in exposed areas.

C. Patch sleeves to match building material.

**3.07 SEALING OF ELECTRICAL OPENINGS**

A. Seal the space around conduits in sleeves through walls, floors and ceilings.

B. Provide adequate clearance to allow for proper sealing.

C. Provide/install fireproof wall and floor sleeves as required at all applicable wall, ceiling, and floor penetrations. Refer to Architectural plans for wall assembly ratings.

D. Sleeves placed in floors shall be flush with the underside of the floor construction and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise noted or detailed.

E. Where sleeves pass through reinforced concrete floors, they shall be properly set in position prior to concrete pouring in such a way that they will be maintained in position until the concrete is set.

F. Conduits passing through below grade perimeter walls or slabs on grade shall have the space between the pipe and sleeve sealed watertight with a mechanically expandable elastomer seal device.

**3.08 EQUIPMENT CONNECTIONS**

A. Make connections to equipment, fixtures and other items included in the work in accordance with the approved shop drawings and rough-in measurements furnished by the manufactures of the particular equipment furnished. All additional connections not shown on the drawings, but called out by the equipment manufacturer's shop drawings, shall be provided at no additional cost.

**3.09 CLEANING**

A. Each Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

**3.10 PAINTING**

A. All electrical systems, equipment, conduit, etc. exposed in finished areas shall be painted to match the surrounding finishes. Refer to specification section 09900 - Coordinate color with Architect

**3.11 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS**

A. Equipment and materials shall be protected from theft, injury or damage.

B. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Equipment set in place in unprotected areas must be provided with temporary protection.

**3.12 ACCESSIBILITY**

A. All equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, as required by the equipment manufacturer and as subject to the approval of the Engineer.

**3.13 NAMEPLATES AND DIRECTORIES**

A. Identify switchgear, unit substations, motor controls, panelboards, safety switches, etc., with

manufacturer's nameplate, shop order, where applicable on composite assemblies, and designations used on the Drawings. Nameplates shall be laminated phenolic plastic, beveled edged white with engraved black letters. Except where impractical, letter and numerals shall be a minimum of 1/2 inch high. Nameplates shall be mechanically secured. Pressure sensitive nameplates are not acceptable. Panel directories shall be neatly typed, showing equipment served and location for each breaker or switch with a clear plastic protective cover.

**3.14 EXTRA WORK**

A. Refer to Division 1, General Requirements.

B. For any extra electrical work which may be proposed, the Electrical Contractor shall furnish to the General Contractor/Construction Manager, an itemized breakdown of the estimated cost of all materials and labor required to complete this work. The estimate cost breakdown shall include unit prices (same prices for increase/decrease of work) for all materials (i.e. wire, conduit, devices, equipment, equipment rental, etc.) and all labor (i.e. manhours, overtime, etc.) which may be required for any proposed extra work. The Contractor shall not proceed until receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

**3.15 DRAWINGS AND MEASUREMENTS**

A. These specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either the drawings or specifications shall be as binding as if call for by both. The work herein described shall be complete in every detail.

B. The Drawings are not intended to be scaled for rough-in measurements, nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement shall be taken by the Contractor. The Contractor shall check latest architectural drawings to locate light switches, check latest structural drawings for interferences, etc.

# END OF SECTION

# SECTION 26 0519

# LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 V AND LESS)

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Wire and cable for 600 volts and less.

B. Wiring connectors and connections.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 SUBMITTALS

A. Test Reports: Indicate procedures and values obtained.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

C. Project Record Documents: Record actual locations of components and circuits.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### 1.05 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Drawings.

B. Conductor sizes are based upon copper unless indicated as aluminum "AL" on the Drawings.

C. Wire and cable routing shown on the Drawings are approximate unless dimensioned. Route wire and cable as required to meet project conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

## PART 2 PRODUCTS

### 2.01 WIRING REQUIREMENTS

A. Concealed Dry Interior Locations: Use only building wire in raceway or metal clad cable.

B. Exposed Dry Interior Locations: Use only building wire in raceway or building wire with Type THHN,THWN,XHHW insulation in raceway.

C. Above Accessible Ceilings: Use only building wire in raceway or metal clad cable.

D. Wet or Damp Interior Locations: Use only building wire with Type THWN, XHHW insulation in raceway.

E. Exterior Locations: Use only building wire with Type THWN or XHHW insulation in raceway.

F. Underground Installations: Use only building wire with Type THWN or XHHW insulation in raceway.

G. Use stranded conductors for control circuits.

H. Use conductor not smaller than 10 AWG for power and lighting circuits.

I. Use conductor not smaller than 14 AWG for control circuits.

J. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).

K. Use 8 AWG conductors for 30 ampere, 120 volt branch circuits longer than 75 feet.

L. Conductor sizes are based on copper unless indicated as aluminum or "AL".

M. All feeders not sized on the plans shall be sized by the CONTRACTOR for a maximum of 2% voltage drop. All branch circuits shall be sized for a maximum of 3% voltage drop.

**2.02 WIRE MANUFACTURERS**

A. Cerro Wire Inc.: www.cerrowire.com.

B. Industrial Wire & Cable, Inc.: www.iewc.com.

C. Southwire Company: www.southwire.com.

D. Royal.

E. Rome.

F. General Cable.

G. Triangle.

**2.03 BUILDING WIRE**

A. Description: Single conductor insulated wire.

B. Conductor: Copper. Class B strand per ICEA S-61-402.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70.

1. For Feeders and Branch Circuits Equal to and Smaller Than 4/0 AWG (Dry and Damp locations): Type THHN rated 90 degrees C.
2. For Feeders and Branch Circuits Equal to and Smaller Than 4/0 AWG (Wet locations): Type THWN rated 90 degrees C.
3. For Feeders and Branch Circuits Larger Than 4/0 AWG (Dry and Damp locations): Type XHHW rated 90 degrees C.

**2.04 METAL CLAD CABLE (TYPE MC CABLE)**

A. Description: NFPA 70, Type MC.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 75 degrees C.

E. Insulation Material: Thermoplastic.

F. Armor Material: Steel.

G. Armor Design: Interlocked metal tape.

H. Fittings: Shall be specifically designed for use with type MC cable.

**2.05 WIRING CONNECTORS**

A. Split Bolt Connectors:

1. Manufacturers:
    a. Black Burn.
    b. T & B.
    c. Burndy.

B. Solderless Pressure Connectors:
1. Manufacturers:
    a. AMP.
    b. T & B.
    c. 3 M.

C. Spring Wire Connectors:
1. Manufacturers:
    a. Buchanah Model B-Cap.
    b. 3 M Model Scotchlok or Hyflex.
    c. Panduit Model P-Conn.

D. Compression Connectors:
1. Manufacturers:
    a. Neer.
    b. T & B.
    c. Appleton.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

C. Verify that raceway installation is complete and supported.

D. Verify that field measurements are as indicated.

## 3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

## 3.03 INSTALLATION

A. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Route wire and cable as required to meet project conditions.
1. Wire and cable routing indicated is approximate unless dimensioned.
2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

C. Use wiring methods indicated.

D. All wiring shall be installed in conduit or approved raceway. All raceways shall be provided with a ground conductor unless noted otherwise.

E. Use stranded conductors for control circuits.

F. Pull all conductors into raceway at same time.

G. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

H. Protect exposed cable from damage.

I. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.

J. Use suitable cable fittings and connectors.

K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

L. Clean conductor surfaces before installing lugs and connectors.

M. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

N. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

O. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

P. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

Q. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

R. Branch circuits may be combined up to 8 conductors (A-phase, B-phase, C-phase, neutral and A-phase, B-phase, C-phase, neutral) and 2 ground conductors in conduit. Contractor shall be responsible for derating conductors as required by N.E.C Article 310, Note 8.

S. Branch circuit neutral conductors: The use of multi-wire branch circuits with a common neutral is not permitted. Each branch circuit shall be furnished and installed with an accompanying neutral conductor sized the same as the phase conductor.

## END OF SECTION

# SECTION 26 0526

# GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Grounding and bonding components.

B. Provide all components necessary to complete the grounding system(s) consisting of:

1. Metal underground water pipe.
2. Concrete-encased electrode.
3. Rod electrodes.

### 1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NFPA 99 - Standard for Health Care Facilities; National Fire Protection Association.

### 1.03 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

### 1.04 SUBMITTALS

A. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

### 1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience with service facilities within 100 miles of Project.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

D. The Contractor shall be responsible for providing all grounding required in accordance with NEC and local code requirements. Grounding shown on the plans is minimum required.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Lightning Master Corporation: www.lightningmaster.com.

D. American Electric.

E. Chance.

F. Burndy.

G. Cadweld.

### 2.02 GENERAL

A. The contractor shall install a grounding system in accordance with the drawings, specifications, and with the National Electrical Code, NEMA, USASI, and IEEE Standards, latest editions. The ground bar at the main service disconnect shall be bonded to the water mains, structural steel, and driven ground rods, by grounding electricode conductors. Maximum grounding resistance shall be achieved per NEC requirements.

### 2.03 ELECTRODES

A. Manufacturers:

1. Cooper Power Systems: www.cooperpower.com.
2. Framatome Connectors International: www.fciconnect.com.
3. Lightning Master Corporation: www.lightningmaster.com.
4. Chance.
5. American Electric - Blackburn.

B. Rod Electrodes: Copper-clad steel.

1. Diameter: 3/4 inch (19 mm).
2. Length: 10 feet (3000 mm).

### 2.04 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.

1. Manufacturers: Chance, Burndy, American Electric - Blackburn.

B. Exothermic Connections:

1. Product: Cadweld.

C. Wire: Stranded copper.

D. Foundation Electrodes: #2/0 AWG minimum.

E. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that final backfill and compaction has been completed before driving rod electrodes.

### 3.02 INSTALLATION

A. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

B. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

C. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

D. Provide bonding to meet requirements described in Quality Assurance.

E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

F. Ground cables shall be protected by sleeves where the cables extend through a concrete

surface. Ground inserts shall be used where ground cables extending through the surface would be exposed to damage during or after construction.

G. Where ground cables are installed in metallic conduit, the cables shall be bonded to the conduit at both ends of the run.

H. Welds on ground cables shall be cleaned and painted with an asphalt base paint where buried underground or imbedded in concrete.

I. Install a minimum #12 AWG green grounding wire for each branch circuit. The grounding wire shall be connected to the grounding terminal bus bars in panelboards, and these bars shall be grounded to the building's grounding system.

J. Circuits run in PVC conduit shall have a separate ground wire.

## END OF SECTION

# SECTION 26 0529

# HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized. All structural supports and channels shall be manufactured from a minimum of #16 gauge ASTM A570 grade 33 steel.

C. Anchors and Fasteners:

1. Do not use spring clips.
2. Obtain permission from ENGINEER before using powder-actuated anchors.
3. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
4. Steel Structural Elements: Use beam clamps or welded fasteners.
5. Concrete Surfaces: Use expansion anchors.
6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use hollow wall fasteners.
7. Solid Masonry Walls: Use expansion anchors or preset inserts.
8. Sheet Metal: Use sheet metal screws.
9. Wood Elements: Use wood screws.

D. Formed Steel Channel:

1. Product: B-Line Strut.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install hangers and supports as required to adequately and securely support electrical system

components, in a neat and workmanlike manner, as specified in NECA 1.

1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
2. Obtain permission from Engineer before drilling or cutting structural members.

B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.

E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

## END OF SECTION

# SECTION 26 0534

# CONDUIT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Conduit, fittings and conduit bodies.

### 1.02 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).

C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC).

D. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

E. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT); National Electrical Contractors Association.

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.

G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association.

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association.

I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association.

J. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

### 1.06 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

D. Coordinate painting requirements of exposed conduit in finished areas with specification section 09900 and color with Architect.

# PART 2 PRODUCTS

## 2.01 CONDUIT REQUIREMENTS

A. Conduit Size: Comply with NFPA 70.

1. Minimum Size: 3/4 inch (19 mm) where concealed within unaccessible construction (i.e. within walls, above drywall ceilings, etc.), 1/2" minimum elsewhere.

B. Underground Installations:

1. More than 5 Feet (1.5 Meters) from Foundation Wall: Use galvanized rigid steel conduit, thickwall nonmetallic conduit, thinwall nonmetallic conduit.

2. Within 5 Feet (1.5 Meters) from Foundation Wall: Use galvanized rigid steel conduit, thickwall nonmetallic conduit.

3. In or Under Slab on Grade: Use galvanized rigid steel conduit, thickwall nonmetallic conduit.

4. Minimum Size: 1 inch (25 mm).

C. Outdoor Locations Above Grade: Use galvanized rigid steel conduit.

D. Dry Locations:

1. Concealed: Use galvanized rigid steel conduit or electrical metallic tubing.

2. Exposed: Use galvanized rigid steel conduit or electrical metallic tubing.

E. Transformer and Motor Connections:

1. Liquidtight flexible metal conduit (maximum length shall be 3'-0").

F. Lighting fixtures:

1. From junction box to lighting fixture shall be flexible metal conduit (maximum length shall be 6'-0").

G. AC/MC Cable:

1. Use for concealed branch circuit drops to devices or light fixtures. Do not use AC/MC cable for homeruns to panelboards.

## 2.02 METAL CONDUIT

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedtube.com.

2. Beck Manufacturing, Inc.: www.beckmfg.com.

3. Wheatland Tube Company: www.wheatland.com.

4. Century.

B. Rigid Steel Conduit: ANSI C80.1. Galvanized Rigid Steel (GRS).

C. Rigid Aluminum Conduit: ANSI C80.5.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

1. Connectors and couplings shall be threaded, set-screw, or compression type, and concrete tight and/or rain tight where required.

2. Locknuts shall be malleable iron or steel. Bushings shall be malleable iron, steel, or plastic.

Malleable iron or steel bushings shall be zinc or cadmium plated and shall have insulating insert of thermostatic plastic molded and locked into bushing ring. Plastic bushings shall be thermostatic phenolic insulating type. Use of non-rigid plastic bushings is prohibited.

**2.03 PVC COATED METAL CONDUIT**

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedtube.com.
2. Thomas & Betts Corporation: www.tnb.com.
3. Robroy Industries: www.robroy.com.

B. Description: NEMA RN 1; rigid steel conduit with external PVC coating.

C. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil (0.1 mm) thick.

D. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

**2.04 FLEXIBLE METAL CONDUIT**

A. Manufacturers:

1. AFC Cable Systems, Inc.: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.

B. Description: Interlocked steel construction.

C. Fittings: NEMA FB 1. cast fittings.

D. Flexible metal conduit shall have a separate grounding conductor.

**2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT**

A. Manufacturers:

1. AFC Cable Systems, Inc.: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.
4. Anaconda Type "UA" for less than 1-1/4" and Type "EF" for larger than 1-1/2".

B. Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1. cast fittings.

D. Flexible metal conduit shall have a separate grounding conductor.

**2.06 ELECTRICAL METALLIC TUBING (EMT)**

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedtube.com.
2. Beck Manufacturing, Inc.: www.beckmfg.com.
3. Wheatland Tube Company: www.wheatland.com.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron set screw type.

1. Connectors and couplings shall be threaded, set-screw, or compression type, and concrete tight and/or rain tight where required.

2. Locknuts shall be malleable iron or steel. Bushings shall be malleable iron, steel, or plastic. Malleable iron or steel bushings shall be zinc or cadmium plated and shall have insulating insert of thermostatic plastic molded and locked into bushing ring. Plastic bushings shall be thermostatic phenolic insulating type. Use of non-rigid plastic bushings is prohibited.

### 2.07 NONMETALLIC CONDUIT

A. Manufacturers:

1. AFC Cable Systems, Inc.: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. Carlon.

B. Description: NEMA TC 2; Schedule 40 = Thinwall; 80 = Thickwall PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify routing and termination locations of conduit prior to rough-in.

B. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

### 3.02 INSTALLATION

A. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install steel conduit as specified in NECA 101.

C. Install nonmetallic conduit in accordance with manufacturer's instructions.

D. Arrange supports to prevent misalignment during wiring installation.

E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of Section 26 0529.

H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

I. Do not attach conduit to ceiling support wires.

J. Arrange conduit to maintain headroom and present neat appearance.

K. Route exposed conduit parallel and perpendicular to walls.

L. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

M. Route conduit in and under slab from point-to-point.

N. Do not cross conduits in slab.

O. Maintain adequate clearance between conduit and piping.

P. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

Q. Cut conduit square using saw or pipecutter; de-burr cut ends.

R. Bring conduit to shoulder of fittings; fasten securely.

S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

T. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations, and to cast boxes.

U. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch (50 mm) size. Elbows larger than 3" dia. shall be long radius elbows.

V. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

W. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

X. Provide suitable pull string in each empty conduit except sleeves and nipples.

Y. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Z. Ground and bond conduit under provisions of Section 26 0526.

AA. Identify conduit under provisions of Section 26 0553.

BB. Underground exterior conduits shall be sloped away from the building at a minimum of 4" per 100' or 0.33%.

CC. Install insulating bushings at open ends of telephone, data, video, security, etc. conduits.

DD. Drawstrings shall be provided for all new empty conduits. Drawstring shall be wax impregnated, nylon, or other synthetic material resistant to moisture and mildew to prevent deterioration.

EE. All underground conduits and/or duct banks shall be installed 24" minimum below grade (unless noted otherwise) and shall slope minimum of 0.33% to manholes, handholes, cable vaults, or other structures.

**3.04 PAINTING**

A. All conduit exposed in finished areas shall be painted to match the surrounding finishes. Refer to specification section 09900 - Coordinate color with Architect.

## END OF SECTION

# SECTION 26 0537

# BOXES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Pull and junction boxes.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.

C. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.

E. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 SUBMITTALS

A. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. Pull boxes, junction boxes, and cable support boxes of proper size and design shall be provided in accordance with the N.E.C. and as required to facilitate installation of wires. All boxes shall be sized in accordance with the N.E.C. Covers shall be gasketed and held in place with corrosion resistant machine screws. Cable supports for vertical runs shall be provided at code required locations, within pull or junction boxes. Boxes shall be NEMA 12 for inside and NEMA 4 for outside use where exposed to the weather or where otherwise called for on the drawings.

## PART 2 PRODUCTS

### 2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.

B. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box

manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: As specified in Section 26 2726.

D. Outlet and switch boxes shall be minimum of 2-1/8" deep. When installed in a poured wall a 2-1/2" minimum deep box shall be used. When installed in masonry a 3-1/2" minimum deep box shall be used.

E. Use 2-gang 4" square boxes with single plaster rings for single device outlets.

### 2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 26 2716.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "ELECTRIC".

E. Fiberglass Handholes: Die molded glass fiber hand holes:

1. Composite handholds shall be constructed of polymer concrete and reinforced by a heavy weave fiberglass. The handholes shall have internal dimensions not less than that indicated. The material shall have the following properties:
   a. Compressive strength: 11,000 PSI; Tensile strength: 1,700 PSI; Flexural strength: 7,500 PSI.
2. Cable Entrance: Pre-cut 6 x 6 inch (150 x 150 mm) cable entrance at center bottom of each side.
3. Cover: Glass fiber weatherproof cover with nonskid finish.
4. Manufacturer:
   a. Quazite.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

B. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

### 3.02 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

C. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.

D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.

F. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

G. Maintain headroom and present neat mechanical appearance.

H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

J. Provide identification labels on all junction boxes indicating what systems/equipment circuits are feeding (i.e. Lights in Room #102) and where they are being fed from (i.e. Panel LP-1)

K. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

L. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

M. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

N. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

O. Use flush mounting outlet box in finished areas.

P. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

Q. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.

R. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

S. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

T. Use adjustable steel channel fasteners for hung ceiling outlet box.

U. Do not fasten boxes to ceiling support wires.

V. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.

W. Use 2-gang 4" square boxes with single plaster rings for single device outlets.

X. Use cast outlet box in exterior locations and wet locations.

**3.03 ADJUSTING**

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

**3.04 CLEANING**

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

## END OF SECTION

# SECTION 26 0553

# IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

D. Underground waring tape.

E. Panel schedules.

### 1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

C. Thomas & Betts.

D. Panduit.

### 2.02 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Locations:

1. Each electrical distribution and control equipment enclosure (including starters, disconnects, panelboards, breakers at distribution panels, etc.).

2. Communication cabinets.

C. Letter Size:

1. Use 1/2 inch letters for identifying equipment and loads. Identification shall indicate where the load is fed from.

### 2.03 WIRE MARKERS

A. Description: Vinyl cloth type self-adhesive wire markers.

B. Description: tape or split sleeve type wire markers.

C. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2. Control Circuits: Control wire number indicated on shop drawings.

### 2.04 CONDUIT MARKERS

A. Description: Size: 1-1/8"x4-1/2" minimum. Color: Background color as specified below with black lettering.

B. Location: Furnish markers for each conduit longer than 6 feet (2 m).

C. Spacing: 20 feet (6 m) on center.

D. Legend:

1. 240 Volt System: 240 Volt.

### 2.05 UNDERGROUND WARNING TAPE

A. Description: 4 inch (100 mm) wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

### 2.06 PANEL SCHEDULES

A. Each panel shall have a typewritten panel schedule indicating loads. A clear plastic cover over the schedule shall be provided to protect it.

B. Existing panel schedules shall be improved to indicate all existing loads and/or updated to indicate all changes that have occurred during renovation. Typing over writing over existing entries on existing schedules is not acceptable. A new schedule shall be provided. Entries must be in type written form.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

### 3.02 INSTALLATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplates to equipment front using screws or rivets.

C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.

D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches (75 mm) below finished grade.

E. Identify all boxes for fire alarm circuits by painting cover plates red.

## END OF SECTION

# SECTION 26 2416

# PANELBOARDS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

### 1.02 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision D.

B. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association.

G. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.

H. NFPA 70 - National Electrical Code; National Fire Protection Association.

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.

### 1.03 SUBMITTALS

A. 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.

B. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

### 1.05 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 ENGINEER of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

### 1.06 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.

### 1.07 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. General Electric Company: www.geindustrial.com.

B. Schneider Electric; Square D Products: www.schneider-electric.us. BASE BID Square D, other approved manufacturers may only be bid as a voluntary alternate to the base bid and must be clarified in the bid as such.

C. Siemens.

### 2.02 ALL PANELBOARDS

A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet (2,000 m).
2. Ambient Temperature:
   a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating: Refer to plans – Contractor shall verify AIC with local utility prior to ordering panelboards.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

2. Boxes: Galvanized steel unless otherwise indicated.

a. Provide wiring gutters sized to accommodate the conductors to be installed.

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.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

**2.03 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: Aluminum.

a. Provide double neutral bus where scheduled.

3. Ground Bus Material: Aluminum.

a. Provide insulated ground bus where scheduled.

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.

F. Manufacturers:

1. Square D NQ or NF type. BASE BID SQUARE D.

2. Equal by approved manufacturer may be bid as alternate.

G. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

H. Minimum Integrated Short Circuit Rating: As indicated on drawings or minimum as listed below.

1. 208/240 Volt Panelboards: 14,000 amperes rms symmetrical.

I. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.

1. Type SWD for lighting circuits.
2. Type HACR for air conditioning equipment circuits.
3. Class A ground fault interrupter circuit breakers where scheduled.
4. Do not use tandem circuit breakers.
5. Lock-on devices shall be provided for all branch circuits supplying exit lighting, un-switched night lighting, emergency lighting, security systems, clock and program systems, and/or fire alarm.

J. Enclosure: NEMA PB 1, Type 1. (Type 3R for exterior locations).

K. Cabinet Front: Flush or Surface (as noted on plans) cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

### 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.

## PART 3 EXECUTION

### 3.01 INSTALLATION

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

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed branch devices, components, and accessories.

H. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

I. Install panelboards plumb.

J. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.

K. Provide filler plates to cover unused spaces in panelboards.

L. Provide computer-generated circuit directory for each lighting and appliance panelboard, and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.

M. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

N. Provide identification nameplate for each panelboard in accordance with Section 26 0553.

O. Provide arc flash warning labels in accordance with NFPA 70.

P. Ground and bond panelboard enclosure according to current electrical codes.

**3.02 FIELD QUALITY CONTROL**

A. Correct deficiencies and replace damaged or defective panelboards or associated components.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

**3.03 ADJUSTING**

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

B. Adjust alignment of panelboard fronts.

## END OF SECTION

# SECTION 26 2701

# ELECTRICAL SERVICE ENTRANCE

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Metering transformer cabinets and Meter bases.

B. Arrangement with Utility Company for permanent electrical service, including payment of Utility Company charges for service. The Contractor shall be responsible for providing drawings to the Utility Company for Coordination of services and charges.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 SYSTEM DESCRIPTION

A. Service Entrance: Undergound service entrance.

### 1.04 QUALITY ASSURANCE

A. Perform work in accordance with utility company written requirements and NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### 1.05 PRE-INSTALLATION MEETING

A. Convene three weeks prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

## PART 2 PRODUCTS

### 2.01 COMPONENTS

A. Metering Transformer Cabinets: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.

B. Meter Base: Furnished by utility company.

C. Utility Transformer Pad: Prefabricated precast concrete transformer pad with cable pit.

D. Other Components: As required by utility company.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Arrange with utility company to obtain permanent electric service to the Project. The Contractor shall be responsible for providing drawings to the Utility Company for Coordination of services and charges.

B. Coordinate location of Utility Company's facilities to ensure proper access is available.

### 3.02 INSTALLATION

A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

# END OF SECTION

# SECTION 26 2717

# EQUIPMENT WIRING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Electrical connections to equipment.

### 1.02 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.

B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.

C. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### 1.04 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Conform to 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 26 2818, 26 2913 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0534.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0537.

## 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. Maximum length shall be 6 feet. Minimum size shall be 3/4" diameter.

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 interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

## END OF SECTION

# SECTION 26 2726

# WIRING DEVICES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates.

### 1.02 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F.

C. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.

E. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association.

F. NFPA 70 - National Electrical Code; National Fire Protection Association.

G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

B. 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.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Cooper Wiring Devices: www.cooperwiringdevices.com.

B. Leviton Manufacturing, Inc.: www.leviton.com.

C. Hubbell.

D. Bryant.

**2.02 ALL WIRING DEVICES**

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.03 WALL SWITCHES**

A. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Wall Switches: NEMA WD 1, General Duty, Spec. Grade, AC only general-use snap switch. Switches shall be binding screw type, side and back wired type.

1. Body and Handle: Ivory plastic with toggle handle. Coordinate color selection with Architect prior to ordering.

2. Ratings: Match branch circuit and load characteristics.

C. Single Pole Single Throw Wall Switches

1. Products:

a. Hubbell 1221.

b. Arrow Hart 1991.

c. Leviton 1221.

**2.04 RECEPTACLES**

A. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.

2. NEMA configurations specified are according to NEMA WD 6.

B. Receptacles: NEMA WD 1, General duty, Spec. Grade, grounded type

1. Configuration: NEMA WD 6, type as specified and indicated.

C. 20 Amp Duplex Convenience Receptacles.

1. Hubbell 5362.

2. Arrow Hart 5362.

3. Leviton 5362.

4. Device Body: Ivory; Coordinate color selection with Architect prior to ordering. All devices on emergency circuits shall be red in color.

D. 20 Amp GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

1. Hubbell.

2. Arrow Hart.

3. Leviton.

4. Device Body: Ivory. Coordinate color selection with Architect prior to ordering. All

devices on emergency circuits shall be red in color.

5. GFCI receptacles shall meet UL 2003 standards.

### 2.05 WALL PLATES

A. All Wall Plates: Comply with UL 514D.

B. Weatherproof Cover Plates (where located outdoors and where indicated on plans as "WP"): Raintight/gasketed, clear impact resistant thermoplastic, spring retained cover with offset device opening for cord exit.

C. Stainless Steel Cover Plates:

1. Hubbell "S" series.
2. Leviton 8400 series.
3. Arrow Hart "S" series.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

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 wall openings are neatly cut and will be completely covered by 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 wiring devices.

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

G. Verify door openings/swings with Architectural trades prior to installation.

### 3.02 PREPARATION

A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

E. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

F. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

G. Install wiring devices plumb and level with mounting yoke held rigidly in place.

H. Install wall switches with OFF position down.

I. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

J. Install wall plates to fit completely flush to wall 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.

K. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

L. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

M. Use jumbo size plates for outlets installed in masonry walls.

N. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

**3.04 INTERFACE WITH OTHER PRODUCTS**

A. Coordinate locations of outlet boxes provided under Section 26 0537 to obtain mounting heights indicated on drawings.

B. Install wall switches, motor control switches at 50 inches to center of box above finished floor. For CMU walls - 48" to top of box above finished floor.

C. Install convenience receptacles 18 inches (450 mm) above finished floor to center of box (not otherwise specified).

D. Install convenience receptacles in CMU walls at 16 inches above floor to bottom of box.

E. Unless noted otherwise, install GFI receptacles in toilet rooms, janitor closets, and storage rooms 48 inches to top of the box above floor.

F. Install convenience receptacles 6 inches (150 mm) above counter. Or as required to accommodate the counter construction - refer to Architectural elevations.

G. Coordinate all finishes and colors of wiring devices with Architect prior to ordering.

**3.05 FIELD QUALITY CONTROL**

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

**3.06 ADJUSTING**

A. Adjust devices and wall plates to be flush and level.

**3.07 CLEANING**

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

## END OF SECTION

# SECTION 26 2818

# ENCLOSED SWITCHES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.

C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association.

D. NFPA 70 - National Electrical Code; National Fire Protection Association.

### 1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Project Record Documents: Record actual locations of enclosed switches.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. General Electric Company: www.geindustrial.com.

B. Schneider Electric; Square D Products: www.schneider-electric.us.

C. Siemens.

### 2.02 COMPONENTS

A. Fusible Switch Assemblies: 30 thru 600A, NEMA KS 1, Type HD quick-make, quick-break, enclosed load interrupter knife switch.

1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.

2. Handle lockable in OFF position.

3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD quick-make, quick-break, enclosed load interrupter knife switch.

1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.

2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R or 4X.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

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 (2000 mm) above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide identification nameplate for each enclosed switch in accordance with Section 26 0553.

I. Provide arc flash warning labels in accordance with NFPA 70.

J. Install fuses in fusible disconnect switches.

K. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

## END OF SECTION

# SECTION 26 5100

# INTERIOR LIGHTING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Interior luminaires.

B. Ballasts.

C. Lamps.

### 1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.

B. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association.

C. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association.

D. NFPA 70 - National Electrical Code; National Fire Protection Association.

E. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association.

F. UL 1598 - Luminaires; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each fixture that is not a standard product of the manufacturer.

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.

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. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

### 1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 70 and NFPA 101.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

### 1.05 EXTRA MATERIALS

A. Furnish one of each plastic lens type.

B. Furnish 5%, not less than 4, replacement lamps for each lamp type.

C. Furnish two of each ballast type.

### 1.06 SUBSTITUTION ITEMS REQUIRING PRIOR APPROVAL

A. All items that the CONTRACTOR proposes to use in the work, that are not specifically named in the contract documents, must be submitted for review/approval. Such items must be submitted in duplicate to the ARCHITECT and/or ENGINEER for approval a minimum of ten (10) days prior to bid opening. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

B. Ligting Substitutions:

1. Furnish lighting fixtures as scheduled on drawings.
2. Lighting fixture substitutions may be considerred for approval by the ARCHITECT/ENGINEER only if all of the following criteria are met:
    a. Provide specification cut sheets marked-up to clearly identify the proposed luminaire including features, options, accessories, etc. required to match products indicated in the schedules.
    b. Submit all cut sheets to the ARCHITECT/ENGINEER no less than 10 days prior to bid date. Substitutions submitted after this date will not be considerred.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Lithonia Lighting.

B. Cooper Lighting.

C. Hubbell Lighting.

D. Or as noted in lighting schedule on the drawings.

### 2.02 LUMINAIRES

A. Provide products that are listed and labeled as complying with UL 1598, where applicable.

B. Provide products that comply with requirements of NFPA 70 and NFPA 101.

C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

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.

### 2.03 LUMINAIRES

A. Furnish products as indicated in Schedule included on the Drawings.

### 2.04 BALLASTS

A. All Ballasts:

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.

### 2.05 LAMPS

A. All Lamps:
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 ENGINEER to be inconsistent in perceived color temperature.

B. Lamp Types: As specified for each fixture.

C. Fluorescent Lamps:
1. T8 lamps shall be rapid start, 4,100K temperature lamps, unless noted otherwise.
2. Manufacturers:
a. Osram Sylvania.
b. General Electric.
c. Phillips.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Install suspended luminaires using pendants supported from swivel hangers (except where noted to use chain hangers). Provide pendant length required to suspend luminaire at indicated height.

F. Support luminaires independent of ceiling framing.

G. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

H. Install wall mounted luminaires at height as indicated on Drawings.

I. Install accessories furnished with each luminaire.

J. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.

K. Connect luminaires to branch circuit outlets provided under Section 26 0537 using flexible conduit.

L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Install specified lamps in each luminaire.

O. Install lamps in each luminaire.

P. All night lights, emergency lights, and exit signs shall be circuited from the unswitched hot leg of the general lighting circuit for the area served by the night/emergency/exit lights.

Q. Coordinate location of emergency battery ballast unit remote test switch/charge light with Architect prior to rough-in.

R. Remote mount battery packs for emergency ballasts in ceiling spaces above heated areas for outdoor emergency fixtures.

**3.02 FIELD QUALITY CONTROL**

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by ENGINEER.

**3.03 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.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

**3.04 PROTECTION**

A. Relamp luminaires that have failed lamps at Substantial Completion.

**3.05 SCHEDULE - See Drawings**

# END OF SECTION