PART 3 EXECUTIONS

3.1 EXAMINATION

A. Take field dimensions and examine conditions of substrates to determine if acceptable for installation in accordance with manufacturer's instructions. Correct all unsatisfactory conditions prior to commencing shutter installation.

B. Coordinate installation of coiling door at ramp with ramp manufacturer.

3.2 INSTALLATION

A. Install all components to comply with project shop drawings and manufacturer's written instructions.

B. After installation test and adjust coiling door to operate properly and free from distortion.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.3 CLEANING

A. Clean installed components in accordance with manufacturer's instruction prior to acceptance. Remove all debris remaining, due to installation, from this installation.

B. Remove labels and visible markings.

3.4 PROTECTION

A. Comply with manufacturer's recommendations and protect completed shutter installations from damage during remaining construction so as not to void warranty.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hinges.
2. Cylinders and Keys.
3. Locksets.
4. Lever Handles.
5. Closers.
6. Doors Stops.
7. Thresholds and Door Weather Strips.
8. Deadbolts.

B. Related Sections include the following:
1. Division 08 Section "Hollow Metal Doors and Frames".

1.3 SUBMITTALS

A. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

B. Final hardware schedule coordinated with Architect's schedule and related work to ensure proper size, thickness, function, and finish of door hardware. Determine hand from plans.
1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Coordinate with Architect's Door and Hardware schedule in the documents. Include the following information:
a. Type, style, function, size, and finish of each hardware item.
b. Name and manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each hardware set cross referenced to Drawings and Schedule.
e. Mounting locations for hardware.
2. Submittal Sequence: Submit initial draft of final schedule along with essential product data in order to facilitate the fabrication of other work that is critical in the Project construction schedule. Submit final schedule after samples, product data, coordination

with shop drawings of other work, delivery schedules, and similar information has been completed and accepted.

C. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of work of other appropriate Sections to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor for consultation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged door hardware items promptly to place of installation.

E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

F. Keys shall be delivered directly to City of Madison Project Manager in packaging separate from other hardware. Obtain receipt and confirmation of delivery in writing with copies to be delivered to Architect and Owner's Construction Representative.

1.6 WARRANTY

A. Manufacturer's written guarantee for periods of time as follows beginning from date of substantial completion.
   1. Closers: Ten years.
   2. Lacquer finishes: Two years.

3. Polyurethane finishes: Five years.
4. All other hardware: One year.

1.7 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of the manufacturer are listed for each hardware type required for the purpose of establishing Owner's requirements. Provide the product designated or, where specific product is not designated, the product of the manufacturer(s) that complies with requirements.

B. Manufacturers: Subject to compliance with Owner's requirements, provide products by the following:
1. Hinges-Hager or Approved Equal
2. Cylinders and keys.-Schlage or Approved Equal
3. Locksets.- Schlage, Best, or Approved Equal
4. Lever Handles- Schlage, Best, or Approved Equal
5. Closers- Schlage, Best, or Approved Equal
6. Door Stops- Hager, HB Ives, or Approved Equal
7. Thresholds and Door Weather Strips- Reese, or Approved Equal
8. Deadbolts: Schlage, or Approved Equal

2.2 MATERIALS AND FABRICATION

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

C. Furnish screws for installation with each hardware item. Provide slotted-head screws sized as appropriate for each item or to match sizes on existing hardware. Finish exposed (exposed

under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.

D. Provide concealed fasteners for hardware units that are exposed when door is closed unless units of type specified are not available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

## 2.3 KEYING

A. Key Material: Provide keys of nickel silver only.

B. Key Quantity: Furnish 3 change keys for each lock.
   1. Furnish one extra blank for each lock.
   2. Deliver keys to Owner.

## 2.4 FINISHES

A. Finishes as indicated above for specified hardware are to be from manufacturers range of standard finishes. Sample to be approved by Architect.

B. All Hardware shall be factory finished in color to match samples.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. Provide protective transparent, dull finish polyester or other approved coating on all exposed hardware surfaces to protect hardware for minimum of two years.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute , except as specifically indicated otherwise or as otherwise directed by Architect.
   1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9

Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

## 3.2 FINAL ADJUSTING AND CHECKING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
   1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Any hardware item or unit proving to be defective as to material, construction or finish during final inspection by Architect or during warranty period shall be replaced in it's entirety by the Contractor at own expense.

C. Clean adjacent surfaces soiled by hardware installation.

D. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

## 3.3 HARDWARE SCHEDULE

A. The hardware groups for each door are listed in the Hardware Schedule on Sheet A4.2 of the Drawing Set.

END OF SECTION 087100

SECTION 088400 - PLASTIC GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Translucent polycarbonate plastic glazing.

B. Accessories

1.2 REFERENCES

A. ASTM Z 97.1 - American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.

C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

D. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

E. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

F. ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics.

G. ASTM F 1233 - Standard Test Method for Security Glazing Materials and Systems.

1.3 SUBMITTALS

A. Submit under provisions of Section 013000.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Physical properties including data on material weight, windload capacity, light transmission, shading coefficient, and thermal expansion.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods and glazing procedures, including edge engagement guidelines.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: Submit samples for each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product and framed on two adjacent sides to show glazing system.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver polycarbonate sheets on enclosed pallets. Do not store stacked sheets in direct sunlight.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store in dry, well-ventilated and covered areas at temperatures below 80 degrees F (27 degrees C).

D. Handle polycarbonate sheets carefully to prevent damage; do not drop, slide, or drag.

1.5 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.6 WARRANTY

A. Provide manufacturer's written 10 year limited warranty covering yellowing, loss of light transmission compared to original value and loss of crash resistance due to atmospheric agents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide products manufactured by Gallina USA LLC, 4335 Capitol Circle, Janesville, WI 53546; ASD. Tel: (608) 531-0450, Fax: (608) 531-0451. www.Gallinausa.com.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 POLYCARBONATE SHEET

A. Polycarbonate Sheet - General: Comply with ANSI Z 97.1 and with properties as follows:
   1. Tensile strength, yield: 8,500-10,200 psi (58.6-70 Mpa), in accordance with ASTM D 638.
   2. Tensile strength, ultimate: 7,830-10,400 psi (54-72 Mpa), in accordance with ASTM D 638.
   3. Tensile modulus: 232-348 ksi (1.6-2.4 GPa), in accordance with ASTM D 638.
   4. Flexural yield strength: 10,900-16,000 psi (75-110 Mpa), in accordance with ASTM D 790.
   5. Flexural modulus: 261-600 ksi (1.8-4.134 GPa), in accordance with ASTM D 790.
   6. Izod impact strength (0.125 inch notched): .937-18.3 ft lb/in/in (0.5-9.77 J/cm) of notch, in accordance with ASTM D 256.
   7. Self ignition temperature: 986 degrees F (530 degrees C), in accordance with ASTM D 1929.
   8. Horizontal Burn Rate for Light Transmitting Plastic is CC-1 with extent of burn 1 inch (25.4 mm) or less per ASTM D635. (Gallina Sheets of 1/4 inch (6

mm), 5/16 inch (8 mm), 3/8 inch (10 mm) and 5/8 inch (16 mm) thicknesses are classified CC-1.)

9. Smoke density rating of less than 450 when tested in accordance with ASTM E 84.
10. Flame Spread and Smoke Developed, Class A for 6, 8, 10 and 16 mm thickness materials.

2.3 ACCESSORIES

A. Glazing Accessories: As recommended by manufacturer of plastic glazing sheet for wet or dry glazing installations.

B. Joint Profiles for Flat and Radius Sheets: U.L. protected polycarbonate to match adjacent sheets.
   1. Provide H Profile polycarbonate profiles for joints between sheets.
   2. Provide U Profile polycarbonate profiles for channel joint sealing.

C. Fixing Washers With Gaskets: Provide 2.09 inch (53 mm) diameter devices for fastening sheet to substrate.

D. Fixing Screws: Provide self tapping, corrosion resistant, gasketed screws as appropriate for the installation.

E. Sealant Tape: 3M Aluminum Tape, AntiDUST Tape or equal.

F. Gaskets for Rib Corrugated and Corrugated Sheets: Provide gaskets suitable for closing the ends of sheet.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect pallets upon delivery for evidence of damage.

B. Inspect and verify that frame openings are correct size and conform to recommendations of the plastic glazing sheet manufacturer.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Clean frame contact surfaces with compatible solvent and wipe dry. Do not allow solvent to pool in glazing channels.

C. Immediately prior to installation, expose glazing edges of plastic sheet by peeling back factory-applied protective masking to a dimension sufficient for edge engagement.

3.3 INSTALLATION

A. Install plastic glazing in accordance with manufacturer's recommendations for edge engagement and expansion allowance.

B. Employ only silicone sealants and glazing accessories that have been approved by manufacturer of plastic glazing sheet.

C. Remove protective film immediately after all glazing operations are completed.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Clean with water and neutral soap only.

C. Repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 099000 – PAINTING AND COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 govern work of the Section.

1.2 SUMMARY

A. Work of this Section includes surface preparation, painting, and finishing of exposed items and surfaces including the following:
   1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Related Work.
   1. Division 08 Section "Hollow Steel Doors and Frames".
   2. Division 08 Section "Metal Windows".
   3. Division 03 Section "Concrete"
   4. Division 04 Section "Unit Masonry".

C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces and operating parts.

1.3 DEFINITIONS

A. "Paint" includes opaque coating materials, primers, emulsions, enamels, stains, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.4 SUBMITTALS

A. Samples for color selection in the form of manufacturer's color charts.

B. Before the start of work in any area, provide the Owner with one full, sealed, unused and properly labeled quart of paint of each color used. Include the mix formula for each color and a 5" x 10" masonite board painted with the color and properly labeled with location, room number and paint color and name.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.

C. Material Quality: Provide the named manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Federal Specification number, if applicable.
   4. Manufacturer's stock number and date of manufacture.
   5. Contents by volume, for pigment and vehicle constituents.
   6. Thinning instructions.
   7. Application instructions.
   8. Color name and number.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F (7°C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

C. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste from site daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

## 1.7 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F.

C. Do not apply paint when the relative humidity exceeds 85 percent, at temperatures less than 5°F above the dew point, or to damp or wet surfaces.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Unless noted otherwise, products named conform to Federal Specification FS TT-P-29.

## 2.2 MASONRY BLOCK FILLER

A. High-Performance Latex Block Filler: Heavy-duty latex block fillers used for filling open textured interior and exterior concrete masonry block before application of top coats:

1. P & L: Pro-Hide Plus Block Filler.

## 2.3 PRIMERS

B. Interior Alkyd Primer: FS TT-S-179B, Type 1; To be used as a primer on plaster, masonry, concrete.

2. P & L: Supreme "12" Interior Alkyd Primer.

C. Interior wood primer: FS TT-P-659C, For priming wood trim.

1. P & L: Supreme "11" Interior Alkyd Primer.

D. Exterior Primer Coating: FS TT-P-620C; Exterior alkyd wood primer for priming wood under alkyd gloss enamels, flat lusterless finish.

1. P & L: Suprime "8" Exterior Alkyd Primer.

E. Exterior Primer Coating: Exterior alkyd primer for ferrous metals.

1. P & L Effecto Rust Inhibiting Primer.

## 2.4 EXTERIOR FINISH PAINT MATERIAL

A. Alkyd Semi-Gloss Enamel: FS TT-P-102D; Weather-resistant, air-drying, high gloss enamel for use on the exterior over prime-coated wood siding, trim, windows and galvanized, prime coated ferrous metals:
1. P & L: Permalize House and Trim Finish.
2. Approved Equal

## 2.5 INTERIOR FINISH PAINT MATERIAL

A. F. Interior Gloss Paint: FS TT-P-002119; Latex (Acrylic) enamel for use over primed concrete and masonry.

1. P & L: Accolade High Gloss.

## 2.6 PAINT STRIPPER

A. Strippers: Nonvolatile, nonsolvent, low odor type product using products such as organic esters.

B. Solvent-based; methylene chloride type strippers are not allowed.

C. Product as approved by Architect.

D. Rinse shall be mineral spirits or other materials as recommended by the stripper manufacturer.

E. See Division 04 Section "Unit Masonry Restoration" for paint removal on masonry.

2.7 EPOXY FLOORS

A. Dex O-Tex Décor Flor.

B. Approved equal.

2.8 CONCRETE SEALER

A. Clear Sealer: Brock-White concrete sealer.

B. Approved equal.

2.9 ACCESSORY MATERIALS

A. Concrete Floors:
   1. P & L Non-Slip Additive.
   2. P & L Commercial solution of muriatic acid.

2.10 OTHER SURFACES AND ITEMS

A. Apply appropriate finishes to miscellaneous surfaces notlister here. Included are all exposed pipes such as gas and other utility lines.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

B. Start of painting will be construed as the contractors acceptance of and responsibility for surfaces and conditions within a particular area to produce acceptable painted surfaces.

3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting

operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning.
2. Coordinate with other trades when scheduling cleaning and painting so that dust and other contaminants from work of other trades and the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Painter shall be responsible for minor repairs to fine cracks and hole fills required to achieve an acceptable painting surface. Start of painting in each room implies acceptance of surface. Notify Architect prior to start of work of conditions requiring greater effort than minor repair.
2. All surfaces to be painted shall be primed. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
3. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
   a. Allow concrete floors to dry for a minimum of 90 days prior to painting.
   b. Determine alkalinity and moisture content of cementitious surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, notify Architect and correct this condition per paint manufacturer's requirements. Provide test results in writing to Architect.
   c. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
   d. Clean concrete floors to be painted with a solution of one part muriatic acid or other etching cleaner and eight parts water. Flush the floor with ammonia water followed by clean water to remove acid, neutralize with ammonia, and rinse; allow to dry and vacuum before painting.
4. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

C. Paint Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

## 3.3 APPLICATION

A. General.

1. Apply paint in accordance with manufacturer's directions. Use brush and roller applicators and techniques best suited for substrate and type of material being applied.

Technique shall be defined as the method in which the applicator is used. No pads are allowed.

2. For roller use, use 3/8 inch knap cover for all paints. A longer knap cover is acceptable for block fill products.
3. Final colors shall be as selected and approved by Architect.
4. The number of coats and film thickness required is the same regardless of the application method.
5. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.
6. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions and project requirements.
7. Apply additional coats of final paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
8. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
9. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
10. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
11. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
12. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
13. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer or noted herein.

D. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.

E. Mechanical items to be painted include but are not limited to:
   1. Piping, pipe hangers, and supports in Rooms 107, 109 and exterior surface mounted locations. See paint schedule.
   2. Inside faces of supply and return diffusers and visible ductwork in Rooms 108, 113, 114 and 116. See paint schedule.

F. Electrical items to be painted include but are not limited to:
   1. Conduit and fittings. See paint schedule.
   2. Switchgear. See paint schedule.
   3. Panel covers. See paint schedule.

G. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing. Tinting of primers is not acceptable.

H. Paint Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, burn through, inconsistent sheen, flashing or other surface imperfections will not be acceptable.
   1. Paint colors, surface treatments, and finishes are to match original existing work.
   2. Apply paint evenly with brush or roller as appropriate. Brush out corners and crevices to avoid build-up. Drips, streaks, runs, brush or roller marks and visible lines of stops and starts are not acceptable.
   3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

## 3.4 FIELD QUALITY CONTROL

A. The Architect will conduct inspection of primer applications on floor by floor basis prior to application of final finish coats.

## 3.5 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

## 3.6 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

C. Touch up and restore damaged or defaced painted surfaces at completion of other trades' activities and in compliance with final punch list by Architect.

## 3.7 SCHEDULE

A. Concrete: 3 coats (primer, two topcoats); total dry film thickness not less than 3.5 mils.

B. Ferrous Metal: 3 coats (primer, two topcoats); total dry film thickness not less than 2.5 mils.

END OF SECTION 099100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Plastic ADA compliant exterior and interior signs.

1.3 SUBMITTALS

A. Submit shop drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.

B. Submit material and color samples.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Plastic ADA signs
1. Quartet- ADA signs
2. Approved Equal

2.2 SIGN SCHEDULE

A. Provide the following plastic ADAAG signs:
1. Model #QRTO1416, ADA Sign: Men's Restroom, qty. 1
2. Model #QRTO1415, ADA Sign: Women's Restroom, qty. 1
3. Accessible ADA Entrance sign for Door D101A, qty. 1

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work. Mounting locations should be smooth and free of all dirt, dust , grease, etc.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and all ADAAG and ANSI standards for persons with disabilities.

B. Mount signs level and plumb using manufacturer's standard mounting hardware of vinyl foam tape or holes and screws. No screws or bolts are to be applied through face of sign.

C. Remove excess adhesives, etc. from exposed sign surfaces as recommended by adhesive manufacturer. Clean sign surfaces as needed.

END OF SECTION 101400

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Accessories for toilet rooms
2. Grab bars.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Accessories: Products listed are made by American Specialties, Inc.; Telephone: 1-914-476-9000, or an approved equal

B. Hand Dryer: World Dryer Corporation; www.worlddryer.com; Telephone: 1-800-323-0701, or an approved equal

C. All items of each type to be made by the same manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide 4 keys for each accessory to Owner; master key all lockable accessories.

2.3 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: Model # 0030, surface mounted dual roll, type 304 stainless steel. Qty: 2

B. Electrically operated- Air Powered Hand Dryer: Model A. Qty: 2

C. Mirror: Model # 0620, 18"W x 36"H, channel frame, stainless steel. Qty: 2

D. Grab Bars: 1-1/2 inches outside diameter, minimum 0.05 inch wall thickness, non-slip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. 3200 Series
   2. Type – 56 configuration
   3. Stainless steel with satin finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION 102800

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire Extinguishers.

B. Fire Extinguisher Cabinets.

C. Accessories

1.02 RELATED SECTIONS

A. Section 06100 - Rough Carpentry

1.03 REFERENCES

A. NFPA 10 - Standard for Portable Fire Extinguishers; 1998

1.04 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITALS

A. Shop Drawings: Indicate cabinet physical dimensions.

B. Product Data: Provide extinguisher operational features.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers, Cabinets and Accessories
   1. Potter Roemer; 769 Edgewood Avenue, Wood Dale, IL 60191; Tel: (630) 766-4545.
   2. Substitutions: See AIA Document A201 - 1997 Edition.

2.02 FIRE EXTINGUISHERS

A. Model No.: 3005.

B. Quantity: 2

2.03 FIRE EXTINGUISHER CABINET

A. Model No. 7072-B

B. Quantity: 1

2.04 ACCESSORIES

A. Wall Mounting Bracket Model No.: 3902

B. Quantity: 1

PART 3 EXECUTION

END OF SECTION 104413

SECTION 133416 BLEACHERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Extent of grandstand replacement is indicated on the drawing.

B. Provide all labor, materials and equipment required for complete installation.

1.2 SUMMARY

A. This Section includes prefabricated bleacher seats, guardrails and handrails for existing concrete grandstand, new metal ramp and all necessary anchors and miscellaneous metals.

B. Related Sections include the following:

1. Division 02 Site Work.

2. Division 03 Concrete.

3. Division 09 Painting.

1.3 SUBMITTALS

Bidders with any deviations from the specifications must be approved by written addenda seven (7) days prior to the bid opening. Failure to comply with this requirement will cause immediate rejection of said bid.

Submit the following to the Owner / Architect:

A. Samples of:

1. Bleacher bench seating.
2. Bleacher bench seating color availability.
3. Handrail support post and cap for each installation type.
4. 12"x12" sample of chain link
5. Bleacher aisle stair rails.
6. Vomitory stair rails.

B. Seating plan indicating aisles, aisle handrails, walkway, seating sections and exits.

C. Calculations by a registered engineer showing the deviations meet or exceed the specified item they are intending to replace.

D. Schedule of work experience, including names of contacts and phone numbers – 10 jobs minimum.

E. List of (3) similar jobs – should the Owners request a site visitation to these jobs, it will be at the bidder's expense.

F. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.

## 1.4 SITE VISITATION

A visitation to the proposed site seven (7) days prior to bid by a qualified representative of the grandstand manufacturer is mandatory. No allowance will be made after the award of contract for any problems encountered which would have been discovered during the pre-bid visitation. In addition, the representative of the manufacturer will revisit the site within six (6) months after completion of the project for reinspection with the Owner.

## 1.5 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the following:

AISC Manual of Steel Construction, Ninth edition, 1989.

Building Code Requirements for Structural Concrete (ACI 318)

Aluminum Association of America

B. Design Loads (Bench Seats)

| | | |
|---|---|---|
| Dead Load | As applicable | |
| Live Load | 120 plf | to seat and footboards |
| Live Load | 100 psf | to structure |
| Wind (Local Conditions) | +30psf | on project surface |
| Sway | 24 plf | per ft. of seat, parallel to seat run |
| | 10 plf | perpendicular per ft. of seat |

C. Design Load (Guardrail System)

Per Wisconsin Enrolled Commercial Building Code.

D. Code Compliance – All work shall comply with current codes.

E. General – The seats and guardrails shall be of adequate size to carry required loads.

1.6 QUALITY ASSURANCE

A. Manufacturer: company specializing in spectator seating with a minimum of ten (10) years of experience in manufacturing bleacher seating.

B. Engineer Qualifications: The renovation of the grandstand seating and handrails shall be under the supervision of, and approved by a registered professional engineer and all submittal drawing shall bear his stamp.

C. Warranty: Bleachers shall be guaranteed for one (1) year against defective material or workmanship. Damage resulting from abnormal use, vandalism, or incorrect installation (if done by other than an installer of the manufacturer) is not applicable.

D. Detailed Certificate of Insurance, including products/completed operations liability insurance, shall be provided.

PART 2 - GENERAL

2.1 ACCEPTABLE MANUFACTURER

A. Dant Clayton Corp. P.O. Box 4520, Parker, CO 80134, tel: (303) 940-8999, fax (502) 214-8709.

B. Steel Structures, 4688 Hwy 16 South, P.O. Box 2048 Graham, Texas 76450

C. Approved Equal.

2.2 PRODUCTS

A. Materials:

B. Guardrail Systems:

1. Rails shall be of anodized aluminum extruded pipe 6061-T6 alloy, 1 5/8" o.d.

2. Handrail supports shall be aluminum channel 3" x 1.438" x .188" and shall be 6061-T6 alloy.

3. Grabrails shall be extruded aluminum pipe of 6063-T5 alloy, 1 15/16" o.d.

4. Chain link fence shall be 2" mesh, 9 gauge galvanized fabric.

C. Extrusions:

1. Bench seats shall be with powder coated paint finish.

2. Support brackets shall be 6063-T6 extruded aluminum and shall be mill finishes. Brackets shall be of such a design to allow a maximum of 17" rise from the foot tread to the seat.

D. Ramps and Ramp Platforms

1. Ramps shall be 9"x1.40 extruded aluminum mill finish channel with 3" x 1.4" extruded aluminum mill finish vertical channel columns.

2. Planks of ramp shall be installed with fluted surface perpendicular to the path of egress.

E. Hardware & miscellaneous metals:

1. Bolts used for field installation shall be hot dipped galvanized after fabrication.

2. End Caps:

a. Seatboard shall be cast aluminum, friction fit.
b. Handrail post shall be capped with a cast aluminum cap.

3. Provide all miscellaneous metals required for completion of work.

## 2.3 COMPONENTS

A. Seatboards shall be powder coated painted.

B. Handrail system at the rear of the grandstand shall consist of rails, with chain link fence.

C. Handrail system at the front and sides of the grandstand shall consist of rails with chain link fence.

D. Grandstand shall have aisles with an aisle handrail system.

E. Handrail systems for vomitory stairs shall have handrails on both sides and a center handrail.

F. Ramp system shall include supports, platforms, ramp, handrails, chain link fence, and connection to concrete Vomitory.

G. New accessible entrance ramp shall have metal handrail.

# PART 3 - EXECUTION

## 3.1 FIELD VERIFICATION

A. Extent of work is as indicated on the drawings; however field verification of quantities, sizes, profiles, materials and finishes by Contractor is required.

3.2 INSTALLATION

A. General. Install replacement components utilizing details identical to and/or compatible with existing installations. Refer questionable details to the Architect for verification prior to installation.

B. Installation. Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

C. Expansion anchors will not be allowed.

3.3 CLEAN UP

A. Clean all surfaces according to manufacturer's recommendations. by manufacturer.

B. Clean up all debris caused by work of this section. Contractor is responsible for cleaning and legally disposing of all debris.

END OF SECTION 133416

SECTION 20 0000- GENERAL MECHANICAL REQUIREMENTS

## PART 1 - GENERAL

### 1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

### 1.2 DESCRIPTION

A. Intent of drawings and Specifications is to obtain complete systems, tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 20, 21, 22 and 23 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.

E. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.

F. Where Architectural features govern location of work, refer to architectural drawings.

G. Contractor may install additional piping, fittings and valves, not shown on drawings, for testing purposes or for convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Architect.

### 1.3 RELATED WORK

A. Utility Services:
   1. Determine utility connection requirements and include in Base Bid all costs to Owner for utility service.
   2. Include costs for temporary service, temporary routing of piping or any other requirements of a temporary nature associated with utility service.

B. Temporary Services:
   1. Division 01 - Temporary Facilities and Controls.

C. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before any work is started.

2. When interruption of services is required, all persons concerned shall be notified and shall agree upon a time.

D. Demolition:
1. Division 02 - Selective Demolition.
2. Perform demolition as required to accomplish new work.
3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
7. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such Work.

E. Painting:
1. Painting of mechanical equipment will be done under Division 09 unless specified otherwise or unless equipment is to be furnished with factory applied finish coats.
2. Furnish equipment with factory applied prime finish unless otherwise specified.
3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Architect.
4. Furnish one can of touch up paint for each factory finish that will be final finished surface of product.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this Specification.

1.5 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
1. AMCA ..... Air Movement and Control Association
2. ANSI ..... American National Standards Institute
3. ASHRAE..... American Society of Heating Refrigerating and Air Conditioning Engineers
4. ASPE ..... American Society of Plumbing Engineers
5. ASSE ..... American Society of Sanitary Engineering
6. AWWA ..... American Water Works Association
7. ASME ..... American Society of Mechanical Engineers
8. ASTM ..... American Society for Testing and Materials
9. CISPI ..... Cast Iron Soil Pipe Institute
10. IEEE ..... Institute of Electrical and Electronics Engineers
11. MCA ..... Mechanical Contractors Association

12. NEC ..... National Electrical Code
13. NEMA ..... National Electrical Manufacturers Association
14. NFPA ..... National Fire Protection Association
15. NSF ..... National Sanitation Foundation
16. PDI ..... Plumbing and Drainage Institute
17. SMACNA..... .....Sheet Metal and Air Conditioning Contractors National Association
18. UL ..... Underwriters Laboratories, Inc.

1.6 SUBMITTALS

A. Shop Drawings (Product Data):
1. Refer to Division 01 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Divisions 20, 21, 22 or 23, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
3. Submit shop drawings for equipment and systems as requested in the respective Specification Sections. Submittals that are not requested may not be reviewed.
4. Mark general catalog sheets and drawings to indicate specific items submitted.
5. Include proper identification of equipment by name and/or number, as indicated in Specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Submittals shall be clearly marked and noted accordingly.
7. When fixtures, equipment and items specified include accessories, parts and additional items under one designation, submittals shall be complete and include all required components.
8. Submittals of electrically powered equipment and devices shall include composite wiring diagrams, motor efficiency and power factor data.
9. Submit equipment room layouts drawn to scale, including equipment, piping, accessories and clearance for maintenance.
10. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
11. Submit shop drawings or product data as soon as practicable after signing Contracts. Submittals must be approved before installation of materials and equipment.
12. Submittals that are not complete, not permanent or not properly checked by Contractor will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Closeout Procedures.
2. Upon completion of Work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit all 3 copies to Owner.

3. Manuals shall be organized by specification section number and shall have table of contents and tabs for each piece of equipment or system.
4. Fire protection system shall be separately bound.
5. Manuals shall include the following:
    a. Copies of all shop drawings.
    b. Manufacturer's operating and maintenance instructions. Include parts lists of all items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, applicable type or model shall be designated.
    c. CD ROM's of O&M data with exploded parts lists, where available.
    d. Phone numbers and addresses of local parts suppliers and service companies.
    e. Internet/WEB page addresses where applicable.
    f. Wiring diagrams.
    g. Startup and shutdown procedures.
    h. Composite electrical diagrams.
    i. Flow diagrams.
    j. Lubrication instructions.
    k. Factory and field test records. (Refer to Test and Balancing in Part 3 of this section.)
    l. Air and water balance reports.
    m. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.
6. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
7. Provide O&M Manuals and instructions to Owner prior to request for final payment.

D. Record Documents:
1. Refer to General Conditions of Contract, and Division 01 - Closeout Procedures. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

1.7 JOB CONDITIONS

A. Building Access:
1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Electrical Coordination:
1. Contractors for Divisions 20, 21, 22 and 23 shall provide the following items as specified under their respective Division(s) (Division 20, 21, 22 and 23):
    a. Electrically powered equipment
    b. Electrically controlled equipment
    c. Starters, where specified
    d. Variable frequency drives, where specified.
    e. Control devices, where specified.
    f. Temperature Control wiring
    g. Wiring diagrams to Electrical Contractor for apparatus indicating external connection and internal controls.

2. Electrical Contractor will provide the following devices required for control of motors or electrical equipment, unless noted otherwise.
    a. Starters
    b. Disconnect devices
    c. Control devices:
        1). Pushbuttons
        2). Pilot lights
        3). Contacts
    d. Conduit, boxes and wiring for power wiring.
    e. Conduit, boxes and wiring for control wiring, except temperature control wiring.
3. Electrical Contractor will make connections, from power source to starter or variable frequency drive and from starter or variable frequency drive, where specified, to motor for ready to operate.
4. Where starters or other similar control devices are furnished by this Contractor, they shall be installed by this Contractor and wired by Electrical Contractor.
5. Should any change in size, HP rating or means of control be made to any motor or other electrical equipment after Contracts are awarded, this Contractor shall immediately notify Electrical Contractor of change. Additional costs due to these changes shall be responsibility of this Contractor.

C. Cutting and Patching:
1. Refer to General Conditions of the Contract, and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore all work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide all materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

D. Housekeeping and Cleanup:
1. Refer to Division 01 - Closeout Procedures.
2. Periodically as work progresses and/or as directed by Architect, remove waste materials from building and leave area of work broom clean. Upon completion of Work, remove tools, scaffolding, broken and waste materials, etc., from site.

1.8 GUARANTEE

A. Guarantee for one year after acceptance by Owner all equipment, materials, and workmanship to be free from defect.

B. Guarantee that systems will operate without objectionable noise, vibration and uncontrolled expansion.

C. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

D. In any case, wherein fulfilling requirements of any guarantee, if this Contractor disturbs any work guaranteed under another Contract, this Contractor shall restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other Contract.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Verify elevations and measurements prior to installation of materials.

### 3.2 EXCAVATION AND BACKFILL

A. Refer to Division 31 - Earthwork.

B. Provide excavation and backfill for all underground work unless otherwise indicated. Blasting is not allowed on this project without written permission of Architect and Owner.

C. Backfill all trenches beneath concrete floor and stair slabs within building and beneath concrete slabs, walks, stairs and drives at exterior of building with gravel fill and compact to same density as surrounding area.

### 3.3 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide during progress of construction all sleeves and inserts that are to be built into structure.

B. Temporary sleeves, if used to form openings, shall be removed prior to installation of permanent materials. Permanent sleeves shall be minimum 24 ga galvanized sheet metal unless otherwise noted.

C. Steel sleeves, when required in interior floor slabs, shall be Schedule 40 carbon steel pipe with integral water stop.

D. For core drilled holes, size and location shall be reviewed and approved by Structural Engineer prior to execution.

E. Submit product data and installation details for penetrations of building structure. Submittal shall include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 20 0573 - Mechanical Systems Firestopping.

G. Openings for pipe shall be either minimum 1" larger in diameter than pipe or, where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer.

H. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2" to concrete. Do not disturb footing bearing soil.

I. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4" clearance to concrete. Seal openings with urethane caulk.

J. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.

K. Openings for duct penetrations shall be no more than 1/2" larger on all sides than size of duct or duct including duct insulation, if applicable. Where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer, but opening shall not exceed one inch average clearance on all sides. Openings for ducts with fire dampers shall be in accordance with fire damper installation requirements.

L. Duct penetrations through concrete floors in mechanical rooms containing liquid heat exchangers and/or pumps shall have 2" high water stopped curbs surrounding openings. This applies to mechanical rooms above the lowest floor level.

M. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

N. Seal non fire-rated wall openings with urethane caulk.

O. Where penetrations occur through exterior walls into building spaces, use sleeves with integral water stop. For piping having outer surface temperature less than 150°F, use plastic (HDPE) sleeves, similar to PSI Link-Seal Model CS, rated to 150°F. For piping having outer surface temperature 150°F or higher, or where steel sleeves are shown or walls are fire rated, use steel sleeves with hot dip galvanizing, similar to PSI Link-Seal Model WS. Seal annular space between sleeves and pipe with Thunderline "Link-Seal" modular wall and casing seals, or sealing system by another manufacturer approved as equal by Engineer. Where "Link-Seals" are used with insulated pipe, insulation shall be butted against seals on both sides. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

P. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.

Q. If total Pro Set system and components are used, opening shall not need additional water proofing or riser clamps.

R. Finish and trim penetrations as shown on details and as specified.

S. Provide chrome or nickel plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

T. Trim duct penetrations exposed in finished areas with 2" wide galvanized or aluminum trim collars properly sized to fit duct. Collars shall be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

U. In clean room areas, no escutcheons are allowed where piping and ductwork pass through walls, floors or ceilings and are exposed in finished areas. Cut and patch holes within 1/4" of pipe or duct then seal opening with sprayable vinyl, flexible PVC coating equal to Andek "Cocoon 72634 - USDA".

3.4 EQUIPMENT ACCESS

A. Install piping, conduit and accessories to permit access to equipment for maintenance. Relocation of piping, equipment or accessories as required to provide access shall be provided at no additional cost to Owner.

B. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment without moving other equipment or system components being installed or already in place.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops or other equipment shall provide access for service, repairs, and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

E. Provide access doors where any valves, shock stops, unions or equipment/devices requiring access for servicing, repairs or maintenance are located in walls, chases or above inaccessible ceilings, unless otherwise noted. Access doors shall be of sufficient size to allow for total maintenance. Location of access doors shall be coordinated with General Contractor and location of equipment shall be roughed in accordingly.

3.5 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.

C. Do not support equipment or piping from metal roof decking.

3.6 EQUIPMENT GUARDS

A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.

B. Paint equipment guards bright yellow.

C. Equipment guards, shall comply with OSHA requirements.

3.7 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and any areas requiring normal maintenance access, certain equipment must be guarded to protect personnel from injury.

B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Threaded rod or bolts shall not extend beyond supporting element and shall be protected as described above.

3.8 MECHANICAL SYSTEMS IDENTIFICATION

A. Refer to Section 20 0553 - Mechanical Systems Identification.

3.9 TEST AND BALANCING

A. Tests for equipment, ductwork and piping systems shall be performed as specified in their respective specification sections in accordance with technical requirements noted.

B. Provide equipment required for testing, including fittings for additional openings required for test apparatus.

C. All ductwork and piping inspections and testing shall be successfully completed and approved before application of covering materials.

D. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or material as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials. Caulking of holes or threaded joints is not allowed.

E. This Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing Test Certification Document.

F. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of Project, include copies of test records and certifications in O&M Manuals.

G. Balancing of various systems shall be in accordance with associated specification sections in addition to requirements noted herein.

H. Balance all systems defined in Section 22 1118 – Water Distribution System.

I. Flushing valves, bleed valves, flow control valves, and other regulating devices in plumbing systems shall be adjusted for proper balancing and flow to fixtures and equipment.

J. When other systems require special balancing, include requirements as specified under their respective sections.

K. If exterior domestic water supply also serves as source for fire protection systems, either exterior or interior or both, it shall be tested according to fire protection system requirements as specified in applicable Specification Section.

3.10 START-UP

A. All systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation. This shall include "Owner-furnished, Contractor-installed" (OFCI) as well as "Contractor-furnished, Contractor-installed" (CFCI) systems and equipment. Follow manufacturer's pre-start-up check-out, start-up, trouble shooting and adjustment procedures. Contractor shall provide services of technician/mechanic knowledgeable in start-up and check-out of types of systems and equipment on project. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel. Coordinate start-up with all trades.

3.11 LUBRICATION

A. Upon completion of work and before turning over to Owner, clean and lubricate bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by manufacturer.

B. Contractor is responsible for maintaining lubrication of mechanical equipment under this Contract until Work is accepted by Owner.

3.12 CLEANING

A. After installation is complete, clean all systems.

B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.

C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.

D. Clean equipment and plumbing fixtures as recommended by manufacturers.

E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.

F. Dirt, plaster dust and other foreign matter shall be blown and cleaned from coils, terminal devices, diffusers, registers and grilles.

G. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

I. Thoroughly disinfect all water heating equipment listed in Section 22 3314 and complete new water distribution piping defined in 22 1118 – Water Distribution System according to Department of Health Requirements.

**END OF SECTION**

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SECTION 20 0520- EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section lists methods and materials for trench excavation and backfill for plumbing piping systems inside and outside the building.

1.2 RELATED WORK

A. Division 31 - Earthwork.

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions of the Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

A. List of materials to be used for backfill.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Type 1 Fill:
   1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3" and no building, organic, corrosive or frozen materials.

B. Type 2A Fill:
   1. Sand or gravel materials with none larger than 2" and of that portion passing #4 sieve less 5% to pass #200 sieve.

C. Type 2B Fill:
   1. Sand or gravel materials with none larger than 1/2" and of that portion passing #4 sieve less 5% to pass #200 sieve.

D. Type 3 Fill:
   1. Gravel of rounded to subangular shape, screened, which will pass 0.75" sieve and retained on #4 sieve.

E. Type 4 Fill:
   1. Pit run rock or gravel with maximum stone size of 1".

F. Type 5 Fill:
   1. Pea gravel, screened, which will pass 0.375" sieve and retained on #4 sieve.

G. Type 6 Fill:
   1. Architect approved fill material, backfilled and compacted beneath building footprint.

PART 3 - EXECUTION

3.1 PREPARATION

A. Establish grade lines and locations of mains and manholes. Provide necessary stakes and batter boards.

B. Verify invert elevations of existing utilities prior to excavation for new utility piping.

3.2 EXCAVATION

A. Provide excavation for all underground work, including piping, manholes, catch basins, tanks, concrete structures, etc., unless otherwise shown or specified. Lay piping in open trench except when Architect gives written permission for tunneling.

B. Include all necessary clearing; tree removal; grubbing; pavement removal; substructure removal such as walls, footings and piers and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing and transportation. Coordinate excavation extending beyond construction limits with Construction Manager and Owner.

C. Blasting is not allowed on this project without written permission of Architect and Owner.

D. Remove all excess excavation material from site unless directed otherwise.

E. Use mechanical methods to remove rock in trenches for piping systems.

F. Include rock excavation in the Bid unless otherwise indicated.

3.3 PIPE INSTALLATION

A. Keep underground piping to proper line and grade and sealed at all times to prevent entrance of animals or foreign matter.

B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of "Manual of Accident Prevention in Construction" published by Associated General Contractors of America.

C. Under no circumstances lay pipe or install appurtenances in water. Keep trench free from water until pipe joint material has hardened.

D. Presence of ground water in soil or necessity of sheet piling or bracing trenches shall not constitute condition for which any increase may be made in Contract price, except, when sheet piling is left in place on written order of Owner, Contract price will be adjusted.

E. Cut off sheet piling left in place not less than 2" below new finished grade. Do not remove sheet piling until trench is substantially backfilled.

F. Place underground piping outside and inside building on 4" compacted bedding of Type 2B, 3, or 5 fill. Shape bedding for clearance for all joints and fittings, tamped in place and graded evenly to insure uniform bearing for full length of pipe. Do not support piping by blocking, planking or mounding of bedding material.

3.4 BACKFILL

A. Exterior:

1. Backfill outside building including all piping beyond construction limits only after piping and appurtenances have been inspected, recorded, tested and approved. Backfill around pipe by hand to depth of 12" above top of pipe with Type 2B, 3 or 5 fill in 6" layers. Take care not to disturb pipe or damage pipe coating. Do not use Type 3 fill where it will come in contact with polyethylene encasement specified in Section 21 1114 - Exterior Fire Suppression Piping Systems and Section 22 1114 - Exterior Services. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. No flooding or jetting with water is allowed.
2. Place backfill from 12" above pipe in layers not exceeding 8" in depth with Type 1 fill. Compact backfill material to the same density as surrounding area prior to that of excavation.
3. When excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain; backfilling from 12" above pipe to subgrade shall be with Type 2A, 2B, 3 or 4 fill. Backfill in 12" layers and compact with mechanical means to density 95% modified proctor. Frequency of compaction testing shall be determined by testing consultant, based on site conditions, materials and workmanship.
4. When excavation occurs on public property or areas beyond property line, all excavation, pipe laying, backfilling, grading and surfacing shall conform as herein specified, except additional requirements for public utility or other authorities shall be complied with when in order. Check with each utility and incorporate cost of any additional requirements in Base Bid.

B. Interior:

1. Backfill inside building only after piping and appurtenances have been inspected and approved. Backfill to 12" above pipe with Type 2B, 3 or 5 fill in 6" layers. Remainder of backfill shall be Type 2A, 2B, 3, 4, or 6 fill in 12" layers.
2. Install lines passing under foundations with minimum of 1-1/2" clearance to concrete and insure there is no disturbance of bearing soil.

3.5 ROCK EXCAVATION

A. Consider material over one cubic yard in size encountered during excavation as rock. Rock excavation will be paid as extra if it cannot be removed by 200 net HP crawler tractor with ripper attachment all in good running condition and operated by an experienced individual.

B. Excavate rock to 4" below intended pipe invert.

3.6 FINISHING

A. On completion of trenching and backfilling operations, restore grades to original elevation or to new subgrade elevation.

B. When trenching is through existing areas or beyond constructions limits, replace surfaces to existing conditions.

C. In landscaped areas use 6" of topsoil and sod to match existing elevations, or as otherwise approved by Landscape Architect.

**END OF SECTION**

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SECTION 20 0529- MECHANICAL SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 20 0700 - Mechanical Systems Insulation

B. Section 23 0550 - Vibration Isolation (Spring Hangers and Mounts)

C. Section 23 3114 - Ductwork (for additional duct supports requirements)

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 0 1 General Requirements.

1.3 DESCRIPTION

A. Provide all supporting devices as specified and as required for proper support of piping, ductwork, equipment, materials and systems.

B. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping and ductwork, to prevent excess stress and allow for proper expansion and contraction.

1.4 SUBMITTALS

A. Shop drawings for each piping system for all pipe sizes and all applicable equipment including, but not limited to, the following:
   1. Manufacturer's name.
   2. Model numbers.
   3. Materials of construction and load ratings (lbs).
   4. Schedule of hangers and support devices with pipe support spacing.
   5. Insulated pipe supports along with application chart or table.
   6. Insulation protection saddles and weight bearing insulation table.
   7. Details and calculations for sizing supplementary steel utilized for trapeze or specially designed supports.
   8. Structural attachments, inserts and concrete anchors.
   9. Drawings showing specific locations of any weld attachments to structure, including weight supported by such attachments.
   10. Equipment mounting devices.
   11. Pipe guides and anchors.
   12. All other appropriate data.

1.5 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall conform to latest requirements of ANSI/ASME Code for Pressure Piping B31.1 and MSS Standard Practice SP-58 (Materials, design and Manufacture), SP-69 (Selection and Application), and SP-89 (Fabrication and Installation Practices), except as supplemented or modified herein.

B. Support materials shall be steel or stainless steel unless specifically indicated.

C. Support devices shall be factory fabricated by manufacturers and have published load ratings.

D. Unless otherwise indicated, design structural support members and support devices, including couplings, rods, trapeze supports and strut systems, with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.

E. Determine maximum deflection using the following equation.

$$D = \frac{H \text{ or } L}{250}$$

Where D = Maximum deflection in Inches
H = Member height in Inches
L = Member length in Inches

F. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have factory standard primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application. Coat cut edges, welds or any damaged finish with galvanized paint.

G. Material in contact with pipe shall be compatible with piping material so that neither shall have deteriorating action on the other. If materials such as copper, stainless steel or other materials are not compatible, provide nonmetallic separation between uninsulated piping and metal supports. Plastic coated steel supports are acceptable.

H. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with either galvanized finish or paint finish. Paint type shall be approved by Architect/Engineer.

I. This Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section 20 0700 - Mechanical Systems Insulation.

J. In addition to hangers specified in this Section, piping connected to pumps, compressors, and similar rotating or reciprocating equipment shall have vibration isolation hangers or supports for distance of 100 pipe diameters or 50 ft away from equipment, whichever is greater.

K. Piping connected to coils, which are in assembly mounted on vibration isolators, shall have flexible piping connections and vibration supports as indicated above. Piping connected to coils, which are in equipment where fan assembly is separately isolated by means of vibration isolators and duct flexible connections does not require additional spring vibration supports. Flexible connections and vibration isolators are specified in Section 23 0550 - Vibration Isolation.

L. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

M. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.

N. Unless otherwise indicated, continuous insert channels are not allowed.

O. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

P. Application of concrete inserts and concrete anchors shall be reviewed and approved by Structural Engineer prior to installation.

Q. Any proposed weld attachments to building structure shall be reviewed by Structural Engineer prior to execution of work. This review may result in use of other welding codes or standards, which may apply to "structural work". Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.

R. Where fire rated fiberglass products are used for channel and support devices, the following properties shall apply:

1. Flame Spread Properties

| | | | |
|---|---|---|---|
| a. | Polyester Fiberglass (PF) | Class 1 | ASTM E-84 |
| b. | Vinylester Fiberglass (VF) | Class 1 | ASTM E-84 |

PART 2 - PRODUCTS

2.1 STRUCTURAL SUPPORTS

A. Provide all supporting steel, not indicated on structural drawings, that is required for installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspend or floor support equipment.

2.2 PIPE HANGERS AND SUPPORTS (METALLIC)

A. Manufacturers: Anvil (formerly Grinnell), Erico (formerly Michigan Hanger), Tolco, or B-Line, equal to Anvil figures listed.

B. Hangers/supports for copper pipe where supports directly contact to pipe, shall be either copper plated or PVC coated.

C. For insulated pipe supports, refer to Insulated Pipe Supports in Part 3 of this Section.

D. Clevis and Roller Type Hangers:

| System | Pipe Size | Clevis | Roller |
|---|---|---|---|
| Hot Pipes with Insulation (120°F and above) | 2" and smaller | 65, 260 | --- |

1. For pipe size 2-1/2" and larger, where there is transverse movement at support points due to thermal expansion/contraction, clevis type hangers similar to Anvil Figure 260 may be used if vertical angle of hanger rod is less than 4 degrees.

| System | Pipe Size | Clevis | Roller |
|---|---|---|---|
| Cold Pipes with Insulation (33°F to 59°F) | 2" and smaller | 65, 260 | --- |
| | 2-1/2" and larger | 260, 295 | --- |

E. Flat Surfaces (Trapeze, Rack Type):

1. Use structural steel members such as struts, angles, channels and beams to support pipes as required. Select members properly for pipe support types and loading conditions. Refer to Part 1 for design criteria. Submit support details with type of members selected and load calculations. Provide straps, clamps, rollers or slides indicated below at each support point.

| System | Pipe Size | Straps or Clamps | Rollers | Slides |
|---|---|---|---|---|
| Hot Pipes with Insulation (120°F and above) | 2" and smaller | 243, 244 | --- | --- |
| Cold Pipes with Insulation (33°F to 59°F) | 10" and smaller | 137 | --- | --- |
| | | | --- | --- |

## 2.3 INSULATION PROTECTION SHIELDS

A. Anvil Fig. 167 constructed of galvanized carbon steel. Select shield to accommodate outer diameter of insulation. Shield length and gauge shall be as follows.

| Pipe Size | Length | Gauge |
|---|---|---|
| 1/4" thru 3" | 12" | 18 |
| 4" thru 6" | 18" | 16 |

## 2.4 INSULATION PROTECTION SADDLES

A. Anvil Fig. 160 Series, constructed of carbon steel or alloy steel plate. Select saddles to accommodate insulation thickness specified in Section 20 0700 - Mechanical Systems Insulation.

## 2.5 WEIGHT BEARING INSULATION INSERTS

A. Insert thickness shall match pipe insulation thickness. Pipe insulation jackets shall be continuous through sections containing inserts.

B. Minimum length of inserts shall be 12" or 2" longer than insulation protection shields, whichever is longer. Quantity and placement of inserts shall be based on weight of pipe and fluid plus 1.5 safety factor.

C. Cold Pipes (59°F and below):

1. Cellular glass insulation (Type G) similar to Pittsburgh Corning Foamglas, maximum compression strength 100 psi, Koolphen K insulation by Kooltherm Insulation, 5 lb/ft$^3$, maximum compression strength 50 psi, or HAMFAB H-Block by ICA Inc., maximum compression strength 30 psi. H-Block inserts shall be coated with vapor barrier coating similar to CADALAR 670 by SKIRGES Corp.

2.6 PRE-INSULATED PIPE SUPPORTS

A. Shaw Pipe Shields, Inc. or Rilco equal to Shaw Pipe Shields models listed.

B. Insulation shall consist of water-resistant calcium silicate of same thickness as adjoining pipe insulation, thermal conductivity not more than 0.38 at 75°F mean temperature, minimum density of 13 lb/ft$^3$, and compressive strength not less than 100 psi.

C. Structural inserts shall be water-resistant, high-density calcium silicate with minimum density of 32 lb/ft$^3$ and minimum compressive strength of 600 psi. Structural inserts shall be used as recommended by manufacturer to meet load ratings.

D. Use vapor barrier steel jacket around insulation. Insulation jackets shall be galvanized steel conforming to ASTM A-527. Hanger bearing surface shall consist of galvanized sheet metal insulation protection shield or casing.

E. When recommended by manufacturer, use double layer insulation protection shield at support bearing surface. Insulation shall extend 1" beyond insulation protection shield to maintain vapor barrier integrity.

F. Pre-insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes and standards: ASME B31.1, MSS SP-58, MSS SP-69, and MSS SP-89.

G. Load tests shall be made on both supporting materials and configurations. All tests shall be performed by independent testing laboratory. Results of pertinent tests shall be available upon request.

H. Unless otherwise indicated, pre-insulated pipe supports shall be as indicated in the following schedule. Model numbers are based on Shaw Pipe Shields, Inc.

1. Pipe supported on hangers: Models A2000, A4000, A9000, D3000 and D3200.
2. Pipe supported on flat surfaces: Models A2000, A4000, A6000, A7000, A7200, and A7400.
3. Pipe supported on pipe rolls: Models A4000, A6000, A8000, A8200, and A8400.
4. Pipe supported on slides: Model "B" Series.
5. A1000, A3000 or A5000 may be used for hot pipes (120°F and above).

I. Select proper model to conform to pipe service, support style, and support spacing.

J. Submit chart or table indicating selected model along with pipe sizes, rated loads, support device types and support spacing for each piping system.

K. Pipe support spacing shall be in accordance with manufacturer's recommendations, but in no case shall exceed maximum spacing indicated under Hanger and Support Spacing in Part 3 of this Section.

2.7 HANGER RODS (METALLIC)

A. Rods shall conform to the latest MSS Standards except as modified herein. Furnish rods complete with adjusting and lock nuts.

B. Rods shall have electroplated zinc or hot dip galvanized finish.

C. Unless otherwise indicated, size rods for individual hangers and trapeze support as indicated in the following schedule. Rod size may be reduced one size for double rod hangers. Total weight of equipment, including valves, fittings, pipe, pipe content and insulation, shall not exceed limits indicated.

| Max. Pipe Size With Single Rod | Rod Diameter (inches) | Maximum Load (lbs.) of Hanger Rod (Not exceeding 650°F Service Temp.) |
|---|---|---|
| 2" | 3/8 | 730 |
| 3" | 1/2 | 1350 |
| 5" | 5/8 | 2160 |
| 8" | 3/4 | 3230 |
| 12" | 7/8 | 4480 |
| 18" | 1" | 5900 |
| 30" | 1-1/4" | 9500 |

2.8 BOLTS, NUTS, STUDS AND WASHERS

A. ASTM A307, electroplated zinc finish.

2.9 ROD ATTACHMENTS

A. Anvil Fig. 290, galvanized finish.

2.10 U-BOLTS

A. Anvil Fig. 137, galvanized finish.

2.11 BEAM CLAMPS

A. Beam Clamps: Anvil Fig. 218, 228 and 292.

B. Top Beam Clamps: Anvil Fig. 227.

C. C-Clamps: Anvil Fig. 86, 92 or 93.

2.12 ADJUSTABLE PIPE SADDLE SUPPORTS

A. Anvil Fig. 264.

2.13 RISER CLAMPS

A. Anvil Fig. 261.

B. Proset system, proseal plug and fire-fill for sleeved and cored holes.

2.14 CONCRETE INSERTS (WOODEN FORMED CONCRETE)

A. Anvil Fig. 281 or 282, suitable for rod diameter and weight supported.

2.15 CONCRETE INSERTS (METAL DECK FORMED CONCRETE)

A. Anvil Fig. 284, Tolco No. 109, B-Line Fig. B3019, Powers Fasteners "Bang-It", or MSCO No. MX34.

2.16 CONCRETE ANCHORS (STATIC/GRAVITY LOADS ONLY, NOT FOR SEISMIC LOADS)

A. Manufacturers: Hilti, Powers Fasteners or Red Head.

B. Flush or shell type, meeting description in Federal Specification FF-S-325, Group VIII, Type 1 for expansion shield anchors, similar to Hilti HDI/HDI-L. Anchors shall be zinc plated in accordance with ASTM B633, Sc. 1, and Type III.

C. Select anchors with minimum safety factor of 8.0.

2.17 METAL FRAMING SUPPORT SYSTEM (STRUT SYSTEM)

A. Manufacturers: Unistrut, B-Line Strut Systems, Power-Strut, Superstrut, Kindorf, and Hydra-Zorb.

B. Channels shall have epoxy paint or electroplated zinc finish.

C. Channels shall not be lighter than 12 ga.

2.18 PIPE MOUNTING PEDESTALS

A. Equal to Roof Products & System Corporation consisting of equipment rail, "U" shaped mounting brackets, galvanized threaded rod and cast iron pipe rollers. Rail shall have built-in raised cant to match roof deck insulation.

2.19 EQUIPMENT RAILS

A. Manufacturers: Roof Products & Systems, ThyCurb, Custom Curb, Inc. or Vent Products equal to Roof Products & Systems Model ER-4 with raised cant style. Mounting rails shall be galvanized steel with integral base plate, continuous welded corner seams, factory installed 2 x 4 wood nailer and 18 gauge galvanized steel counter flashing.

B. Mounting rail gauge shall be selected to support equipment adequately but shall be not less than 18 gauge.

C. Height shall be as detailed, but not less than 8" above finished roof.

D. Equipment rails shall span minimum of 2 joists and not cantilever more than 6" where joists are used. Rails shall be level at top with pitch built in when deck slopes 1/4" per foot or greater.

2.20 PIPE ROOF PENETRATION PROTECTIONS

A. Manufacturers: Roof Products & Systems, ThyCurb or Vent Products equal to Roof Products & Systems "RPS-Pipe Portals" consisting of 12" OD prefabricated roof curb, laminated acrylic coated ABS plastic curb cover with EPDM protective rubber cap and stainless steel clamp.

2.21 PIPE GUIDES

A. Unless otherwise indicated, guides shall be Shaw Pipe Shields or Rilco equal to Shaw Pipe Shields "B" Series B3000, B4000, B7000, B8000, selected by load and movement.

2.22 PIPE ANCHORS

A. Unless otherwise indicated, anchors shall be no-moment type, Shaw Pipe Shields or Rilco equal to Shaw Pipe Shields Insulated Positive Pipe Anchor Model C3000 or C4000 Series, sized to meet anchor forces shown with minimum safety factor of 3.0.

B. Contractor may fabricate anchors of steel sections suitable for location of installation and for withstanding anchor forces shown with minimum safety factor of 3.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Suspend hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

E. Piping and ductwork shall be supported independently from other piping or ductwork.

F. Pipe hangers and supports shall not penetrate vapor barrier of pipe insulation.

G. Do not support equipment or piping from metal roof decking.

H. Install adequate supports during erection of piping so as not to over stress either piping or equipment to which piping is connected.

I. Refer to Section 20 0000 - General Mechanical Requirements for requirements of personnel injury protection guards for supporting devices.

J. Feed mains parallel to joists shall not be supported from single joist. Feed mains parallel to joists shall be supported from trapeze hanger and be positioned equally between 2 joists. Trapeze hangers shall be positioned to load joists at panel points only.

3.2 HANGER AND SUPPORT SPACING

A. Space pipe hangers and supports for horizontal pipe accordance with the following schedule, with exceptions as indicated herein:

B. Steel Pipe (Standard Weight and Extra Strong):

| Pipe Size | Max Spacing |
|---|---|
| 1-1/4" and smaller | 7'-0" |
| 1-1/2" | 9'-0" |
| 2" | 10'-0" |
| 2-1/2" | 11'-0" |
| 3" | 12'-0" |
| 4" | 14'-0" |
| 6" | 17'-0" |
| 8" | 19'-0" |
| 10" and larger | 20'-0" |

C. Copper Tube (Domestic Water, Laboratory Water, Non-potable Water):

| Pipe Size | Max Spacing |
|---|---|
| 1-1/4" and smaller | 6'-0" |
| 1-1/2" and larger | 10'-0" |

D. Copper Tube (Medical Gases):

| Pipe Size | Max Spacing |
|---|---|
| 1/4" | 5'-0" |
| 3/8" and 1/2" | 6'-0" |
| 3/4" | 7'-0" |
| 1" | 8'-0" |
| 1-1/4" | 9'-0" |
| 1-1/2" and larger | 10'-0" |

E. Plastic Pipe

1. PVC Pipe:

| Pipe Size | Max Spacing |
|---|---|
| All sizes | 4'-0" |

2. CPVC Pipe:

| Pipe Size | Max Spacing |
|---|---|
| 1" and smaller | 3'-0" |
| 1-1/4" and larger | 4'-0" |

3. Support plastic pipe at all changes of direction. Adequate consideration shall be given to piping expansion.

F. Cast Iron Pipe:
   1. Maximum hanger and support spacing shall be 10 ft for all pipe sizes. Provide minimum of one hanger per pipe section close to joint on barrel, at each pipe fitting, at change of direction and branch connections.
   2. Support Cast Iron No-Hub pipe as recommended in CISPI Publication "Cast Iron Soil Pipe and Fittings Handbook, Chapter IV - Installation of Cast Iron Soil Pipe and Fittings."

G. Borosilicate Glass:
   1. Maximum hanger and support spacing for borosilicate glass piping shall be 8 ft.
   2. Support borosilicate glass pipe with padded hangers.

H. Maximum spacing shown above may be restricted by strength of attachment to building structure. Submit data with calculations with published load ratings showing attachment to be utilized and maximum spacing allowable for that type of attachment and pipe size.

I. Spacing less than indicated above may be required to conform with building structure design or loading limitations.

J. If pipe size changes between support points, maximum spacing shall be based on the smaller pipe size.

K. If trapeze hangers are used to support multiple services, spacing shall be based on the most restrictive pipe size and material on trapeze hanger.

L. For non-metallic pipe, follow manufacturer's installation recommendations in addition to requirements noted herein.

M. Install supports for vertical piping and anchors as recommended by pipe manufacturer.

N. Place hangers and supports to meet requirements of Section 23 2116 - Pipe and Pipe Fittings or specific pipe system sections, with regard to pitch for drainage and venting and clearance between services.

O. Hangers and supports shall bear on outside of insulation when pipes are to be insulated.

P. Place hangers and supports within one foot of either side of each fitting, such as elbows and tees, and at each valve, strainer, and other piping specialty for piping 4" and larger.

Q. Place hanger or support at first elbow upstream of pump inlet and first elbow downstream of pump outlet.

## 3.3 RISER SUPPORTS

A. Insulated Piping:
   1. Unless otherwise indicated, support vertical piping as indicated below:
   2. Support vertical piping at bottom of riser, secured and anchored to building structure. Provide guides on vertical piping. Use spring hangers at **[top] [top and bottom]** of riser and at take offs from riser at each floor. Use spring hangers for minimum 3 hangers away from top and bottom elbows and from each take off at riser.

3. Guide vertical piping 2" and smaller at every floor. Guide 2-1/2" and larger at every other floor. Spring hangers (Type 6) and guides (Type VSG) are specified in Section 23 0550 - Vibration Isolation.

B. Non-Insulated Piping:
   1. Unless otherwise indicated, maximum vertical support spacing for ambient bare steel and cast iron pipes shall be 15 ft.
   2. Maximum vertical support spacing for other piping including copper tubing and plastic piping shall be 10 ft.
   3. Install riser clamps and intermediate supports as required.
   4. Rest riser clamps on floor or on pipe sleeve.

## 3.4 INSULATION PROTECTION SHIELDS

A. Install insulation protection shields at support points as specified under Insulated Pipe Supports.
   1. Use one shield (bottom) for clevis hanger.
   2. Use 2 shields (top and bottom) for roller hanger/support or strap/clamp support. Apply 2 metal straps to hold top and bottom shields onto insulation jacket.

## 3.5 INSULATION PROTECTION SADDLES

A. Install saddles at support points as specified under Insulated Pipe Supports. Tack weld saddle to pipe. Pack saddle cavity with insulation of same type as specified for piping system.

## 3.6 INSULATED PIPE SUPPORTS

A. Install insulated pipe supports at support points of all insulated pipe.

B. Pipe Size 1-1/2" and Smaller:
   1. Use insulation protection shields. Pipe insulation specified in Section 20 0700 - Mechanical Systems Insulation shall be continuous through support points.

C. Pipe Size 2" and Larger:
   1. Use pre-insulated pipe supports.
   2. In lieu of pre-insulated pipe supports, field-assembled insulated pipe supports may be used. If used, submit application details including materials, thickness, compression strength, load bearing surfaces, load calculations of support assembly and total pipe weight based on support spacing.
   3. Field-assembled insulated pipe supports shall consist of weight bearing insulation inserts and insulation protection shields.
   4. Insulation protection saddles may be used in lieu of assembled insulated pipe supports on roller hangers/supports for hot water pipes, low pressure steam and steam condensate pipes.

## 3.7 CONCRETE INSERTS

A. Concrete insert application, size, loading, and placement shall be reviewed and approved by Structural Engineer prior to installation.

B. Coordinate with General Contractor for placement of inserts before concrete pour. Minimize use of inserts and anchors after concrete pour.

3.8 BEAM CLAMPS

A. Provide locknut for hanging rod at clamp.

B. C-clamps are allowed for rod size 3/8" or smaller and only for static loading such as air piping, cold water piping, fire protection piping and, other similar piping and ductwork. C-clamps are not allowed for hot water piping and steam and steam condensate piping, except hot water runouts to terminal heating devices.

3.9 TRAPEZE SUPPORTS

A. Construct trapeze supports with struts, angles, or channels and hang them by inserts or welded beam attachments and rods.

B. Determine trapeze supports spacing by the smallest pipe on trapeze.

3.10 PIPE MOUNTING PEDESTALS

A. Use for all piping on roof. Install bottom of pedestal flat on roof deck, insulate exterior of pedestal, flash and counter flash.

3.11 EQUIPMENT RAILS

A. Use for all roof-mounted equipment, which is not curb mounted. Install bottom of equipment rail flat on roof deck. Insulate exterior of equipment rail.

B. Flashing will be by General Contractor. Provide counter flashing as specified and secure to wood nailer with stainless steel truss head screws.

3.12 CONCRETE ANCHORS

A. Anchor application, size, and placement shall be reviewed and approved by Structural Engineer prior to installation.

3.13 PIPE ROOF PENETRATION PROTECTIONS

A. Install at points where pipes are penetrating roof. Install as shown and according to manufacturer's installation instructions.

3.14 PIPE GUIDES

A. Install where shown on drawings.

B. For manufactured expansion devices, install minimum of 2 pipe guides at each side of manufactured pipe expansion device. Locate first guide no more than 4 pipe diameters from expansion device and second guide at 14 pipe diameters from first guide. Install intermediate guides in accordance with guide spacing data recommended by manufacturer or the following table, whichever is more stringent.

MAXIMUM DISTANCE BETWEEN INTERMEDIATE GUIDES (FT)

| | Pipe Operating Pressure | | | |
|---|---|---|---|---|
| Pipe Size (inches) | 0 to 50 psig | 51 to 100 psig | 101 to 150 psig | 151 to 200 psig |
| 3 | 21 | 19 | 17 | 16 |

| | | | | |
|---|---|---|---|---|
| 4 | 35 | 29 | 25 | 22 |
| 6 | 57 | 44 | 37 | 32 |

C. If anchor is located within 4 pipe diameters from expansion joints, guides need not be installed on anchor side.

3.15 PIPE ANCHORS

A. Install anchors where shown on drawings or in conjunction with expansion joints, loops and swing joints as required to allow proper expansion and contraction of piping without damage to structure, equipment or piping.

B. Do not anchor piping to concrete block walls, wood, or partition walls.

**END OF SECTION**

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SECTION 20 0700

MECHANICAL SYSTEMS INSULATION

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. Section 20 0529 - Mechanical Supporting Devices

B. Section 23 3114 - Ductwork (Duct Lining)

### 1.2 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

### 1.3 DESCRIPTION

A. Provide insulating materials and accessories as required for mechanical systems as specified below.

B. Insulating products delivered to construction site shall be labeled with manufacturer's name and description of materials.

### 1.4 DEFINITIONS

A. Concealed areas, where indicated in this Section, shall apply to shafts, furred spaces and space above finished ceilings, inaccessible tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

B. Unless otherwise indicated, unit of thermal conductivity is (BTU in)/(hr $ft^2$ °F).

C. Interstitial spaces are considered as concealed areas.

### 1.5 SUBMITTALS

A. Shop drawings for each piping system for all pipe sizes, each ductwork system, and all equipment including, but not limited to, the following:

1. Manufacturer's name.
2. Schedule of insulating materials.
3. Insulation material and thickness.
4. Jacket.
5. Adhesives.
6. Fastening methods.
7. Fitting materials.
8. Intended use of each material.
9. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings.
10. Insulation installation details (manufacturer's installation instruction/details, Contractor's installation details, MICA plates where applicable.)
11. All other appropriate data.

1.6 DELIVERY, STORAGE AND HANDLING

A. Insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weather-tight transportation. Protect insulation materials from moisture and weather during storage and installation. Protect insulation material against long exposure to UV light from sun.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Owens Corning, Johns Manville, Knauf or CertainTeed similar to product indicated except where product of manufacturers not listed above is specifically identified for special type of insulation.

2.2 MATERIALS

A. Products used for or related to air conditioning and ventilating systems shall conform to NFPA 90A possessing flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Unless otherwise indicated, all products, material itself or on a composite basis, shall meet ASTM E-84, UL 723 or NFPA 255 and shall not exceed 25 flame spread and 50 smoke developed.

C. Outdoor insulation may have flame spread rating up to 75 and smoke developed rating up to 150.

D. Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36.

2.3 INSULATION

A. Insulation materials shall be fire retardant, moisture and mildew resistant, vermin proof and suitable to receive jackets, adhesives and coatings as indicated.

B. Glass fiber insulation shall be of inert inorganic material, non-corrosive to mechanical surfaces.

C. Insulating cement shall be Quick-Cote by PK Insulation MFG Co. or Ryder GP, with dry density of no more than 38 $lb/ft^3$, thermal conductivity of 0.96 at 400°F mean temperature, and service temperature to 1200°F.

D. Filling and finishing cement shall be Super-Stik by PK Insulation MFG Co., or Ryder MW, with dry density of no more than 24 $lb/ft^3$, thermal conductivity of 0.74 at 500°F mean temperature, and service temperature to 1900°F.

E. Type R Insulation (Rigid Glass Fiber):
   1. Minimum nominal density of 3 $lb/ft^3$, with thermal conductivity of not more than 0.23 at 75°F mean temperature. Minimum compressive strength at 10% deformation shall be 25 $lb/ft^2$.
   2. Pipe insulation shall be suitable for temperatures to 850°F, Johns Manville Micro-Lok 850, Owens Corning Fiberglas ASJ/SSL-II.
   3. Duct and equipment insulation shall be suitable for temperatures to 450°F, Johns Manville Spin-Glas Type 814, Owens Corning Type 703.
   4. Pipe and tank wrap faced with specified jacket may be used for equipment and round ducts insulation, provided that it meets all insulation characteristics requirements stated above and maintains same R-value as specified.

F. Type A Insulation (Closed Cell Elastomeric Thermal Insulation):

1. Minimum nominal density of 6 lb/ft$^3$, thermal conductivity not more than 0.27 at 75°F mean temperature, maximum water vapor transmission of 0.08 perm-inch and suitable for temperatures from -70°F to 220°F, Armstrong Armacell, or Nomaco (Rubatex).

2.4 JACKETS

A. Jacket puncture resistances shall be based on ASTM D-781 test methods. Vapor barrier permeance ratings shall be based on ASTM E-96 Procedure A.

B. Type P-1 Jackets:

1. Heavy-duty, fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket shall have neat, white Kraft finish or white vinyl finish suitable for painting, with beach puncture resistance of 50 units minimum. Vapor barrier shall be 0.0005" aluminum foil adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm. Owens Corning "ASJ-SSL", Johns Manville flame-safe "AP-T".

2.5 ADHESIVES, MASTIC, COATINGS, SEALANTS, AND REINFORCING MATERIALS

A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

B. Products shall be fire retardant, moisture resistant and mildew resistant and vermin proof.

C. Adhesives, mastic, sealants, and protective finishes shall be as recommended by insulation manufacturer for specified application.

D. Glass fiber fabric reinforcing shall be 10 x 10 or 20 x 10 mesh.

E. Wire mesh reinforcing shall be 22 ga, 1" galvanized.

F. Insulation cement shall be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement shall be ASTM C449.

H. Butt joint and longitudinal joint adhesive for Type A insulation shall be Armstrong 520, Rubatex 373 or Manville 57.

I. Weather-resistant protective finish for Type A insulation shall be equal to Armstrong WB Armaflex finish.

2.6 METAL BANDS AND WIRES

A. Aluminum bands shall be 0.5" x 0.020" up to 48" diameter and 0.75" x 0.020" over 48" diameter.

B. Stainless steel bands shall be 0.5" x 0.015" or 0.75" x 0.015".

C. Stainless steel wires shall be 16 ga.

2.7 REMOVABLE INSULATING BLANKETS

A. Custom designed removable, reusable, flexible, blanket thermal insulation system.

B. Acceptable Manufacturers: Thermal Energy Products, Inc., Advanced Thermal Corp. and Remco Technology, Inc.

C. Removable insulation system shall be custom designed for each individual item to provide close contour fit. Overlapping seams and gaps are not acceptable.

D. Removable insulation shall be designed to overlap adjoining pipe insulation by 2".

E. Insulation: Minimum 2" thick, 2.4 lb/ft$^3$ density, 1000°F thermal insulating wool; Owens Corning Fiberglass or equal.

F. Interior and Exterior Fabric: 17.5 oz/sq yd silicone rubber coated fiberglass cloth.

G. Securement: Blanket seams shall be closed with buckle and strap assembly (D ring closure).

H. Identification/Tagging: Label each removable insulation device with plastic or 304 stainless steel tag with raised letters. Tag as directed by Owner.

2.8 ACOUSTICAL BARRIER MATERIALS

A. Acoustical barrier material shall be similar to Kinetics Model KNM-100ALQ. Barrier material shall have acoustic ratings of STC-28, 1.0 lb/ft$^2$ nominal density, flame spread index less than 25, smoke developed index less than 50, and minimum continuous operating range from 40 to 220°F.

B. Minimum sound transmission loss at each octave band shall be as follows:

| Sound Transmission Loss (dB) | | | | | |
|---|---|---|---|---|---|
| Octave Band Center Frequency (Hz) | | | | | |
| 125 | 250 | 500 | 1000 | 2000 | 4000 |
| 13 | 16 | 24 | 33 | 43 | 49 |

## PART 3 - EXECUTION

3.1 APPLICATION

A. Provide insulation and jackets as indicated in the following schedule. The schedule applies to both exposed and concealed applications unless noted otherwise.

| | Piping System | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Insulation Thickness According to Pipe Size | | | | |
| Service | Jacket Type | Insulation Type | 3/4" and less | 1" - 1-1/4" | 1-1/2" - 3" | 4" - 6" | 8" and Larger |
| Domestic Cold Water | P-1 | R | 1" | 1" | 1" | 1" | 1" |
| (Type A Insulation is an option | -- | A | 3/4" | 3/4" | 3/4" | 3/4" | 3/4" |
| Domestic Hot Water and Hot Water Return (105-140°F) | P-1 | R | 1" | 1" | 1-1/2" | 1-1/2" | 1-1/2" |
| | -- | A | 1" | 1" | 1-1/2" | NA | NA |

3.2 INSTALLATION - GENERAL

A. All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of Specifications.

B. Install products with good workmanship, with smooth and even surfaces. Use full-length factory-furnished material where possible. Do not use scrap pieces.

C. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed. Do not insulate any section of system that must be pressure tested until after it has been successfully tested. Any removal and reinstallation to correct system defects prior to end of guarantee period shall be accomplished at no expense to Owner.

D. Install insulating materials with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection, service or repair is required, and to allow for expansion.

E. Where possible longitudinal joints in jackets shall face toward wall or ceiling.

F. Apply insulation to each pipe or duct individually. Common insulation applied to adjacent pipes or ducts will not be accepted.

G. Unless otherwise indicated, pipe and duct insulation shall be continuous through walls and floors.

H. Where multiple layers of insulation are used, stagger and secure each layer with metal bands.

I. Where penetrations occur through fire-rated walls, partitions, or floors, provide fire seal as specified in Section 20 000 - General Mechanical Requirements and Section 20 0573 - Mechanical Systems Firestopping.

J. Insulate water piping within walls up to fixture stop. Insulate water piping within walls up to pipe penetration through the wall. Termination of insulation shall be in neat and workman like manner with insulation jacket cap.

K. Insulate the following systems for complete vapor barrier protection:
   1. Cold Water

L. Apply Type A insulation for insulation and jackets requiring vapor barrier protection where specified insulations are cut for mounting sensors, control devices, parts of valves, devices or components which extend out from specified insulation to prevent condensation.

3.3 PIPING, VALVE AND FITTING INSULATION

A. Apply insulation to pipe, unions, flanges, fittings, valves and piping specialties with butt joints and longitudinal seams closed tightly.

B. Laps on factory-applied jackets shall be 2" minimum width firmly cemented with lap adhesive, or shall be pressure sealing type lap.

C. Cover joints with factory furnished tape (3" minimum width) to match jacket. Cement firmly with lap adhesive.

D. Secure insulation, except insulation covered with vinyl jackets, additionally with staples.

E. Where staples are used, they shall be on 6" maximum centers. When used for systems requiring vapor barrier, cover lap and staples with finish coat of lagging adhesive.

F. Built-up insulation for fittings and valves shall be made with sectional insulation, wrapped firmly to thickness of adjoining pipe insulation, and bound with jute twine, or built up with insulating cement, and finished to smooth hard surface, and covered with minimum of 9 oz per sq yd rewettable glass cloth similar to Clairmont Diplag 60.

G. For valves and fittings requiring vapor barrier, apply 2 coats of vapor barrier mastic with glass fiber reinforcing fabric after application of insulating cement. For valves and fittings not requiring vapor barrier, apply 2 coats of weatherproof mastic with glass fiber reinforcing fabric after application of insulating cement. Apply coating in accordance with manufacturer's recommended procedure.

H. For finishing of insulated pipe fittings and valves where surface temperature of insulation is not higher than 125°F, one piece PVC fitting covers, minimum thickness of 20 mil, may be used. Fitting covers located in mechanical rooms within 8 ft above floor shall be 30 mil thickness. Johns Manville Zeston 2000 PVC, PROTO Fitting Covers, or similar by other manufacturers listed. Where fitting and valve insulation requires vapor barrier, seal joints of PVC covers with vapor barrier adhesives. Insulation type, R-value and density of insulation used at fittings shall match those of adjacent piping. Install insulation at pipe fittings and valves completely prior to applying PVC covers.

I. Where terminations of pipe insulation are required, insulation shall have tapered ends, built up and finished as specified for fittings.

J. For pipes 1-1/2" and smaller, install specified pipe insulation and jacket continuous through hanger or support locations. Install insulation protection shields to protect insulation from compressing.

K. For pipes 2" and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. Where vapor barrier is required, this Contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. Use 3" wide vapor barrier tape on hot and cold systems at pipe supports.

L. For pre-insulated pipe supports and insulation protection shields, refer to Section 20 0529 - Mechanical Supporting Devices.

M. For Contractor-fabricated anchors, secure insulation directly to pipe surface and extend insulation up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Where applicable, take special care to assure vapor seal at anchor.

N. Where mechanical grooved pipe connections are used in piping system, insulate couplings as specified for pipe.

O. Piping, fittings and valves not to be insulated:
   1. Heating hot water piping inside fin tube radiation enclosures.
   2. Control valves and balancing valves for heating terminal devices.
   3. Valves furnished with removable insulation/jacket.
   4. Steam system traps.

3.4 EQUIPMENT INSULATION

A. Apply insulation to equipment shells with bonding adhesive and wire in place. Fill joints and seams with insulating cement and cover insulated surfaces with wire reinforcing mesh. Apply additional coat of insulating cement, cover with glass fabric as specified herein, and finish to smooth hard surface.

B. For equipment shells requiring vapor barrier, apply 2 coats of vapor barrier mastic with glass fiber reinforcing fabric after application of insulating cement. For equipment shells not requiring vapor barrier, apply 2 coats of weatherproof mastic with glass fiber reinforcing fabric after application of insulating cement. Apply coating in accordance with manufacturer's recommended procedure.

C. Install removable insulating boxes where access is required for cleaning, repair and inspection, including pump heads and strainers. Construct removable insulating boxes with split metal enclosures using minimum 24 ga galvanized sheet metal lined with Type A insulation adhered to inside of box with 520 adhesive. Do not apply bonding adhesive to equipment surface. Finish interior surface of insulating box to allow removal without damage. Provide fasteners, supports and membranes as required.

D. Provide Removable Insulating Blankets on expansion joints.

E. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.

F. Equipment not to be insulated:
   1. Equipment furnished with factory insulation.

**END OF SECTION**

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SECTION 21 0000- GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Specification requirements defined in Division 20 of this specification apply to, and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 21. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.2 RELATED WORK

A. Section 20 0000 - General Mechanical Requirements

B. Section 20 0513 - Motors

C. Section 20 0520 - Excavation and Backfill

D. Section 20 0529 - Mechanical Supporting Devices

E. Section 20 0549 - Seismic Anchorage and Restraints

F. Section 20 0553 - Mechanical Systems Identification

G. Section 20 0573 - Mechanical Systems Firestopping

H. Section 20 0700 - Mechanical Systems Insulation

PART 2 - PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION.

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION.

**END OF SECTION**

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SECTION 21 1314- AUTOMATIC FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies materials, methods, and equipment to be used for automatic sprinkler system and related fire protection piping to 5 ft outside building.

B. As shown on drawings, system(s) shall consist of:
   1. 1 dry sprinkler zones

C. This Section specifies design criteria for fire protection system. Zone and main piping layouts of fire protection system have been established, as it relates to architecture, structure and mechanical/electrical systems. Fire Protection Contractor, based on these layouts, shall produce installation drawings which are also referred to as shop drawings in this Specification.

1.2 RELATED WORK

A. Section 20 0520 - Excavation and Backfill

B. Section 20 0553 - Mechanical Systems Identification

C. Section 28 3113 - Fire Detection and Alarm Systems

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 1 General Requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards:
   1. This installation shall conform to the following:
      a. NFPA 13, Installation of Sprinkler Systems
      b. NFPA 72, National Fire Alarm Code
      c. Underwriters Laboratories (UL) Fire Protection Equipment Directory
      d. Factory Mutual Research Corporation (FMRC) Approval Guide
      e. Local and State Building, Mechanical and Fire Codes
      f. International Building Code (IBC)

B. Contractor Installation Program:
   1. Licensed persons employed by Sprinkler Contractor shall perform planning, calculations, layout, and installation. Certified sprinkler designer, National Institute for Certification of Engineering Technologies, (NICET) Level IV or licensed Professional Engineer for planning and calculations, and journeyman sprinkler fitters for installation foreman and supervisory personnel.
   2. Journeyman automatic fire sprinkler fitter(s) shall supervise field installation.
   3. Contractor shall be licensed in the State of WI for Installation of Fire Protection Systems.

4. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
5. Distortion or misrepresentation of qualification evidence may result in Contract cessation.

C. Electrical Coordination
1. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for power side or the control of electrical equipment shall be furnished by electrical contractor, except as specifically noted elsewhere in this specification.
2. Should any change in electrical equipment size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, sprinkler contractor is to immediately notify electrical contractor of this change and pay any costs due to this change.
3. Electrical contractor shall provide all power wiring and sprinkler contractor shall provide all control wiring and its conduit. Control wiring shall conform to Division 28 requirements for control wiring.
4. Sprinkler contractor shall provide exterior waterflow alarm and coordinate installation with electrical contractor and fire alarm contractor.
5. Furnish wiring diagrams to electrical contractor for all equipment and devices furnished by the sprinkler contractor which have been indicated to be wired by the electrical contractor.

1.5 SUBMITTALS

A. Shop Drawings on Items Specified:
1. Pipe and Fittings.
2. Valves.
3. Tamper Switches.
4. Flow Switches.
5. Exterior Weatherproof Waterflow Alarm.
6. Sprinkler Heads.
7. Sprinkler Head Cabinet.
8. Dry Pipe Valve and Accessories.
9. Hanger Assemblies.
10. Pressure Gauges.
11. Fire Department Connection (FDC).
12. Double Check Backflow Prevention assembly (DCBP).
13. Hydraulic Calculations.
14. Drawings.

B. Include items listed in product section and additional items required to provide complete installation.

C. Indicate by red marking or arrow, items to be used where more than 1 item appears on manufacturer's catalog sheet.

D. Submit shop drawings, equipment submittals, and hydraulic calculations to Engineer and Owner's Insurance representative prior to installation or fabrication of system components.

E. Submit shop drawings, product data sheets and hydraulic calculations to Local Fire Department prior to installation or fabrication of system components.

F. Include copy of Fire Department plan review letter in submission to Engineer.

G. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.

H. At completion of acceptance tests:
   1. Send copy of test log to Engineer.
   2. Send copy of Contractor's Material and Test Certificates to:
      a. Engineer
      b. Owner
      c. Authority Having Jurisdiction
   3. Provide Owner with following:
      a. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
      b. Current copy of NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Materials and Equipment:
   1. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
   2. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of 1 manufacturer.
   3. Clean and cap pipe after fabrication and prior to placing pipe in building.
   4. Mark pipe with tags that can be removed during installation so no permanent markings remain on unpainted pipe located in exposed areas.
   5. Couplings shall be tees with capped outlets. These capped tees may be used in future to connect piping extensions to protect locker room areas.

B. Approval Guides:
   1. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory **or** Approved in the latest Factory Mutual Approval Guide for service intended.

### 2.2 PIPE

A. Above Ground:
   1. Carbon steel pipe, Schedule 10, ASTM A795, ASTM A53 or A135, roll-grooved for mechanical fittings.
   2. Carbon steel pipe, Schedule 40, ASTM A795, ASTM A53 or A135, cut-grooved for mechanical fittings.
   3. Galvanized steel pipe, Schedule 10, ASTM A795, ASTM A53 or A135, roll-grooved for mechanical fittings.
   4. Galvanized steel pipe, Schedule 40, ASTM A795, ASTM A53 or A135, cut-grooved for mechanical fittings.

5. Provide metal pipe's exposed threads with corrosion inhibitive paint.

2.3 FITTINGS

A. Above Ground:
1. Cast iron threaded, Class 125, 175 psi WOG pressure rating, ANSI B16.4.
2. Cast iron flanged, Class 125, 175 psi WOG pressure rating, ANSI B16.1.
3. Grooved:
   a. Ductile iron or malleable iron, grooved for mechanical coupling, 175 psi WOG pressure rating, malleable iron conforming to ASTM A536 for ductile iron and ASTM A47 for malleable iron.
   b. Fitting, gasket and coupling shall be furnished by same manufacturer.
   c. Acceptable manufacturers: Gruvlok, Victaulic, Viking Corp. or equal.
4. Fitting, gasket and coupling shall be furnished by same manufacturer.
5. Galvanized, cast iron, threaded fittings, 175 psi WOG pressure rating, ANSI B16.4.
6. Fittings shall be galvanized when installed on galvanized piping.
7. Pipe-o-lets or similar clamp on or saddle type fittings are not allowed as fittings.
8. Weld-o-lets welded to piping in fabrication shops are permitted. No welding allowed at project site.
9. Saddle type devices that strap or clamp onto piping are not allowed

2.4 JOINTS:

A. Above Ground:
1. Threaded joints:
   a. Tapered pipe threads, ANSI B1.20.1.
2. Flanged:
   a. Cast iron, 175 psi WOG pressure rating, ANSI B16.1.
   b. Square head machine bolts with semi-finished hexagon nuts, ASTM A183.
   c. Neoprene gasket.
3. Mechanical coupling:
   a. Grooved couplings shall be of same manufacturer as used for grooved fittings.
   b. Malleable iron, ASTM A47, equal to Victaulic No. 75.
   c. Rigid mechanical, ASTM A536, equal to Victaulic No. 005.
   d. Gaskets:
      1). Dry system: Victaulic "FlushSeal" or equal.
   e. Rigid or zero flex type couplings shall be used when operating pressures may cause piping to move out of place or sway on hangers. Flexible couplings may be used where piping is securely braced or clamped into rigid position.
   f. Plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) are not allowed on either new or existing sprinkler systems.
4. Shop welded joints.
   a. Welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.

## 2.5 VALVES

A. Gate Valve:
   1. Acceptable manufacturers: Kennedy, Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic.
   2. Outside screw and yoke (OS&Y), gate valve, bronze body and trim or cast iron body bronze mounted and rated for 175 psi, non-shock cold water working pressure, Nibco F-607-OTS or equal.

B. Check Valve:
   1. Acceptable manufactures: Tyco Fire Products, Reliable, Viking Corp.
   2. Iron body, bronze seat, stainless steel clapper with a replaceable rubber seal and 175 psi non-shock cold water working pressure. Viking Model G-1 or equal.

C. Ball Valve:
   1. Acceptable manufacturers: Nibco, Milwaukee Valve Co., Mueller, Stockham, Victaulic.

D. Butterfly Valve:
   1. Acceptable manufacturers: Kennedy, Nibco, Milwaukee Valve Co., Mueller, Stockham, Victaulic.
   2. Milwaukee Valve Co., Series BB or equal.
   3. Kennedy Valve Co., Fig. 0IG, Victaulic Series 705 Firelock or equal for valve sizes 2-1/2" to 8".

E. Double Check Backflow Prevention Assembly (DCBP):
   1. Acceptable manufacturers: Conbraco, Cla-Val, Febco, Watts.
   2. Weighted clapper double check valve assembly including 2 OS&Y gate valves.
   3. Assembly shall be double check valve assembly for cross connection devices.
   4. Certified in accordance with ASSE 1015 and AWWA C510-97.
   5. Double check valve shall be selected based on minimal pressure drop to allow maximum available pressure to sprinkler system.

F. Test and Drain Valves:
   1. Acceptable manufacturers: AGF, Victaulic or equal.
   2. AGF TESTanDRAIN Victaulic Style 720 TestMaster II or equal may be installed.

G. Drain Valves:
   1. Acceptable manufacturers: Kennedy, Nibco or equal.
   2. Thread-in bonnet bronze globe valves, rated to 175 psi non-shock cold water working pressure.
   3. Low point drain valves shall have, 3/4" brass nipple with 3/4" male hose threads and cap.

## 2.6 DRY PIPE VALVE

A. Acceptable manufacturers: Tyco Fire Products, Reliable, Victaulic, Viking Corp.

B. Dry pipe valve shall assembly shall include accelerator.

C. Include standard trimmings, such as gauges; drain valve, test valve, air connection, and air supervisory pressure switch.

D. Maintenance air compressor shall be floor mounted type with capacity to refill system within 30 minutes.

E. Water flow alarm bell shall be included with dry pipe valve.

2.7 TAMPER SWITCH

A. Acceptable manufacturers: Potter, System Sensor or equal.

B. Outside screw and yoke (OS&Y) supervisory switch, NEMA 4 enclosure, provided with 2 sets of contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Equal to Potter OSYSU-2. Provide with optional cover tamper kit. For areas identified as hazardous locations, provide "EX" Model.

C. Control valve supervisory switch, NEMA 4 enclosure, provided with 2 sets of contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Equal to Potter PCVS-2. Provide with optional cover tamper kit. For areas identified as hazardous locations, provide "EX" Model.

D. Tamper switch shall be capable of transmitting signal during first 2 revolutions of handwheel or during 1/5 of travel distance of valve control apparatus from its normal position.

E. Unit shall be compatible with Fire Alarm System.

2.8 FLOW SWITCH

A. Acceptable manufacturers: Potter, System Sensor, or equal.

B. Vane type waterflow switch for use in wet sprinkler systems, 450 psi service pressure rating, 10 gpm minimal flow rate to activate alarm, 2 sets of SPDT (Form C) contacts rated at 2 Amps at 30 VDC and 15 Amps at 125/250 VAC. Provide with optional cover tamper kit. Equal to Potter VSR-F.

C. Unit shall be compatible with Fire Alarm System. Potter model VSR-F or equal.

2.9 SPRINKLER HEAD

A. Manufacturers:
   1. Unless otherwise noted below, shall be manufactured by Reliable Automatic Sprinkler Corporation, Tyco Fire Products or Viking Corp.

B. Automatic, having temperature rating suitable for location.

C. Light Hazard occupancies shall be Quick Response type sprinkler heads.

D. Architect will review deviations from the specified styles for approval prior to installation.

E. Provide the following type of sprinkler head.
   1. Unfinished areas such as mechanical spaces, central utility plant, tunnels.
      a. Brass Upright or Pendent, 1/2" orifice, ordinary temperature class (155°F), Viking Model M, Micromatic or equal.
   2. In areas where ceiling conditions do not permit installation of pendent head or finished area where sidewall head provides better coverage of hazard.
      a. Polished Chrome Sidewall, 1/2" orifice, ordinary temperature class (155°F), 2-piece adjustable chrome escutcheon, Viking Model M, HSW horizontal or VSW vertical sidewall with Viking E-1 escutcheon or equal.

F. Submit samples for examination and approval when appearance is different than sprinkler head specified.

G. Temperature ratings of sprinkler heads shall vary if installed close to heat sources, under skylights or in special hazard areas.

H. Sprinkler Cabinets:
   1. Complete with required number of spare sprinkler heads of each type and temperature rating and special wrenches per NFPA 13.
   2. Provide multiple cabinets to meet this requirement.
   3. Coordinate cabinet locations with Owner's representative.

2.10 FIRE DEPARTMENT CONNECTION (FDC)

A. Manufacturers:
   1. Acceptable Manufacturers: Badger-Powhatan, Elkhart Brass, Croker Corp., Potter-Roemer, Tyco Fire Products, or equal.

B. Fire Department Connection:
   1. Flush type, cast brass body with drop clappers, rough chrome plated finish, with lettering reading AUTOSPKR .
   2. Unit shall include four 2-1/2" chrome plated brass snoots with rigid end threading to match local fire department standards by pin-lug hose thread swivels, pin-lug plugs and chains, Elkhart 166 or equal.

2.11 BALL DRIP

A. Acceptable manufacturer: Potter-Roemer, Reliable, Tyco Fire Products or equal.

B. Provide bronze ball drip for Fire Department connection inside of building and pipe to nearest floor drain, or discharge to exterior.

C. Exterior discharge must be coordinated with Architect and Owner.

2.12 HANGERS

A. Provide hangers to support piping: in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13.

B. Riser clamps shall not protrude more than 2" beyond edge of hole. Provide Anvil Fig. 261 or equal.

C. Concrete expansion anchors are to be Hilti, Rawl, or Phillips concrete fasteners.

2.13 PRESSURE GAUGES

A. Acceptable manufacturers: Potter-Roemer, Viking or equal.

B. Pressure gauges shall be 3-1/2", corrosion resistant moving parts, polycarbonate window, and provided with connection not smaller than 1/4" NPT.

C. Include shutoff valve with provisions for draining on each pressure gauge.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. Flow Test:
   1. Sprinkler contractor shall be responsible for obtaining hydrant flow information.

B. Send current hydrant flow test data to Engineer.

C. Fire pump shall be designed to meet Fire Protection System demand.

D. Hydraulically calculated system is not required to be designed to a minimum of 10% below available water flow curve.

E. Systems that are hydraulically calculated must include 1.2 factor for design area.

F. Basis of Design:
   1. Toilet rooms, ticket and concession shall be hydraulically designed to provide minimum density of 0.10 gpm per sq ft for most remote1950 sq ft. Maximum spacing shall not exceed 225 sq ft per head.

G. Hose Streams:
   1. Add 250 gpm hose stream to sprinkler zone hydraulic calculations.

H. Fire Protection System Layout and Shop Drawings:
   1. Contractor shall review Design Drawings and Specifications, and shall produce Shop Drawings, calculations, and product data sheets.
   2. Conceal sprinkler piping above ceilings where possible.
   3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
   4. Submit shop drawings, calculations and product data sheets for coordination review to: architect, insurance carrier, City of Madison and other Authorities Having Jurisdiction over this Project prior to installation (see submittals).
   5. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
   6. Contractor shall coordinate routing of piping with other trades and Architect.
   7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

3.2 INSPECTION

A. Investigate site conditions; verify utility locations and elevations before start of excavation. Discrepancies will be forwarded to Architect/Engineer before proceeding with construction.

3.3 INSTALLATION

A. Install hydraulically designed sprinkler system and associated accessories according to requirements of NFPA 13 and as shown on drawings.

B. Install pipe and fittings according to recommendations of pipe manufacturer.

C. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.

D. Pipe and fittings shall be of corresponding materials when assembled.

E. Provide readily removable fittings at end of cross-mains. Minimum size of flushing connection shall be 2".

F. Provide test connection for each flow switch.

G. Discharge test connections inside building to receptacles provided as part of plumbing system or to drain standpipe.

H. Drain line detailed adjacent to sprinkler risers shall be considered as part of Sprinkler System from combination test/auxiliary drain valve for each zone or sub-zone shown on plans to plumbing receptacle.

I. Provide auxiliary drains at low points of systems. Where trapped section of pipe exceeds 5 gallons, drain shall consist of, as a minimum: valve, 3/4" brass nipple with 3/4" male hose threads, and cap.

J. Identify valve with brass tag denoting which flow switch is being tested, when test valves are located remote from flow switch.

K. Clamp-on or saddle type fittings are not allowed. Outlet fittings inserted into holes drilled into piping or pipe-o-lets are not allowed.

L. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler/standpipe systems. No bushings or grooved reducing couplings, such as Victaulic Style 750, are allowed.

M. Piping, dry pipe valves, sprinkler heads and test/auxiliary drain piping of dry sprinkler systems shall be galvanized steel or copper to retard or eliminate corrosion due to oxidation in these sub-systems. Provide dielectric fittings between dissimilar pipe materials.

N. Provide minimum 1" outlets with sprigs or drops for sprinklers located in shelled spaces.

O. Install tamper switch on each shutoff valve.

P. Install locking device with each shutoff valve to prevent inadvertent closing of valve. Keys shall be indexed to identify valve location.

Q. Install sprinkler heads as recommended by manufacturer. Sprinklers shall be set level and at locations to avoid interference with spray pattern of sprinkler. When ducts and lights are obstructions to sprinkler distribution, provide additional heads beneath obstruction.

R. Make joints of threaded pipe by cutting pipe square and reaming inside.

S. Coat exposed threads with corrosion inhibitive paint. Use joint compound sparingly.

T. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer's gasket lubricant sparingly.

U. Pipe shall be cut grooved for Schedule 40 steel pipe or roll grooved for Schedule 10 steel pipe as specified by coupling manufacturer.

V. Welded joints shall be made in fabrication shop. No welding allowed at project site.

W. Hang pipe from building members using concrete inserts or beam clamps. Expansion type inserts may be used for branch piping.

X. Support piping in accordance with NFPA 13 in accordance with State and Local seismic restraint requirements.

Y. Install pressure gauges as required in manufacturer's installation instructions, and as required per NFPA.

3.4 TESTING

A. Refer to testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Perform all NFPA required acceptance tests.

C. Test sprinkler system as entire system or partial system. System shall be hydrostatically tested at not less than 200 psi or 50 psi above static pressure in excess of 150 psi for 2 hrs. No leakage allowed. Replace defective joints with new materials. No caulking of defective joints allowed. Re-test system after defective joints are replaced, until satisfactory results are obtained.

D. Hydrostatically test piping between the exterior fire department connection (FDC) and the check valve in the fire department inlet pipe in the same manner as the balance of the system.

E. Pipe shall not be concealed until satisfactorily pressure tested.

F. In addition to hydrostatic test, dry pipe system shall be air pressure tested at 40 psi for 24 hrs. Leakage in excess of 1-1/2 psi during 24 hrs will not be permitted.

G. Conduct drain test. Record static pressure and residual pressure per NFPA 13.

H. Owner's representative or engineer may witness tests. Contractor shall notify Owner and Engineer a minimum of 3 days in advance to allow for participation.

I. Log of tests shall be kept at job site and shall identify:
   1. Who performed test.
   2. Time of test.
   3. Date of test.
   4. Section of system tested.
   5. Results of test.
   6. Along with completed Contractor's Material and Test Certification form(s) from NFPA 13.

J. Operate flow switches to test that signals are transmitted to Fire Alarm Control Panel.

K. Include test for tamper switches.

**END OF SECTION**

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SECTION 22 1118- WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section covers interior domestic cold water, domestic hot water and nonpotable cold water to point 5 ft outside building wall.

1.2 RELATED WORK

A. Section 20 0520 - Excavation and Backfill

B. Section 20 0529 - Mechanical Supporting Devices

C. Section 20 0700 - Mechanical Systems Insulation

D. Section 22 2114 - Material Specialties

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

A. Order pipe with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.

B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

E. Before shipping, piping shall be cleaned, free of rust and scale, and chemically treated to protect inside of pipe from rusting, and furnished with end caps.

1.6 SUBMITTALS

A. Manufacturer's technical data for the following:
   1. Pipe.

2. Fittings.
3. Joints.
4. Valves.
5. Unions.
6. Dielectric fittings.

B. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials herein specified shall be new unless otherwise noted.

2.2 PIPE, FITTINGS, AND JOINTS

A. Underground 3" and Larger:
1. Ductile Iron:
a. Pipe: Ductile iron, Class 52, AWWA C151, with standard cement mortar lining, AWWA C104.
b. Fittings:
1). Ductile iron or grey iron, mechanical joint, cement mortar lined, Class 250, AWWA C110.
2). Ductile iron, mechanical joint compact fittings, Class 350, AWWA C153.
c. Joints: elastomeric gasket joints with non-toxic gasket lubricant, AWWA C111.
d. Encasement: provide 8-mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
2. Polyvinyl Chloride (PVC):
a. Pipe:
1). PVC pressure pipe, DR 18, Class 150, AWWA C900; integral bell and elastomeric gaskets, ASTM D3139.
2). PVC pressure pipe, Schedule 80, ASTM D1785, AWWA C900.
b. Fittings:
1). Ductile iron or grey iron, mechanical joint, cement mortar lining, AWWA C104.
2). Ductile iron, mechanical joint compact fittings, Class 350, AWWA C153.
3). PVC, Schedule 80, socket pattern.
c. Joints:
1). Elastomeric gaskets, ASTM C3139.
2). Primer, ASTM F656; solvent cement, ASTM D2564.

B. Underground 2-1/2" and Smaller:
1. Copper:
a. Pipe: Copper tube, Type K, soft (annealed) temper, ASTM B88.
b. Fittings: Copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, ANSI B16.26.
c. Joints: Lead free (<0.2%) solder, Bridgit or Silvabrite, ASTM B32, flux, ASTM B813.

C. Above Ground:

1. Copper (2-1/2" and Smaller):
   a. Pipe: Copper tube, Type L, hard drawn, ASTM B88.
   b. Fittings:
      1). Cast bronze, solder joint, pressure rated, ANSI B16.18.
      2). Wrought copper, solder joint, pressure rated, ANSI B16.22.
2. Copper (3" and Larger):
   a. Pipe: Copper tube, Type L, hard drawn, ASTM B88.
   b. Fittings:
      1). Wrought copper, ASTM B75 or ASTM B152 and ASME B16.22, roll grooved.
      2). Copper alloy CDA 836(85-5-5-5), sand cast per ASTM B584 and ASME B16.18, roll grooved.
      3). Manufactured to copper tube dimensions with factory grooved ends. Flaring of tube and fitting ends to IPS dimensions is not permitted.
   c. Joints: Roll grooved with ductile iron couplings, ASTM A536. Coupling housing shall be cast with off-setting, angle-pattern bolt pads. Heat-treated carbon steel bolts, ASTM A183, pressure responsive EPDM gasket UL classified in accordance with NSF-61, and enamel coated. Victaulic Style 606.
   d. Joints: Lead free (<0.2%) solder, ASTM B32, flux, ASTM B813.
   e. Nipples: Red brass pipe, threaded.
3. Galvanized Steel:
   a. Pipe: Galvanized steel, Schedule 40, Grade A, ASTM A53
   b. Fittings:
      1). Cast iron, threaded, Class 125, ANSI B16.4.
      2). Forged steel, threaded, ANSI 16.11.
      3). Mechanical cut groove couplings and fittings; galvanize coat, ASTM A153.
         a). Mechanical couplings shall consist of two housing segments cast of ductile iron, ASTM A 536. Gasket shall be pressure-responsive, synthetic rubber, Grade EPDM, secured together with heat-treated carbon steel bolts and nuts, ASTM A 183 and A 449.
            i. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9. Victaulic Style 07.
            ii. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77.
         b). Grooved end fittings shall be ASTM A 536 ductile iron, ASTM A 234 forged steel, or ASTM A 53 fabricated from carbon steel pipe, supplied with grooved ends designed to accept Victaulic couplings.
   c. Joints: Threaded
   d. Nipples: Galvanized steel, Schedule 40. Short and shoulder nipples shall be Schedule 80.

## 2.3 UNIONS AND FLANGES

A. General:

1. Unions, flanges and gasket materials to have pressure rating of not less than 150 psig at 180 degrees.

B. Copper 3" and Smaller:

1. Wrought copper union, Nibco Figure 733. Mueller Brass equal.

C. Steel 3" and Smaller:

1. ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

## 2.4 VALVES

A. Shutoff Valves:

1. Ball Valves:
   a. Acceptable manufacturers: Apollo, Crane, Hammond, Milwaukee, Nibco, Stockham and Watts with indicated features and equal to model listed. Note that not all manufacturers make all sizes.
   b. Full Port, 2 Piece: Bronze body, ASTM B584, stainless steel ball, teflon seats, stem extension, 600 psi WOG pressure rating, Apollo Series 77-240, Hammond Series 8303/8513 or Nibco 585-70-66.
   c. Insulated Handle: For insulated systems to prevent condensation on valve body with thermal and vapor seal, equal to Nibco Nib Seal.
2. Butterfly Valves:
   a. Acceptable Manufacturers: Apollo, Crane, Hammond, Milwaukee and Stockham with indicated features and equal to model listed. Note that not all manufacturers make all sizes or styles.
   b. Threaded or Solder Ends: Bronze body, stainless steel disc and stem, viton disk seal, Milwaukee Series BB2.
   c. Lug Type: Ductile iron body, aluminium bronze disc, EPDM liner, 316 stainless steel stem, brass bushings (lower, upper and collar), 200 psi WOG pressure rating, lever handle through 6", gear operator 8" and larger, Crane Quartermaster 44-B-S-Z.
   d. Grooved Type:
      1). Bronze body, double-seal elastomer encapsulated ductile iron disc, integrally cast stem, copper tubing sized grooved ends, 300 psi CWP pressure rating, manual level or gear operator with handwheel for 2-1/2" to 6", Victaulic Series 608.
      2). Ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem. Disc shall be offset from stem centerline to provide full 360 degree seating. Seat and seal material shall be pressure responsive EPDM, TFE lined fiberglass bearings, grooved ends, 300 psi CWP pressure rating, manual lever lock handle or gear operator with handwheel, 2" to 12", Victaulic Vic 300 MasterSeal.

B. Check Valves:
   1. Size 3" and Smaller:
      a. Bronze body, ASTM B62, Y pattern, Buna-N resilient disc, horizontal swing, 200 psi WOG rating, Nibco 413.

C. Balancing Valves:
   1. Acceptable Manufacturers: Armstrong, Bell and Gossett or Taco.
   2. Circuit setter, bronze body, meter connections with built in check valve, 125 psi steam pressure rating, ITT B&G Circuit Setter.

2.5 DIELECTRIC FITTINGS

A. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation or Victaulic Style 47.

B. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180 degrees. Watts Regulator Company, Lochinvar, Wilkins or Epco Sales, Inc.

2.6 WATER HAMMER ARRESTORS

A. Mechanical Water Hammer Arrestors:
   1. Piston-compressed air column type, with sealed air chamber.
   2. Manufacturers: Watts, Sioux-Chief, and Precision Plumbing Products (PPP), Inc., equal to size shown. Provide access panels when mechanical shockstops are installed in non-accessible concealed locations.

2.7 IN-LINE CENTRIFUGAL PUMPS

A. Recirculating Pump (PP-1)
   1. Bell and Gossett model #PL-36 or equal.

B. Manufacturers: Aurora, Bell and Gossett, Deming, Ingersoll-Rand, Taco, Weinman, or Worthington.

C. Pumps shall be pipeline mounted, single suction type with cast iron casing, bronze fitted with working pressure of 150 psi and operating temperature of 225°F continuous, 250°F intermittent.

D. Impellers shall be steel and shall be directly hung form motor shafts without using flexible couplings.

E. Pump shafts shall be steel or stainless steel, sealed and gasketed from pumped fluid.

F. Pumps shall be furnished with mechanical carbon/silicon carbide seals.

G. Bearing assemblies shall be permanently oil lubricated and maintenance free.

H. Pump shall be controlled by adjustable programmable time clock.

I. Refer to Section 26 2913 - Enclosed Controllers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

B. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

C. Include connections to plumbing fixtures, to equipment by others, and to equipment requiring water. Provide proper backflow and back siphonage protection to safeguard potable water system from contamination.

D. Lay out water system so as to conform to intent of drawings. Coordinate piping with building features and work of other trades. Plans indicate, general routing, provide additional offsets as required. Install piping with necessary swing joints and offsets to allow for expansion. Install shut-off valves on branch lines near mains to avoid long dead-leg branches when valves are closed. Install water piping plumb and square with building. Pitch water pipe to drain with drain valves at low points.

E. Install shut-off valves where indicated and at base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

F. Provide protective sleeve covering of elastomeric pipe insulation where copper or steel piping is embedded in masonry or concrete.

G. Provide dielectric fittings between dissimilar piping materials.

H. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

I. Install valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to equipment, fixtures and systems installed by others where same requires piping services indicated in this Section.

J. Install water pipe using proper pipe and fittings. Use reducing fittings for changes in pipe size.

K. Threaded Pipe Joints:
   1. Make threaded pipe joints with square cut and reamed pipe. Provide tapered pipe threads in conformance with ANSI B2.1.
   2. Cut threads so that exposed threads at joint are less than 3. Coat exposed threads with asphaltum or other corrosion inhibiting substance. Use joint compounds or teflon tape on pipe threads to achieve leak free joint.

L. Soldered Copper Pipe Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut pipe square and ream before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.

5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.

M. Brazed Copper Pipe Joints:
1. Cut pipe square and ream before assembly.
2. Joints shall be cleaned and polished before brazing.
3. Flux of any type shall not be used.
4. Apply heat carefully to prevent damage to pipe, fittings and valves. Disassemble valves where possible to prevent damage to seats during brazing.
5. Purge lines with dry nitrogen during brazing.

N. Grooved Copper Pipe Joints:
1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
3. Use only those couplings and gaskets so designated for copper tube.
   a. The gasket style and elasomeric material (grade) shall be verified as suitable for the intended service as specified.
   b. Gaskets shall be supplied by the grooved coupling manufacturer.
4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
6. Factory-trained field representative shall provide on-site training for contractor's field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

O. Grooved Steel Pipe Joints:
1. Grooved joint piping systems shall be installed in accordance with manufacturer's guidelines and recommendations.
2. Gasket style and elasomeric material shall be verified as suitable for intended service as specified. Gaskets shall be supplied by grooved coupling manufacturer.
3. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
4. Factory-trained field representative shall provide on-site training for contractor's field personnel in proper use of grooving tools, application of groove and installation of grooved piping products. Factory-trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

## 3.2 WATER HAMMER ARRESTORS

A. Use water hammer arrestors to control water hammer. Installed devices shall be sized and located according to manufacturer's recommendations or as shown on drawings.

B. Use water hammer arrestors with flush valves, quick-closing valves, at top of risers and at branch main risers serving more than 1 fixture.

C. Provide access panels when water hammer arrestors are installed in non-accessible concealed locations.

3.3 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions or flanges at points where copper-to-steel pipe connection is required in domestic water systems.

B. Install unions on equipment side of shutoff valves for items such as: water heaters, water softeners, pumps, filters, and similar equipment requiring periodic replacement.

3.4 CLEANING

A. Flush and clean piping prior to testing. Remove corrosion by mechanical or chemical means. Use chemicals that are non-toxic.

3.5 TESTING

A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 150 psi for 2 hrs. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not conceal pipe until satisfactorily tested.

E. Testing with air will not be allowed.

3.6 BALANCING

A. Balance water distribution system. Adjust control valves for proper operation. Set balancing valves to maintain hot water in hot water system.

B. Balance flush valves, flow control valves and mixing valves for adequate flow and temperature to plumbing fixtures and equipment.

3.7 DISINFECTION

A. Disinfect water piping in the following manner:
   1. Clean and flush water pipe with water until water at remote tap is clear.
   2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 hrs. Alternately use solution of 200 ppm of chlorine (minimum concentration) for 3 hrs.
   3. Flush water system of chlorine solution.
   4. Allow clean water to stand in system for 24 hrs. Take sample from remote tap for bacteriological test.

B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.8 BACTERIOLOGICAL TESTS

A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Standard Plate Count) test and test for presence of Pseudomonas aeruginosa as well as regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner's acceptance of building. If tests fail, make corrections and retest.

B. When connecting to existing water supply of unknown quality, sample for analysis and comparison with finished water system analysis shall be taken prior to making new connection. This will allow isolating source of contamination from within scope of work or pre-existing water supply. Final conditions shall meet criteria specified above for areas within scope of work.

**END OF SECTION**

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SECTION 22 1314- SANITARY WASTE DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes materials and methods for sanitary waste and vent, piping systems within and including piping to 5 ft outside building wall.

1.2 RELATED WORK

A. Section 20 0513 - Motors

B. Section 20 0520 - Excavation and Backfill

C. Section 20 0529 - Mechanical Supporting Devices

D. Section 22 2114 - Material Specialties

E. Section 22 4000 - Plumbing Fixtures

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

A. Order piping with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.

B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.6 SUBMITTALS

A. Manufacturer's technical data for the following:
   1. Pipe and Fittings.
   2. Joints.

3. Cleanouts.
4. Floor Drains
5. Traps.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials herein specified shall be new, unless otherwise noted.

2.2 PIPE, FITTINGS, AND JOINTS

A. Interior Underground 6" and Smaller:
   1. Cast Iron:
      a. Pipe: Hub and spigot pipe, service weight, ASTM A74
      b. Fittings: Hub and spigot fittings, service weight, ASTM A74
      c. Joints: Neoprene rubber compression gaskets, ASTM C564
   2. Cast Iron:
      a. Pipe: Hubless cast iron pipe, ASTM A-888, CISPI 301
      b. Fittings: Hubless cast iron fittings, ASTM A-888, CISPI 301
      c. Joints: Heavyweight no-hub couplings with 0.060" thick stainless steel clamps, FM 1680 Class 1, ASTM Standard C-1540, Mission Heavyweight, Husky Series 4000 or Clamp-All Hi-Torq 125.
   3. Polyvinyl Chloride (PVC):
      a. Pipe:
         1). Schedule 40, Class 12454-B (PVC 1120), ASTM D1785
         2). DWV pipe and fittings, ASTM D2665
      b. Fittings: Socket fitting patterns, ASTM D3311
      c. Joints: Primer, ASTM F656; solvent cement, ASTM D2564

B. Interior Above Ground:
   1. Cast Iron:
      a. Pipe: Hubless cast iron pipe, ASTM A-888, CISPI 301
      b. Fittings: Hubless cast iron fittings, ASTM A-888, CISPI 301
      c. Joints:
         1). Heavyweight Couplings: No-hub couplings with 0.060" thick stainless steel clamps, FM 1680 Class 1, ASTM Standard C-1540 Mission Heavyweight, Husky Series 4000 or Clamp-All Hi-Torq 80.
   2. Copper:
      a. Pipe: Type DWV copper tube, ASTM B306
      b. Fittings:
         1). Cast copper drainage fittings (DWV), ANSI B16.23
         2). Wrought copper drainage fittings (DWV), ANSI B16.29
      c. Joints: Lead free (<0.2%) solder, ASTM B32; flux, ASTM B813
   3. Polyvinyl Chloride (PVC):
      a. Pipe: Schedule 40, Class 12454-B (PVC 1120), ASTM D1785

b. Fittings: Drain, waste and vent (DWV) pattern fittings, ASTM D2665; socket fitting patterns, ASTM D3311.

c. Joints: Primer, ASTM F656; solvent cement, ASTM D2564

4. Galvanized Steel:

a. Pipe: Schedule 40, Type F, Grade A, ASTM A53

b. Fittings: Cast iron threaded drainage fittings, ASTM B16.12

## 2.3 CLEANOUTS

A. Josam, Smith, Wade or Zurn, equal to number listed.

B. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

C. Floor Cleanouts: Cleanout with cast iron ferrule, adjustable top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, equal to J.R. Smith 4033L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4033L-F-C.

D. Floor Cleanouts, Unfinished Floors: Cleanout with cast iron ferrule, adjustable round top, scoriated cast iron tractor cover, and bronze taper-thread plug, equal to J.R. Smith 4239L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4239L-F-C.

E. Wall Cleanouts: Cleanout with cast iron counter sunk ferrule, bronze or brass taper-thread plug, secured stainless steel access cover, equal to J.R. Smith 4472T.

## 2.4 FLOOR DRAINS, AREA DRAINS AND TRENCH DRAINS

A. ACO, Josam, Smith, Wade or Zurn, equal to number listed herein.

B. Floor drains shall be in accordance with ANSI A112.21.1. Provide with caulked or no-hub connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drain pipe.

C. FD-1: Cast iron body with round 8" diameter satin nickel bronze strainer. J.R. Smith 2005Y-A or equal.

D. AD-1: Same as FD-1.

E. Trench Drain TD-1:

1. Trench: Polymer concrete body, pre-sloped, 4.41"- 4.65" depth with drill out. ACO Model #K100S or equal.

2. Grate: Perforated galvanized steel. ACO Model #410Q or equal.

## 2.5 TRAPS

A. Same material as pipe or fittings unless specified with fixtures. Refer to Section 22 4000 - Plumbing Fixtures. Provide 17 gauge brass, chrome plated traps for exposed traps.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

B. Connect piping to fixtures, each piece of equipment, and drains. Install required piping as shown on drawings.

C. Grade horizontal lines with minimum of 1/8" per ft, except piping 2" diameter or smaller which shall be run at 1/4" per ft slope.

D. Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.

E. Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door or intake openings. Coordinate closely with roofing contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.

F. Where interferences develop, offset or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

G. Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.

H. Install underground warning tape 6" to 12" below finished grade above exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

I. Maintain piping in clean condition internally during construction.

J. Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.

K. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

L. Set cleanouts true and level and protect properly throughout construction. Provide safing for cleanouts installed in elevated slabs.

M. Set floor drains true and level and protect properly throughout construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Provide safing for floor drains installed in elevated slabs.

N. Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.

O. Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.2 COPPER PIPE

A. Remove slivers and burrs remaining from cutting operation by reaming and filling both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from cleaning operation, apply approved, non-acidic flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joining. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.3 THREADED PIPE

A. Make joints for threaded pipe by cutting pipe square and reaming inside. Threads shall be cut so that end of pipe extends to shoulder of fittings. Exposed threads shall not exceed 3 in number and shall be painted with heavy coat of asphaltum. Use approved joint compounds, thread lubricant or teflon tape sparingly and only on outer threads.

3.4 GROOVED PIPE

A. Assemble joints with coupling, gasket, lubricant and bolts according to coupling and fitting manufacturer's installation instructions.

3.5 POLYVINYL CHLORIDE (PVC) PIPE

A. Pipe Joints:

1. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints with PVC pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if fitted with wheels designed for use with PVC pipe that do not leave raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Check dry fit of pipe and fittings. Reject materials, which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
2. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 size of pipe diameter. Apply primer to fitting socket and pipe surface with scrubbing motion. Check for penetration and reapply as needed to dissolve surface to depth of 4-5 thousandths. Apply solvent cement to fitting socket and pipe in amount greater than needed to fill gap. While both surfaces are wet, insert pipe into socket fitting with quarter turn to bottom of socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set, whichever is longer. Reference manufacturer's recommendations for initial set time before handling and for full curing time before pressure testing.

B. Install plastic pipe and fittings as recommended by manufacturer. Include adequate offsets or expansion joints to allow for pipe expansion.

C. Do not install plastic pipe in plenum space.

3.6 CAST IRON PIPE

A. No-hub Piping: Place gasket on end of one pipe of fitting and clamp assembly on end of other pipe or fitting. Firmly seat pipe or fittings ends against integrally molded shoulder inside neoprene gasket. Slide clamp assembly into position over gasket. Tighten fasteners to manufacturer's recommended torque.

B. Hub and Spigot Piping: Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off ground so lubricant does not pick up dirt. Push spigot end into end of gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

C. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".

D. Support piping at every coupling. Locate hanger within 18" of coupling.

E. Installations with multiple joints within four ft developed length shall be supported at every second joint.

F. Brace horizontal piping 5" and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.7 DUCTILE IRON PIPE

A. Clean pipe end and socket. Clean and lubricate pipe end and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

B. Provide thrust blocks or restrained joints for piping sized 3" and larger. Provide thrust restraint at each change of direction exceeding 15 degrees and each fitting.

C. Pour concrete thrust blocks against compacted or undisturbed soil. Where soil-bearing capacity is less than 2000 psf or adjacent construction may affect soil-bearing capacity, use both concrete thrust blocks and strapped/rodded restraints or restrained joints. Field apply, continuous anti-corrosion coating to strapped and rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover.

D. Anchors and tie rods can be provided in lieu of thrust blocks. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts. Tie rods, clamps and bolts shall be liberally coated with asphaltum.

3.8 GROOVED JOINTS

A. Assemble joints with coupling, gasket, lubricant and bolts according to coupling and fitting manufacturer's installation instructions.

3.9 TESTING

A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not backfill pipe until successfully tested.

E. Testing with air will not be allowed.

**END OF SECTION**

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SECTION 22 1414

BUILDING SUBSOIL DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies pipe and materials for connection to subsoil drainage system by others.

1.2 RELATED WORK

A. Section 20 0520 - Excavation and Backfill.

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

A. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS AND JOINTS

A. Underground
   1. Polyvinyl Chloride(PVC):
      a. Pipe: Schedule 40, Class 12454-B (PVC 1120), ASTM D1785.
      b. Fittings: Socket fitting patterns, ASTM D3311.
      c. Joints: Primer, ASTM F656; solvent cement, ASTM D2564.

B. Pressurized Under Ground
   1. Polyvinyl Chloride(PVC):
      a. Pipe: Schedule 40, Class 12454-B (PVC 1120), ASTM D1785.
      b. Fittings: Socket fitting patterns, ASTM D3311.
      c. Joints: Primer, ASTM F656; solvent cement, ASTM D2564.

2.2 VALVES

A. Ball Valves:
   1. Acceptable manufacturers: Asahi, Chemtrol, Ipex, Plast-O-Matic, Spears.
   2. Size 3" and smaller: PVC body, full port, true union, Teflon seats, EPDM seals, socket ends. Ipex VX Series.

B. Check Valves:
   1. Acceptable manufacturers: Asahi, Chemtrol, Hayward, Ipex, Spears.
      a. Size 3" and smaller: PVC body, ball check, EPDM seals, socket ends.

2.3 STONE

A. Drainage stone shall be washed rock or gravel evenly graded with stone smaller than 2" size and larger than 3/4" size.

2.4 CLEANOUT

A. Manufacturers: Josam, Wade, Zurn or Smith equal to item listed in Section 22 1314 – Sanitary Waste and Storm Drainage Systems.

2.5 STRUCTURES

A. Settling Basin:
   1. Reinforced precast concrete manhole sections, ASTM Specification C478. Size to accommodate piping shown.

2.6 PUMPS

A. Acceptable Manufacturers: Aurora/Hydromatic, Gould, Myers, Paco, Weil, and Zeoller.

B. Pump shall be submersible type constructed of enamel coated cast iron shell, cast iron volute, two vane enclosed semi-open non-clog bronze cast iron impeller, stainless steel shaft, stainless steel fasteners, upper sleeve and lower ball bearings factory sealed grease lubricated, and ceramic mechanical seal.

C. Pump shall be hermetically sealed, capacitor start, built-in thermal overload protection sized for non-overloading over entire pump curve.

D. Pump shall be of capacity and electrical service as indicated in equipment schedules on drawings.

E. Pump controls shall include:
   1. Four UL Listed float switches (Lead pump On, Lag pump On, Pumps Off, High water level alarm).
   2. NEMA 1 indoor alarm panel with warning light, horn, silent switch, test switch and high level float switch, UL Listed.
   3. Combination magnetic starter with fused disconnect switch, HOA switch, pump run light, resettable overload heaters, NEMA 1, UL Listed.
   4. Electrical pump alternator and alarm panel with combination magnetic starter, fused disconnect switch, HOA switch, run light and resettable overload heaters for each pump; warning light; horn; silent switch; test switch; labeled terminal switch and devices; auxiliary dry contacts for remote alarm; NEMA 1, UL Listed.

F. Pump accessories shall include:
   1. Power cord length as required.
   2. NEMA 4 junction box.
   3. Discharge check valve, full port ball valve and union for each pump.
   4. Dual mechanical seals, seal leak detector probe and warning light in control panel.
   5. Dual stainless steel lift out guide rails, stainless steel wall, pump, and sump brackets, bronze and neoprene quick disconnect fitting, corrosion resistant pull chain or cable.

2.7 FIBERGLASS SUMP BASIN

A. Basin shall be constructed of 25-30% fiberglass and 70-75% polyester resin with no fillers with minimum design safety of four. Basin shall have side hub inlet and outlet fittings and tapped top vent flange.

B. Basin shall have bolted galvanized steel or fiberglass gasketed cover with inspection access plate. Access plate shall have discharge pipe flange for each pump and vent pipe, and hole for control cabling.

C. Basin shall have anti-floatation ring and be encased in minimum of 6" concrete.

D. Minimum wall thickness for basins as follows:

| Sump Diameter (inches) | 24 | 30 | 36 | 42 | 48 | 60 | 72 |
|---|---|---|---|---|---|---|---|
| Max 10' Depth | 3/16 | 1/4 | 1/4 | 1/4 | 5/16 | 5/16 | 3/8 |
| Max 15' Depth | 1/4 | 5/16 | 5/16 | 5/16 | 3/8 | 3/8 | 7/16 |
| Max 20' Depth | 5/16 | 5/16 | 3/8 | 3/8 | 7/16 | 1/2 | 1/2 |

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install subsoil drainage system as shown on drawings and details. Pipe shall be pitched at grade of 2" per 100 ft.

B. Install jointing systems for pipe to accomplish proper pipe alignment and pitch.

C. Where subsoil drains are required to penetrate foundation work, sleeve subsoil drains and use non-perforated sections of piping and place prior to foundation work.

D. Install settling basins base on undisturbed soil with setting pad of level concrete to bed base, build up basin with standard sections and epoxy based concrete mortar joints. Adjust cover slab and access frame to align with poured floor level.

**END OF SECTION**

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SECTION 22 2114- MATERIAL SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section covers material specialties for piping systems.

1.2 RELATED WORK

A. Section 22 1118 - Water Distribution System

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

A. Manufacturer's technical data for the following:
   1. Thermometers
   2. Pressure gauges
   3. Air vents
   4. Flashings
   5. Safings

B. Shop drawings on items specified herein.

C. Certificates: Submit performance testing certificates for reduced pressure backflow preventers and double check backflow preventers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials herein specified shall be new unless otherwise noted.

2.2 THERMOMETERS

A. Manufacturers: Taylor, Trerice, and Weiss equal to Trerice number listed.

B. Thermometers shall be 5" round bi-metal type, stainless steel case, readable scale and gradations from 30 to 240°F, external calibrator adjustment, back or bottom connection as appropriate. Provide brass extension neck sockets of appropriate length. Trerice Series No. B85200. Provide with minimum or maximum registering pointers.

2.3 PRESSURE GAUGES

A. Manufacturers: Marsh, Ashcroft, Marshalltown, Taylor, Trerice, U.S. Gauge and Weiss equal to Trerice number listed.

B. Pressure gauge shall be 4-1/2" die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 to 200 psi, phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge, Trerice Series No. 600. Provide with No. 301 Series maximum registering pointer.

C. Pressure gauges shall be calibrated for the following pressure ranges:
   1. Domestic Water: 0 to 160 psi at 2 psi increments.

2.4 BALANCING VALVES

A. Calibrated Circuit Balancing Valves (2" and smaller):
   1. Provide fixed orifice indicator machined to specific flow rate at maximum 25" WG differential and integral with positive shut-off ball valve with memory stop. Accessories shall include:
      a. Bayonet type, quick disconnects and nipples for meter connections.
      b. Metal identification tag with the following information: venturis size, flow rate, and differential in inches WG.
   2. Flowmeter: Provide fully cased, portable, 6" dial differential meter with over-range protection. Range of meter shall be (0-50" or 0-100") of water as required to balance units. Meter shall read direct in gpm for specific Venturis sizes. Accessories shall include:
      a. 10 ft sensor hoses.
      b. Vent valves.
      c. Disconnects.
   3. Manufacturers: Gerand Engineering Co., Minneapolis, MN and Thrush/Amtrol Inc., Kokomo, IN.

2.5 AIR VENTS

A. Manual Air Vents: Bell and Gossett Model 4V, 125 psi pressure at 210°F temperature, or approved equal. Use 1/2" ball valve for main pipes.

2.6 FLASHINGS

A. Elastomer Membrane Roofing:
   1. Pipe clamps, Fernco Series 1056 flex coupling with Series 300 stainless steel clamps.

B. Built-Up Roofing:
   1. 4 lb sheet lead, to 18" beyond drain perimeter.
   2. Preformed lead vent collar, 4 lb sheet lead, to 18" beyond vent perimeter; 18" minimum square base flange.
   3. Nobleflex roof drain flashing of Chloraloy and 20 lb asphalt saturated roofing felt bonded together.

2.7 SAFINGS

A. 4 lb sheet lead, to 18" beyond edge of drain on all sides.

B. Chlorinated polyethylene (CPE) as manufactured by Noble Company under trade name Chloraloy 240.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide thermometers where indicated on drawings. Thermometers shall be easily read from floor or maintenance platforms. Calibrate thermometers to insure accuracy.

B. Install pressure gauges where indicated on drawings. Gauges shall be easily read from floor or maintenance platforms. Provide extensions as required to make gauges easily readable. Calibrate gauges to insure accuracy.

C. Install backflow preventers as indicated on drawings. Flush debris from strainers. Certified tester shall test reduced pressure zone backflow preventers to verify that functions are operational. Route vent line to adjacent hub drain.

D. Install trap primer units as recommended by manufacturer and as indicated for priming drain traps. Insure positive air gap to protect against backflow.

E. Install air vents at high points in water systems where air may collect.

F. Safing:
   1. Membrane roofing material, preformed elastomer pipe pots, flashing seams are provided by Roofing Contractor for pipe penetrations and drain flashing. Plumbing Contractor shall provide drain flashing clamps and stainless steel strap clamps for piping penetrations. Coordinate with General Contractor to facilitate sealing drain flashing and pipe penetrations.

G. Flashing:
   1. Coordinate flashings on roof closely with Roofing Contractor. Install flashings as required to insure proper vapor barrier and as directed by Architect.
   2. Install flashing for vents through roof. Flashing shall extend minimum of 18" from center of pipe. Flashing shall turn into pipe in neat workmanlike manner. Install 1" insulation between outside of pipe and flashing.

3.2 TESTING

A. Safings shall be subject to standing water test to detect leaks and proper drainage to weep holes of floor drain.

**END OF SECTION**

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SECTION 22 3100- WATER CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section lists equipment to be used to condition domestic water systems.

1.2 RELATED WORK

A. Section 20 0700 - Mechanical Systems Insulation.

B. Section 22 2114 - Material Specialties.

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

A. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Culligan, Hellenbrand, U.S. Filter

2.2 SOFTENER WS-1

A. Description: Single water softener shall include one fiberglass vessels with internal distributors, piping, fully automatic brass multi-port control valves, pressure gauges, sample valves, resin, gravel, outlet "Y" strainer, structural base, dry-brine maker and brine eductor. Unit shall be preassembled, prewired, and hydrostatically tested. Media shall be packaged separately.

B. Design Conditions:
   1. Design flow: ..... .....20 GPM
   2. Pressure: ..... .....30-80 psig
   3. Temperature:..... .....50-80°F

C. Design Criteria:
   1. Volumetric Flow Rate:.....less than 15 gpm/$ft^3$ at design flow rate
   2. Backwash Flow Rate: .....greater than 1.2 gpm/$ft^3$
   3. Maximum Hardness Leakage: .....5 ppm (less than)
   4. Normal Hardness Leakage:.....0 ppm

D. Resin:
   1. Type: ..... .....Gel - strong acid cation
   2. Ionic Form ..... .....Sodium

3. Regenerant Chemical:.....NaCl saturated
4. Regenerant Quantity:.....15 lb./$ft^3$ maximum
5. Method of Chemical Introduction:.Eductor
6. Capacity/$ft^3$ (est.):.....30,000 grains (as $CaCO_3$) at max salt dosage

E. Mechanical:

1. Softener vessel:
   a. Material: Fiberglass or epoxy coated carbon steel
   b. Pressure Rating: 100 psig/150 psig
   c. Temperature Rating: 120°F
   d. Piping Connections: threaded or soldered
   e. Warranty: two years against interior, exterior and lining defects.
   f. Upper distributor: Single point baffle type, schedule 40 galvanized
   g. Lower distributor: hub and radial arm type, PVC or ABS
2. Strainer: ..... .....Bronze or PVC body with 20 mesh screen

F. Brine tank:

1. Quantity: ..... .....one
2. Material: ..... .....Polyethylene
3. Salt Dose:..... .....6-15 lb/$ft^3$

G. Electrical

1. Controls: Motor-driven control valve shall stage softener through regeneration steps. Regeneration shall be initiated by a signal from alternator controller. Regeneration frequency shall be based on throughput volume, totalized at common effluent of softener.
2. 120vac, 1ph, 60HZ power supply

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water conditioning equipment level in location as shown on drawings. Support pipe to and from equipment from building structure; do not support piping from equipment.

B. Follow installation instructions of equipment manufacturer. Installation instructions shall always be at site.

C. Provide start up service by manufacturer or authorized representative.

D. Fill salt storage/brine tank after successful test results.

3.2 TEST

A. Operate equipment through regeneration cycle. Verify proper cycle time and brine injection.

B. After satisfactory performance of sequence of operation, take water samples of raw and conditioned water and send to lab to verify performance of the equipment.

3.3 BALANCING

A. Adjust equipment to work with minimum dosage of brine.

**END OF SECTION**

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SECTION 22 3314

WATER HEATING EQUIPMENT

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions of the Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 QUALITY ASSURANCE

A. Water heating equipment shall conform to State and Local Codes, meet national standards, and be certified by respective organization and bear its stamp.

1.3 SUBMITTALS

A. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials specified herein shall be new unless otherwise noted.

2.2 ELECTRIC WATER HEATER (WH-1)

A. A.O. Smith Model #DEL-40 or equal.

B. Water heater shall be high efficiency electric water heater. Water heater design shall bear "CSA Designed Certified" mark, have 5-year tank warranty and have 1-year part warranty.

C. Elements shall be zinc plated copper with thermostat adjustment of 120° to 180°F. Controls shall be arranged for emergency shut off in event of pilot failure.

D. Tank shall be glass lined steel rated for 150 psig. Tank shall have removable magnesium anode rod, pressure and temperature relief valve, drain valve, boiler-type hand-hole cleanout, drat hood, polyurethane insulation, painted steel jacket and inlet and outlet thermometers.

E. Water heater shall be 480 volt, unbalanced 3-phase delta.

F. Acceptable manufacturers: Rheen, Ruud, State.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water heaters as recommended by manufacturer. Provide final connections as required. Coordinate water heater location with other Contractors.

B. Initial start up and balancing service shall be provided by, representative of manufacturer.

**END OF SECTION**

SECTION 22 4000- PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section lists plumbing fixtures and accessories including method of installation.

1.2 RELATED WORK

A. Section 22 1118 - Water Distribution System

B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems

1.3 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.

B. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless steel fixtures shall be 302/304 types of non-corrosive steel, 18 ga self rim for cabinet sinks, 14 ga for free standing compartment type sinks. Sink material shall have satin finish and cover corners.

2.2 MANUFACTURERS

A. Water closets, urinals, and lavatories: Acorn, American Standard, Eljer, Kohler, or Zurn equal to number listed.

B. Flush Valves: Delaney, Sloan or Zurn equal to number listed.

C. Supplies and Stops: Chicago Faucet, Kohler, McGuire or equal to number listed.

2.3 WATER CLOSETS

A. WC-1 Water Closet (wall hung)

1. Fixture: Kohler, "Kingston" Model #K-4330, white vitreous china wall hung siphon jet, elongated bowl, 1.6 gallon per flush, 1 ½" top inlet spud.
2. Fixture Fittings and Accessories: Gaskets-wax, bolts with chromium plated caps, nuts, and washers.
3. Flush Valve: Sloan Royal #111-ES-S, exposed sensor operated flushometer, top spud connection, 1.6 gallons per flush, with 120v/24v transformer and over-ride button.

4. Seat: Bemis #1955-SS/C, heavy duty, elongated bowl, open front, plastic seat, less cover, white color, with stainless steel self-sustaining check hinge.

B. WC-2 Water Closet (wall-hung, barrier-free)
   1. Same fixture and fittings as WC-1.
   2. Provide carrier support for barrier free mounting height of minimum 17" to top of bowl from finished floor.

2.4 URINALS

A. UR-1 Urinal (wall-hung)
   1. Fixture: Kohler "Bardon" model #K-4960-ET, wall mounted washout type, rim extended to 14 1/8" from wall, 3/4" top inlet spud.
   2. Fixture Fittings and Accessories: Gaskets-wax, bolts with chromium plated caps, nuts, and washers.
   3. Flush Valve: Sloan Royal # 186-1, exposed diaphragm type flushometer, side oscillating handle, 3/4" top spud connection, 1.0 gallon per flush.
   4. Provide carrier support for barrier-free mounting height of maximum 17" to top of rim from finished floor.

2.5 LAVATORIES

A. L-1 Lavatory (wall-hung, barrier Free)
   1. Fixture: Kohler "Greenwich" K-2032, 20" x 18", vitreous china, wall hung, 4" centers, drilled for carrier support, mount at 34" above finished floor to rim.
   2. Faucet: Chicago Faucet 2200 single handle, E12 aerator.
   3. Drain & Trap: McGuire Prowrap Model PW2125, WC pre-wrapped off-set grid drain, 1- 1/4" tailpiece, 1- 1/4" x 1/2" cast brass P-Trap with cleanout, 17 ga tubing outlet. Insulation kit for hot and cold water supply and stops included with the kit.
   4. Stops & Supplies: Chicago Faucet 1017-CP, angle pattern, lock shield cap, loose key handle, with copper alloy control valve bodies, stems, and gland nuts, 1/2" NPT inlet x 3/8" compression outlet.
   5. Carrier: Josam 17100/17105, J.R. Smith 700-M31, Zurn Z-1231, concealed arms, rectangular steel uprights.

2.6 ELECTRIC WATER COOLERS

A. EWC-1 Electric Water Cooler (Barrier Free):
   1. Fixture: Oasis Model #P8ACSL, high/low wall mounted self contained module with stainless steel bowl, drain, and with flow restricting bubbler. Vinyl cover material shall be designer color as selected by Architect.
   2. Trap: Kohler K-9000, 1-1/4" w/cleanout.
   3. Supply/Stop: Chicago Faucet #1006, angle pattern, lock shield cap, loose key handle, with copper alloy control valve bodies, stems, and gland nuts, 1/2" NPT inlet x 1/2" compression outlet.

## 2.7 JANITOR'S SINKS

A. JS-1 Janitor's Sink:

1. Fixture: Fiat #TSB-800 stain resistant, white, pre-cast terrazzo, 24" x 36" x 12" deep, integral stainless steel grid strainer drain outlet.
2. Faucet: Chicago Faucet 911-IS, cast or wrought copper alloy, combination faucet mounted 36" above finished floor. Spout shall have pail hook, 3/4" hose connection, top or bottom wall brace. Handles on faucets shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Valves shall include concealed integral stops, 8" centers. Elevated vacuum breaker mounted 7'-6" above finished floor. Exposed parts shall be polished chrome plated.
3. Stop: Chicago Faucet #1771 straight check stop with through wall operation, loose key type, exposed surfaces shall be polished chrome plated.
4. Trap: 3" p-trap to match piping system.
5. Accessories: Fiat #832-AA hose and hose bracket, 30" long, 5/8" rubber hose, and stainless steel hose bracket. Mount bracket at least 18" above finished floor and 6" left of faucet center.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

B. Support fixtures with proper carrier for each use. Insure that carrier is solidly anchored to prevent rocking whatever piping is used. Anchor bolts in carrier foot shall extend 3" minimum into concrete slab.

C. Fixture carriers shall be suitable for securing each plumbing fixture in place solidly, yet allowing its removal when necessary. Carriers shall be capable of mounting "Barrier Free" fixtures at suitable heights.

D. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

E. Install barrier free fixtures in compliance with local code and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27" above finished floor to avoid contact by wheelchair users.

F. Return fixture waste and supply piping into wall as high as practicable under fixture. Provide accessible shutoff in fixture supply. Protect "barrier free" supply and drain piping with white colored wrap neatly trimmed to prevent contact with hot or sharp surfaces by user.

G. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft and laterally. Provide additional blocking as required.

H. Install flush valves for barrier-free water closets with operator handle facing wide side of toilet stall.

## 3.2 PROTECTION

A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.3 CLEANING

A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer, and remove stains and marks from surrounding walls and countertops.

**END OF SECTION**

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SECTION 23 3114- DUCTWORK

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

A. Furnish and erect ductwork free of objectionable vibration, chatter, and pulsations. Verify dimensions at site, making field measurements and drawings necessary for fabrication and erection.

B. Duct sizes indicated are net inside dimensions.

C. Where size for a duct segment is not indicated, the duct segment size shall be equal to the largest duct segment to which it is connected. Transition to smaller size shall occur on side of fitting where smaller size is indicated.

1.3 DESIGN CRITERIA

A. All products shall conform to NFPA 90A, and shall possess flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Unless otherwise indicated, construct all ductwork of galvanized sheet metal for pressure class not less than +2" WG for positive pressure ductwork and not less than -2" WG for negative pressure ductwork.

C. Ductwork shall comply with Local, State and Federal requirements.

D. Unless otherwise indicated, construct ductwork to meet functional criteria defined in Chapter VII of SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1995 and other SMACNA Duct Construction Standards where applicable.

E. Unless otherwise indicated, pressure class for constant air volume system ductwork shall be equal to external static pressure (fan entrance or discharge pressure minus associated unit internal component pressure drop), but not less than + or - 2" WG.

F. Duct transverse joints and reinforcement material, including angle ring flanges and stiffeners, shall be of same material as duct.

PART 2 - PRODUCTS

2.1 GALVANIZED STEEL SHEET

A. First quality, Lock Former Quality (LFQ), cold rolled, open hearth soft steel sheet capable of double seaming without fracture, ASTM A924 or ASTM A653. Galvanized coating shall be G90.

B. Use G90 Galvaneal or Zincgrip where painting is specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Install ductwork parallel to building walls and ceilings and at such heights not to obstruct any portion of ceiling, window, doorway, stairway, or passageway. Install ductwork to allow adequate access and service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical ductwork plumb. Where interferences develop in field, offset or reroute ductwork as required to clear such interferences. In all cases, consult drawings for exact location of duct spaces, ceiling heights, door and window openings or other architectural details before installing ductwork.

B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Check plans showing work of other trades and consult with Engineer in event of interference. Transform, divide, or offset ducts as required, in such a manner as to maintain same cross sectional area of duct as indicated on drawings. Where it is necessary to install pipes or similar obstructions through ducts, consult with Engineer and obtain written approval from Engineer and Owner. If approved, provide streamlined encasement or collar designed in accordance with SMACNA Standards and seal to prevent air leakage.

C. Ductwork shall be free of kinks and dents.

D. Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc., in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in this Section of Specifications.

E. Provide transitions where different size or different shape ductwork segments are connected. Use concentric transitions unless otherwise shown. Unless otherwise indicated, make diverging transitions with maximum angle of 15 degrees per side (30 degrees total diverging) and converging transitions with maximum angle of 25 degrees per side (50 degrees total converging).

F. Provide transitions at ductwork system components and connections to equipment. Refer to Specification Section 23 3713, for additional information regarding diffuser/register/grille connections.

G. Refer to ductwork symbols list on drawings for additional and dimensional requirements for fittings.

H. Seal duct seams and joints to meet SMACNA Class A as minimum for all ductwork including low-pressure ductwork.

I. Construct ductwork so that interior surfaces are smooth. Internal duct hangers and internal bracing are not allowed. Refer to Part 1, Design Criteria for internal tie rods.

J. Support coils, filters, air terminals, dampers or other devices installed in duct systems with angles or channels, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets, nuts, bolts and washers.

K. Air terminal devices may be supported by strap hangers if air terminal manufacturer approves. Strap hangers are not allowed for fan powered devices, double wall type and Titus Steri-Loc type devices.

L. Install outside air intake duct to pitch down at 1" per 20 ft toward intake louver or plenum and to drain to outside of building. Solder or seal seams to form watertight joints.

M. Where 2 different metal ducts meet, install joint in such a manner that metal ducts do not contact each other by using proper gasket seal or compound.

N. Do not install ductwork over electrical panelboards, switchgear, switchboards or motor control centers.

O. When original galvanized finish is altered or damaged, apply field galvanizing paint as follows:
   1. Prepare surface with use of power sanders or wire brushes to remove rust, paint, etc.
   2. Apply cold galvanizing material equal to ZRC Products, Inc.

3.2 DUCT SUPPORTS

A. Unless otherwise indicated, use trapeze hangers with rods or angles to support the following rectangular ductwork:
   1. Non-insulated ductwork 48" and wider.
   2. Externally insulated ductwork.

B. For round ducts 24" diameter or smaller, use single hanger.
   1. Cable Suspension System may be used up to 16" diameter.
   2. Round Duct Strap Bracket by Ductmate Industries may be used up to 24" diameter.

3.3 LOW PRESSURE DUCT CONSTRUCTION (PRESSURE CLASS 2" AND UNDER)

A. Use welds, rivets or nuts, and bolts for fabricating ductwork. Fully threaded sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if screw does not extend more than 1/2" into duct. Sheet metal "TEK" screws 3/4" in length may be used as fasteners in conjunction with factory made transverse joints.

B. Unless otherwise indicated, construct branch take-off fittings as follows:
   1. For branch take-offs including branch ducts serving more than one diffuser or grille, use 45 degree entry fittings. For supply air ducts, expanded or conical taps may be used.
   2. For take-offs serving single diffuser, register or grille, use straight spin-in collars with manual balancing dampers.

C. Do not use splitter dampers and/or extractors unless manual volume dampers alone do not accomplish the intended balancing. Obtain Engineer's written approval before installing them. Use of splitter dampers and/or extractors will not eliminate need for specified or indicated manual volume dampers.

**END OF SECTION**

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SECTION 23 3400- FANS

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 SUBMITTALS

A. Shop drawings including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Fan curves
   5. Materials of construction
   6. Sound power levels
   7. Fan type, size, class, drive arrangement, discharge/rotation, bearings, drives
   8. Wheel type, diameter, rpm, tip speed
   9. Required fan horsepower including drive losses
   10. Motor data (refer to Section 20 0513 - Motors)
   11. Vibration isolators furnished with fans
   12. Dimensions and weights
   13. Special coatings where applicable
   14. Color selection charts where applicable
   15. Manufacturer's installation instructions
   16. All other appropriate data

B. Indicate performance data, based on both design air quantity and 110% of design air quantity.

1.3 DESIGN CRITERIA

A. Fan ratings shall be tested and certified in accordance with AMCA Standards 211 and 311 and fans shall bear AMCA Seal.

B. Fans shall be furnished complete with motors, wheels, drive assemblies, bearings and accessories as hereinafter specified. Motors for V-belt drives shall be furnished with adjustable rails or bases.

C. Each fan wheel shall be statically and dynamically balanced to grade G6.3 per ANSI S2.19. Complete fan assembly shall be factory balanced statically and dynamically in accordance with Standard AMCA 204-96 for Balance Quality and Vibration Levels for Fans and meet or exceed guidelines in Application Category BV-3.

D. Furnish fans specified with V-belt drives with either variable-pitch or fixed-pitch sheaves for drives 3 HP and smaller. Select variable pitch sheaves to drive fan at such speed as to produce specified capacity at approximate midpoint of sheave adjustment.

E. When fixed-pitch sheaves are furnished, system air balancing shall be accomplished by either trial of different fixed-pitch sheaves or use of temporary adjustable-pitch sheaves. This Contractor shall provide necessary trial and final sheaves and drive belts as required by TAB Contractor.

F. Select each fan to operate at single stable operating point as predicted by fan curve. Fans having 2 potential operating points on fan curves are not acceptable.

G. Unless otherwise indicated, V-belt drives shall be selected for 150% of motor nameplate horsepower.

H. Provide OSHA Compliant belt and shaft guards for belt driven fans. Provide speed test openings at shaft locations. Paint guards bright yellow.

I. Sound power levels shall be based on tests performed in accordance with AMCA Standards 300 and 301.

J. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. Motor furnished with fan shall not operate into motor service factor in any of these cases.

K. Consider drive efficiency in motor selection according to manufacturer's published recommendation, or according to AMCA Publication 203, Appendix L.

L. Where inlet and outlet ductwork at any fan is changed from that shown on drawings, submit scaled layout of change and system effect factor calculations indicating increased static pressure requirements as described in AMCA Publication 201. This Contractor shall be responsible for costs associated with any motor, drive, and/or wiring changes required as a result of duct configuration changes at fan.

## PART 2 - PRODUCTS

### 2.1 IN LINE DUCT FANS

A. Manufacturers: Greenheck, Twin City, Cook, Acme, Jenn-Air, Carnes, or Penn.

B. Fan housing shall be designed for installation in straight run of duct with transitions as indicated. Housing shall be designed for complete access to fan and motor without removing fan assembly from ductwork.

C. Wheels shall have backward inclined blades. Motor or drive compartment shall be isolated from airstream and be externally ventilated. Bearings shall be prelubricated and sealed and designed for minimum life of 40,000 hrs operation (ABMA L-10).

D. Paint fan parts with prime coat after metal cleaning and surface preparation. In addition, apply second coat of paint to exterior surfaces.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install units as shown on drawings, and according to manufacturer's installation instructions. On units provided with drain connection, install drain valve and cap discharge of drain.

B. Verify lubrication of motor and fan bearings and lubricate properly in accordance with manufacturer's recommendation and Section 20 0000, Part 3 under LUBRICATION.

**END OF SECTION**

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## Fan Data Sheet

**General**

- Project _____
- Identification _____
- Service _____
- Location _____
- Type _____
- Manufacturer _____
- Model Number _____

**Performance**

- Capacity _____
- Efficiency (%) _____
- Brake Horsepower at design flow rate (cfm) _____
- Brake Horsepower at 110% of design flow rate (cfm) _____

**Physical Characteristics**

- Size _____
- Class _____
- Drive Arrangement _____
- Discharge Rotation _____
- Drive _____
- Bearing _____

**Motor**

- Manufacturer _____
- Horsepower _____
- Voltage _____
- Phase _____
- Hertz _____
- RPM _____
- Type _____
- Enclosure Type _____
- Frame Type _____
- Insulation Class _____
- NEMA Design Designation _____
- Service Factor _____
- Nominal Efficiency _____
- Nominal Power Factor _____
- Full Load Amps _____
- Variable Frequency Drive Driven (Yes or No) _____

**Miscellaneous**

- Vibration Isolators _____
- Special Coating (Yes or No) _____
- Special Coating Type _____

SECTION 23 3713- DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Manufacturer's name and model number.
   2. Identification as referenced in the Documents.
   3. Capacities/ratings.
   4. Materials of construction.
   5. Sound ratings.
   6. Dimensions.
   7. Finish.
   8. Color selection charts where applicable.
   9. Manufacturer's installation instructions.
   10. All other appropriate data.

1.3 DESIGN CRITERIA

A. Performance data shall be based on tests conducted in accordance with ASHRAE Standard 70.

B. Screw holes on surface shall be counter sunk to accept recessed type screws.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Titus, E. H. Price, Carnes or Krueger.

B. Acceptable manufacturers for specialty products are listed under each item.

2.2 REGISTERS AND GRILLES

A. Registers and grilles shall be aluminum or steel as scheduled unless otherwise indicated, and furnished with frame type appropriate to installation.

B. Return and exhaust registers and grilles shall have fixed blade core.

C. Register and grille models, sizes and finishes shall be as shown on drawings and/or as scheduled. Unless noted otherwise, registers and grilles shall have baked enamel finish with color selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

B. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar sizes.

C. Seal connections between ductwork drops and diffusers/registers/grilles air tight.

D. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

**END OF SECTION**

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SECTION 23 8214- HEATING AND COOLING TERMINAL DEVICES

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 SUBMITTALS

A. Shop drawings for all items in this Section including, but not limited to, the following:
   1. Manufacturer's name and model number.
   2. Identification as referenced in the documents.
   3. Capacities/ratings.
   4. Materials of construction.
   5. Dimensions and weights.
   6. Color selection chart where applicable.
   7. Wiring diagrams.
   8. Motor data (refer to Section 20 0513 - Motors).
   9. All other appropriate data.

1.3 REFERENCE STANDARDS AND DESIGN CRITERIA

A. Electric Heaters: Shall be listed by UL, bear appropriate UL Label, contain latest devices for protection of installation, and shall be installed in strict accordance with the latest revision of National Electric Code and other applicable State and Local Codes. Provide grounding lugs on all apparatus.

PART 2 - PRODUCTS

2.1 ELECTRIC HEATERS

A. Manufacturers: Berko, Trane, Electromode, or Singer.

B. Heating elements shall be corrosion resistant, installed to prevent noise of expansion and contraction. Units shall be designed for even distribution of air across heating element.

C. Units shall be furnished with necessary over-heat protection, reset devices, contactors, transformers and control as required. Provide adjustable thermostatic control for operation of fan and heater.

D. For units with integral fans, furnish units with fans switches to maintain fan operation until all residual heat in elements has been dissipated.

E. Fans shall be statically and dynamically balanced. Fans and motors shall be mounted for vibration free operation.

F. Cabinets shall be 20 ga steel. Exposed cabinets shall have baked enamel finish in one of manufacturer's standard colors, selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units as indicated on drawings, and according to manufacturer's installation instructions.

B. Unless otherwise shown on drawings, mount vertical type wall mounted heating units 12" above finished floor.

3.2 ELECTRIC HEATERS

A. Units shall be provided by Mechanical Contractor and wired by Electrical Contractor.

**END OF SECTION**

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SECTION 26 0000- GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

A. Intent of drawings and Specifications is to obtain complete systems tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 26 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.

E. Included in this Contract are electrical connections to equipment provided by others. Refer to Architectural, Mechanical, and final shop drawings for equipment being furnished under other sections for exact locations of electrical outlets and various connections required.

F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.

G. Where architectural features govern location of work, refer to Architectural Drawings.

H. Work shall be performed in "neat and workmanlike" manner as defined in ANSI/NECA 1, Standard Practices for Good Workmanship in Electrical Contracting.

1.3 RELATED WORK

A. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before work is started.
   2. When interruption of services is required, persons concerned shall be notified and shall agree upon time.

B. Demolition:
   1. Division 01 - Selective Demolition.
   2. Division 02 - Building Demolition
   3. Perform demolition as required to accomplish new work.

a. Remove abandoned wiring to source of supply.
b. Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.
c. Disconnect abandoned outlets and remove devices.
d. Remove abandoned outlets if conduit servicing them is abandoned and removed.
e. Provide blank cover for abandoned outlets that are not removed.
f. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
g. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
h. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

4. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.
5. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
6. Equipment noted to be removed and turned over to Owner shall be delivered to Owner at place and time Owner designates.
7. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
8. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

C. Concrete Work:
1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of electrical equipment.

## 1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and local authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

## 1.5 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
1. AEIC Association of Edison Illuminating Companies
2. ANSI American National Standards Institute
3. ASME American Society of Mechanical Engineers
4. ASTM American Society for Testing and Materials
5. BICSI Building Industry Consulting Services International
6. EIA Electronic Industries Association
7. FIPS Federal Information Processing Standards
8. FCC Federal Communications Commission

9. ICEA Insulated Cable Engineers Association
10. IEEE Institute of Electrical & Electronics Engineers
11. IESNA Illuminating Engineering Society of North America
12. NEC National Electrical Code
13. NECA National Electrical Contractors Association
14. NEMA National Electrical Manufacturers Association
15. NESC National Electrical Safety Code
16. NETA National Electrical Testing Association
17. NFPA National Fire Protection Association
18. NIST National Institute of Standards & Technology
19. OSHA Occupational Safety and Health Administration
20. TIA Telecommunications Industries Association
21. UL Underwriters Laboratories, Inc.

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.6 LISTING

A. Material installed on project shall bear UL label or be UL listed, unless UL label or listing is not available for that type of material.

B. Other nationally recognized testing agencies, acceptable to AHJ, are approved.

1.7 ENCLOSURES

A. Typical NEMA Enclosures and Usage
1. NEMA 1 - Indoors. Falling dirt.
2. NEMA 2 - Indoors. Falling dirt. Falling liquids. Light splashing.
3. NEMA 3 - Outdoors. Sleet, snow, rain. Windblown dust.
4. NEMA 3X - Same as NEMA 3 plus corrosion resistant.
5. NEMA 3R - Outdoors. Rain, snow, sleet.

1.8 SUBMITTALS

A. Submit shop drawings for equipment provided under this Section:
1. Refer to Section 01 3300 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Division 26, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Section 01 3300. However, the expression "Shop Drawings" is generally used throughout specification.
3. Submit shop drawings for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
4. Mark general catalog sheets and drawings to indicate specific items submitted.
5. Include proper identification of equipment by name or number, as indicated in specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Submittals shall be clearly marked and noted accordingly.

7. When luminaires, equipment and items specified include accessories, parts and additional items under one designation, submittals shall be complete and include required components.
8. Include wiring diagrams for electrically powered or controlled equipment.
9. Submit electrical equipment room layouts drawn to scale, including equipment, raceways, accessories and clearance for maintenance.
10. Submit shop drawings or product data as soon as practicable after signing Contracts. Submittals must be approved before installation of materials and equipment.
11. Submittals, which are not complete, not permanent, or not properly checked by Contractor, will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Section 01 7700 - Closeout Procedures.
2. Upon completion of work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
3. Manuals shall be organized by specification section number and shall have table of contents and tabs for each piece of equipment or system.
4. Manuals shall include the following:
   a. Copies of shop drawings
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment. Where manufacturer's data includes several types or models, applicable type or model shall be designated.
   c. CD ROM's of O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams
   g. Start up and shut down procedure
   h. Factory and field test records
   i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
5. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
6. O&M manuals and instructions to Owner shall be provided prior to request for final payment.

D. Record Documents:
1. Refer to General Conditions of Contract, and Section 01 7700 - Closeout Procedures. Prepare complete set of record drawings in accordance with Section 01 7700.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

## 1.9 JOB CONDITIONS

A. Building Access:

1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Coordination:

1. Equipment provided under other Divisions of these specifications.
   a. Motors
   b. Electrically powered equipment
   c. Electrically controlled equipment
   d. Starters, where specified
   e. Control devices, where specified
   f. Temperature Control wiring
2. This Contractor shall provide, unless noted otherwise:
   a. Starters
   b. Disconnect devices
   c. Control devices:
      1). Pushbuttons
      2). Pilot lights
      3). Contacts
   d. Power wiring
   e. Control wiring, except temperature control wiring.
3. Connect and wire equipment complete and ready to operate according to wiring diagrams furnished by various trades.
4. Where starters or other devices are furnished, by others they shall be connected and wired by this Contractor.
5. This Contractor's drawings and/or specifications shall show number and HP rating of motors furnished by others, together with their actuating devices. Should any change in size, HP rating or means of control be made to any motor or other electrical equipment after Contracts are awarded, Contractor responsible for change shall immediately notify this Contractor. Additional costs due to these changes shall be responsibility of Contractor initiating change.
6. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)
7. Motors shall be furnished by others for starting in accordance with local utility requirements and shall be compatible with starters as specified herein or under various trade sections of these specifications.

C. Cutting and Patching:

1. Refer to General Conditions of the Contract, and Section 01 7329 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.

4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.

D. Housekeeping and Cleanup:
   1. Refer to Section 01 7700 - Closeout Procedures.
   2. Periodically as work progresses or as directed by Architect, remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.10 GUARANTEE

A. Guarantee for one year after acceptance by Owner equipment, materials, and workmanship to be free from defect.

B. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

C. Wherein fulfilling requirements of any guarantee, if Contractor disturbs any work guaranteed under another Contract, restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other Contract.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

A. Refer to Section 01 6000 - Product Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify elevations and measurements prior to installation of materials.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

3.3 FLOOR AND WALL

A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide during progress of construction sleeves and inserts that are to be built into structure.

B. Temporary sleeves, if used to form wall openings, shall be removed prior to installation of permanent materials. Permanent sleeves for wall penetrations shall be minimum 24 ga galvanized sheet metal unless otherwise noted

C. Steel sleeves, when required, shall be Schedule 40 carbon steel pipe with integral water stop.

D. Submit product data and installation details for penetrations of building structure. Submittal shall include schedule indicating penetrating materials, (steel conduit, PVC conduit, cables, cable tray, etc.), sizes of each, opening sizes and sealant products intended for use.

E. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 26 0593 - Electrical Systems Firestopping.

F. Openings for penetrations shall be minimum 1/2" larger on all sides than outside dimensions of raceways or cables. However, where fire resistant penetrations are required, size openings in accordance with recommendations of firestopping systems manufacturer.

G. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

H. Seal non-rated wall openings with urethane caulk.

I. Where penetrations occur through exterior walls into building spaces, use steel sleeves with integral water stop, similar to type "WS" wall sleeves by Thunderline Corporation. Seal annular space between sleeves and pipe with "Link-Seal" modular wall and casing seals by Thunderline Corporation, or sealing system by another manufacturer approved as equal by Architect. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

3.4 EQUIPMENT ACCESS

A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocation of raceways, or accessories as required, to provide access shall be provided at no additional cost to Owner.

B. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.

C. Locate electrical outlets and equipment to fit details, panels, decorating or finish at space. Architect reserves right to make minor position changes of outlet locations before work has been installed.

D. Verify door swings before installing room lighting switch boxes and install boxes on latch side of door unless otherwise noted

3.5 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.

C. Do not support equipment or luminaires from metal roof decking.

3.6 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, certain equipment must be guarded to protect personnel from injury.

B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Threaded rod or bolts shall not extend beyond supporting element and shall be protected as described above.

3.7 HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all floor-mounted equipment.

B. Pads shall be 3.5" high and be 2" wider and longer than equipment it supports.

3.8 ACCEPTANCE TESTING

A. When testing is to be witnessed by Architect/Engineer or Inspector, notify them at least 10 days prior to testing date.

B. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test. Make repairs with new materials.

C. This Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.

D. Maintain copies of certified tests, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.9 START-UP

A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation.
   1. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.

B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.

C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and checkout of types of systems and equipment on project.

D. Provide start-up services, by manufacturer's representative where specified or where Contractor does not have qualified personnel.

E. Coordinate start-up with all trades.

3.10 CLEANING

A. After installation is complete, Contractor shall clean all systems.

B. Vacuum debris from panelboards, switchboards, motor starter and disconnect switch enclosures, junction boxes and pull boxes two weeks before energization and again prior to completion.

C. Where louvers are provided in switchgear or transformer enclosures, vacuum louvers free of dust and dirt.

D. Clean luminaire lenses and lamps at time of installation and clean lens exteriors just prior to final inspection.

E. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

**END OF SECTION**

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SECTION 26 0519- LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 0533 - Raceway and Boxes for Electrical Systems

C. Section 26 0533.13 - Surface Metallic Raceway System

D. Section 26 0553 - Electrical Systems Identification

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. Conductor and conduit sizes in these Contract Documents are based on copper wire, and only copper wire shall be used.

1.4 REFERENCE STANDARDS

A. UL83 - Thermoplastic - Insulated Wires and Cables

B. UL44 - Rubber-Insulated Wires and Cables

C. UL486A - Wire Connectors and Soldering Lugs for use with Copper Conductors

D. UL4868 - Wire Connectors for use with Aluminum Conductors

E. UL486C - Splicing Wire Connectors

F. UL1569 - Metal-Clad Cable

1.5 SUBMITTALS

A. Submit Shop Drawings for equipment provided under this Section:
   1. Wire
   2. Connectors
   3. Supports
   4. Pulling Compounds

PART 2 - PRODUCTS

2.1 FABRICATION AND MANUFACTURER:

A. Conductors for use at 600 volts or below shall have 600 volt rated insulation.
   1. Wire No. 12 and smaller may be solid or stranded

2. Wire No. 10 and larger shall be stranded only
3. Provide stranded conductors where conductors terminate in crimp type lugs

B. Motor circuit branch wiring and associated control wiring:
1. Type THHN insulation
2. Motor wiring to be stranded copper

C. Wiring in fluorescent fixture channels:
1. Type THHN insulation

D. Feeder Circuit Wiring:
1. Type THWN or XHHW insulation rated for wet location
2. 75°C rated cable, or 90°C rated cable sized at 75°C rating for connection to 100% rated devices

E. Branch Circuit Wiring:
1. Use Type THHN, THW-2, THWN-2 or XHHW-2 insulation

PART 3 - EXECUTION

3.1 SEQUENCING-SCHEDULING

A. Do not pull wire in until building is enclosed and weather tight.

3.2 INSTALLATION

A. Color code power wiring as follows:
1. 208Y/120 volt, 3-phase, 4 wire: phase A-black, phase B-red, phase C-blue, neutral-white ground conductor-green.
2. 480Y/277 volt, 3-phase, 4 wire: phase A-brown, phase B-orange, phase C-yellow, neutral-gray ground conductor-green.

B. Pull wire and cables into conduits and raceways in such manner that insulation will not be damaged or undue strain placed on conductors.
1. Lubricants shall be UL listed

C. Branch circuit wires in panels shall be neatly arranged with surplus wire cut off and wires tied with non-metallic ties.
1. Metallic ties not permitted

D. Conductors shall be attached to terminal screw or lug per UL listing.

E. Joints, taps and splices sizes No. 10 and smaller:
1. Ideal-Nut Connectors or Scotchlok Spring connectors

F. Joints, taps and splices sizes No. 8 and larger:
1. Aluminum/copper compression connectors
a. Install with hydraulic compression tool.

G. Joints, taps and splices sizes larger than No. 1:
   1. Tape with electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half lapped layers of plastic electrical tape.

H. Plastic snap-on splice insulators are not allowed.

I. Support conductors in vertical raceways using OZ type "S" cable supports for 600 volt conductors.

J. Support conductors above 600 volts in vertical raceways using OZ type "R" cable supports.

3.3 APPLICATION

A. Wire and cable boxes and reels shall bear date of manufacture.
   1. Date of manufacture shall not precede contract date by more than one year.

B. Minimum conductor sizes shall be as follows:
   1. No. 12 - Branch circuits of any kind
   2. No. 14 - Signal systems, fire sprinkler supervision control system
   3. No. 10 - Exit light circuits, emergency circuits, security lighting

C. Limit conduit fill to maximum of 9 current carrying conductors.

3.4 BRANCH WIRING

A. 208Y/120 volt circuits over 100 ft in length: Increase wire size one size for each 100 ft of length. Increase conduit size as required.

B. 480Y/277 volt circuits over 150 ft in length: Increase wire size one size for each 150 ft of length. Increase conduit size as required.

3.5 ACCEPTANCE TESTING

A. Testing by Electrical Contractor

B. Acceptance testing shall be performed in accordance with Section 26 0800 - Commissioning of Electrical Systems.

C. Perform electrical acceptance testing on 600-volt feeders serving panelboards, switchboards and secondary voltage service entrance equipment.
   1. Acceptance testing shall include the following:
      a. Verify tightness of accessible bolted connections.
      b. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors.
         1). Applied potential to be 1000 volts DC for one minute
         2). Minimum insulation resistance shall be 50 megohms
         3). Correct deviations between adjacent phases and values below minimum
      c. Perform continuity test to insure correct cable connection.

D. Cables, which are found defective, shall be replaced by Contractor at no expense to Owner.

**END OF SECTION**

# SECTION 26 0526- GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. Section 20 0000 - General Electrical Requirements

B. Section 26 4113 - Lightning Protection for Structures

### 1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

### 1.3 DESCRIPTION OF WORK

A. Provide a complete grounding system for services and equipment as required by State Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

B. Maximum resistance to ground shall be less than 5 ohms.

### 1.4 REFERENCE STANDARDS

A. UL 467 Electrical Grounding and Bonding Equipment

### 1.5 SUBMITTALS

A. Submit shop Drawings for equipment provided under this section.

B. Dimensioned plans showing grounding electrode locations and connections.

C. Test Reports:
   1. Test reports of resistance to earth.
   2. Testing shall be done based on "Fall-of-Potential" method.
   3. Each test report shall include:
      a. Date of test, soil moisture content, and soil temperature
      b. Test operator
      c. Instrument or other test equipment used
      d. Electrode designation or location
      e. Ground impedance in ohms
      f. Assumptions made - if required

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Ground connectors may be irreversible compression or exothermic welded type.

B. Grounds in concealed, outdoor or in damp/wet locations shall meet IEEE 837 requirements and shall be UL 467 listed.

C. Grounded conductors (system neutral) shall be copper with white or gray insulation.

D. Grounding conductors shall be copper, either bare or with green insulation.

PART 3 - EXECUTION

3.1 SEQUENCING, SCHEDULING

A. Service grounds shall be permanently attached before permanent building service is energized.

B. Equipment grounds shall be permanently attached prior to energizing equipment.

3.2 INSTALLATION

A. Connections shall be exposed and visible for inspection at all times. Do not install insulation over ground connections.

B. Identify grounding conductors by system and room number of termination at building grounding electrode point.

C. Water pipe, by itself, is not an adequate grounding electrode and must be supplemented by another electrode system. Bonded system together.

D. Install ground rods 1 ft minimum below grade.

E. Grounding connections shall be made on surfaces, which have been cleaned of paint, dirt, oil, etc., so that connections are bare metal to bare metal contact.

F. Grounding connections shall be tight and shall be made with UL listed grounding devices, fittings, bushings, etc.

G. Duplex receptacles of any amperage shall be grounding type and shall have separate grounding contact. Install separate jumper between grounding terminal on device and metallic box.

H. Single and duplex receptacles shall have grounded metal mechanically bonded together. Pressure bonding only is not acceptable.

3.3 APPLICATION

A. Green wire grounding conductor shall terminate in panelboard at green wire ground bus.

B. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.

C. Where flexible metallic conduit, non-metallic rigid conduit or liquid tight flexible conduit is used, green wire grounding conductor shall be provided with phase conductors in conduit.

1. Conductor to provide ground continuity between equipment or device and conduit-raceway system.

D. Provide separate green wire grounding conductor for each branch circuit to motor or fixed equipment connection.

E. Provide separate green wire grounding conductor for each branch circuit neutral originating from panelboards, excluding lighting circuits.

F. This ground shall be used to ground device or load fed
   1. Bond to components of raceway system, such as junction boxes, starter or disconnect switch enclosures, equipment cases, etc.

G. Grounding conductors for branch circuits shall be size indicated in NEC, except minimum size grounding conductor shall be No. 12 AWG.

H. Each branch panel feeder originating at switchboards shall have an identified grounding conductor originating at ground bus in switchboard and terminating at ground bus in panelboard.
   1. Size as indicated in NEC except in no instance smaller than No. 8 AWG.

I. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.

J. Provide grounding conductor from secondary side of each transformer to grounding electrode system as required for separately derived system.

3.4 TESTING

A. Test ground resistance before connecting to existing ground system or grounded piping system.

3.5 INSPECTION

A. Prior to backfilling, completed system shall be inspected by commissioning authority.

**END OF SECTION**

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SECTION 26 0529- HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 0533 - Raceway and Boxes for Electrical Systems

C. Section 26 2200 - Low-Voltage Transformers

D. Section 26 2416.13 - Lighting and Appliance Panelboards

E. Section 26 2913 - Enclosed Controllers

F. Section 26 5100 - Interior Lighting

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and section sunder Division 01 General Requirements.

1.3 DESCRIPTION

A. Provide supporting devices as specified and as required for proper support of conduit and electrical equipment.

B. Provide supporting steel, not indicated on structural drawings, that is required for installation of Electrical equipment and materials, including angles, channels, beams, etc. to suspend on floor support equipment.

C. Support for conditions of operation to prevent excess stress and allow for proper expansion and contraction.

D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. Straps shall have steel or malleable backing plates when conduit is installed on interior or exterior surface of exterior building wall.

1.4 SUBMITTALS

A. Submit shop drawings for equipment provided under this section.
   1. Equipment this section, including:
      a. Manufacturer's name
      b. Model numbers
      c. Materials of construction and load ratings (lbs)
   2. Schedule of hangers and support devices with support spacing
   3. Details and calculations for sizing steel utilized for trapeze or special designed supports
   4. Structural attachments, inserts and concrete anchors

1.5 DESIGN CRITERIA

A. Support materials shall be steel or stainless steel unless specifically indicated.

B. Design, structural support members and support devices with safety factor of not less than 2.0.

C. Hangers, support devices and hardware shall be steel and shall have factory standard primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application. Coat cut edges, welds or damaged finish with galvanized paint.

D. Where conduit can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

E. Unless otherwise indicated, continuous insert channels are not allowed.

F. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

G. Application of concrete inserts and concrete anchors shall be reviewed and approved by Structural Engineer prior to installation.

H. Proposed weld attachments to building structure shall be reviewed by Structural Engineer.
   1. Execution of this work may be assigned to General Trades responsible for building structural steel.
   2. Cost for this work, however, will remain the responsibility of this Contractor.

I. Fasteners including concrete anchors for seismic application shall meet ICBO Evaluation Report and requirements of local authorities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Conduit Hangers and Supports
   1. Erico
   2. Cooper B-Line

B. Beam Clamps
   1. Erico

C. Wall Anchors
   1. Hilti
   2. Rawl

D. Metal Framing Support System (Strut System)
   1. Cooper B-Line
   2. Kindorf
   3. Unistrut

2.2 HANGER RODS

A. Furnish rods complete with adjusting and lock nuts.

B. Rods shall have electro-plated zinc or hot dip galvanized finish.

C. Size rods for individual hangers and trapeze supports as required.

2.3 BEAM CLAMPS

A. Bolt-On

B. Hammer-On

C. Malleable Iron

D. Stamped Steel

E. Support 1/4" and 3/8" threaded rod.

2.4 WALL ANCHORS

A. Flush or shell type, meeting description in Federal Specification FF-S-325, Group VIII, Type 1 for expansion shield anchors.

B. Select anchors with minimum safety factor of 8.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install all supports as required to fasten electrical components required for project, including free standing supports required for those items remotely mounted from building structure, catwalks, walkways, etc.

B. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).

C. Select and size building attachments in accordance with manufacturer's instructions.

D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors in concrete structures; sheet metal screws in sheet metal studs and wood screws in wood construction.

E. Do not use powder-actuated anchor devices.

F. Fabricate supports from galvanized structural steel or steel channel. Use hexagon head bolts with spring lock washers under nuts.

G. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.

H. Coordinate hanger and support installation to avoid work of other trades.

I. Suspend hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

J. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit.

K. Do not drill structural steel members unless approved by Structural Engineer.

L. Do not support equipment or conduit from metal roof decking.

M. Conduit shall not be supported by other conduit.

N. Install surface-mounted cabinets and panelboards with minimum of 4 anchors. Provide steel channel supports to stand cabinet 1" off wall.

O. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud wall.

P. Refer to Section 26 0000 - General Electrical Requirements for requirements of personnel injury protection guards for supporting devices.

3.2 BEAM CLAMPS

A. Provide locknut for hanging rod at clamp.

B. C-clamps are allowed for rod size 1/2" or smaller.

3.3 TRAPEZE SUPPORTS

A. Construct trapeze supports with struts, angles, or channels and hang them by inserts or welded beam attachments and rods.

3.4 CONCRETE ANCHORS

A. Anchor application, size, and placement shall be reviewed and approved by Structural Engineer prior to installation.

**END OF SECTION**

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SECTION 26 0533- RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 0526 - Grounding and Bonding for Electrical Systems

C. Section 26 0529 - Hangers and Supports for Electrical Systems

D. Section 26 0553 - Electrical Systems Identification

E. Section 26 0593 - Electrical Systems Firestopping

F. Section 26 2726 - Wiring Devices

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. This Section includes raceways, fittings, wireways, wall ducts, indoor service poles, outlet boxes, pull and junction boxes, floor boxes, tap boxes and raceway seals.

1.4 REFERENCE STANDARDS

A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting

B. ANSI C80-1 - Rigid Steel Conduit-Zinc Coated (GRS)

C. ANSI C80-3 - Electrical Metallic Tubing-Zinc Coated (EMT)

D. ANSI C80-5 - Aluminum Rigid Conduit-Zinc Coated (ARC)

E. ANSI C80-6 - Intermediate Metal Conduit-Zinc Coated (IMC)

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

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

I. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

J. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports

K. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

L. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit

M. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

N. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT)

O. NFPA 70 - National Electrical Code

P. UL 1 - Flexible Metal Conduit

Q. UL 6 - Electrical Rigid Metallic Conduit-Steel

R. UL 6A - Electrical Rigid Metallic Conduit-Aluminum and Stainless Steel

S. UL 360 - Liquid-Tight Flexible Steel Conduit

T. UL 514A - Metallic Outlet Boxes

U. UL 514B - Conduit, Tubing, and Cable Fittings

V. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

W. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings

X. UL 797 - Electrical Metallic Tubing-Steel

Y. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings

Z. UL 1242 - Electrical Intermediate Metal Conduit-Steel

AA. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit

1.5 SUBMITTALS

A. Product Data:
   1. Raceways
   2. Fittings
   3. Wireways
   4. Outlet boxes
   5. Pull and junction boxes
   6. Raceway seals

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

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual routing of raceways larger than 2".
      b. Record actual location and mounting heights of wireways, outlet, pull and junction boxes.

2. Operation and Maintenance Data:
    a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
    b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
    1. Comply with NFPA 70.
    2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Protect PVC conduit from sunlight.

C. Comply with manufacturer's written instructions.

1.8 WARRANTY

A. Manufacturer shall provide standard one-year written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

A. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6; heavy wall galvanized steel

B. Intermediate Metal Conduit (IMC): ANSI C80.6, UL 1242; thinner wall, galvanized steel

C. Rigid Aluminum Conduit (RAC): ANSI C80.5; heavy wall aluminum

D. Fittings (couplings, conduit bodies, connectors and bushings): NEMA FB 1, UL 514B; steel; threaded; connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings for conduits 2" and smaller; conduit bodies cover: steel, with stainless steel screws and neoprene gaskets; PVC coated to match conduit.

E. Fittings Manufacturers: Cooper Crouse-Hinds, Carlon Electric Products, O-Z/Gedney, Appleton, Hubbell, approved equal.

2.2 ELECTRICAL METALLIC TUBING (EMT)

A. ANSI C80.3, UL 797; galvanized steel tubing

B. Fittings (couplings, conduit bodies, and connectors): NEMA FB I, UL 514B; steel, watertight gland compression type or steel concrete-tight set-screw type connectors with double locknuts and insulated throat; conduit bodies cover: cast, with stainless steel screws and neoprene gaskets. Indentor, drive-on, die-cast or pressure cast fittings not permitted.

C. Fittings Manufacturers: Same as manufacturers listed in 2.1.F.

2.3 FLEXIBLE METAL CONDUIT (FMC)

A. UL 1; interlocked steel or aluminum.

B. Fittings: NEMA FB I, UL 514B; steel.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. UL 360; interlocked steel or aluminum, with PVC jacket.

B. Fittings: NEMA FB 1, UL 514B; steel.

2.5 RIGID NONMETALLIC CONDUIT (RNC)

A. NEMA TC 2, UL 651; Schedule 80 PVC.

B. Fittings: NEMA TC 3, UL 651.

2.6 ELECTRICAL NONMETALLIC TUBING (ENT)

A. NEMA TC 13; hand-bendable, corrugated PVC conduit.

B. Fittings: NEMA TC 3.

2.7 METAL WIREWAYS

A. NEMA 250, UL 870; sheet metal troughs with hinged or removable cover, Type 3R, unless otherwise indicated.

B. Size: 6" x 6" length as indicated on drawings.

C. Fittings and Accessories: couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps and other fittings to match and mated with wireways as required for complete system.

D. Wireways Covers: hinged type.

E. Knockouts: none.

F. Finish: Manufacturer's standard enamel finish.

G. Manufacturers: Hoffman, Square D Co., approved equal.

2.8 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, UL 514A; galvanized steel with stamped knockouts.
   1. Luminaire and Equipment Supporting Boxes: rated for weight of equipment supported, 1/2" male fixture studs, where required.
   2. Concrete Ceiling Boxes: concrete type.

B. Cast-Metal Outlet Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover and threaded hubs.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Gangable type boxes are not allowed.

E. Manufacturers: O-Z/Gedney, Raco, Cooper Crouse-Hinds, approved equal

2.9 PULL AND JUNCTION BOXES

A. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, galvanized steel.

B. Minimum size: 4" square by 2-1/8" deep for use with 1" conduit and smaller; 4-11/16" square by 2-1/8" deep for use with 1-1/4" conduit and larger.

C. Sheet Metal Boxes larger than 12" in any direction: hinged cover or chain installed between box and cover.

D. Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.

E. Manufacturers: same as manufacturers listed in 2.14.E.

2.10 EXPANSION FITTINGS

A. Malleable iron, hot dip galvanized allowing 4" (+/-2") raceway movement.

B. Manufacturers: OZ/Gedney AX Series, or equivalent by manufacturer listed in 2.1.F.

2.11 RACEWAY PENETRATION SEALS

A. Thruwall and Floor Seals

B. Manufacturers: New construction - OZ/Gedney FSK Series, existing construction - OZ/Gedney CSM Series, or equivalent by manufacturer listed in 2.1.F.

2.12 CABLE SUPPORTS

A. Manufacturers: OZ/Gedney Type S, or equivalent by manufacturer listed in 2.1.F.

2.13 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052" or 0.138" thickness and of length to suit application.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate size and location of required built-in openings.

B. Coordinate with Architect/Engineer cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings or steelwork.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 - Electrical Systems Firestopping.

D. Verify that exterior wall or wet location boxes are gasketed type cast boxes with matching cover.

E. Verify with manufacturer that "touch-up" paint kit and PVC-coating kit are available for use.

## 3.2 EXAMINATION

A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway's installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 3.3 INSTALLATION

A. Raceways:

1. Comply with ANSI/NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
2. Arrange raceways to maintain headroom and present neat appearance.
3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
4. Keep raceways at least 6" away from parallel runs of flues and steam or hot-water pipes or ductwork. Install horizontal raceway runs above water and steam piping. Install raceways level and square and at proper elevations: 6'-6" minimum headroom, except in exit pathways 7'-0" minimum headroom. Do not block access to junction boxes, mechanical equipment or prevent removal of ceiling panels, etc.
5. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
6. Avoid exposed raceway runs. Run raceways exposed where it is impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to construction. Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.
7. Cut raceways square using saw or pipecutter.
8. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 2", unless sweep elbows are required. Bend raceways according to manufacturer's recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
9. Use raceway fittings compatible with raceways and suitable for use and environment.
10. Provide bushings on raceways 1-1/2" and larger.
11. Raceways minimum sizes:
    a. Minimum raceway size 3/4", except as noted on drawings.
    b. Minimum home run size: 3/4", except as noted on drawings.
    c. Minimum size for flexible metal conduit is 1/2" except 3/8" for luminaires.
    d. Minimum size for liquid tight flexible metal conduit is 1/2".
12. Install empty raceways 2-1/2" and larger with No. 10 galvanized fishwire; install nylon pull cord in raceways smaller than 2-1/2"; leave at least 12" of slack at each end of pull wire.
13. Feed devices in exterior or load-bearing walls by horizontal conduit runs. Install horizontal conduit runs from device to device on same wall. Do not install horizontal bends in conduit around corners. Feed devices on same wall vertically from above or junction box in suspended ceiling.

14. Raceways Supports:
    a. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
    b. Raceway supports for horizontal or vertical single runs:
        1). Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
        2). Spring steel type pressure clamps for raceways 3/4" and smaller.
    c. Raceway supports for horizontal and vertical multiple runs:
        1). Trapeze-type supports fabricated with steel slotted channel systems with appropriate components.
        2). Support horizontal runs with appropriately sized rods.
        3). Anchor vertical runs to structure.
        4). Spring-steel type pressure clamps for raceways 3/4" and smaller.
    d. Do not support raceways with wire, perforated pipe straps or plastic tie-wrap. Remove wires used for temporary support.
    e. Arrange raceway supports to prevent misalignment during wiring installation.
    f. For fasteners and supports, including but not limited to, steel slotted support systems, support devices, support spacing, support of conductors in vertical raceways, and hanger rod size, refer to Section 26 0529 - Hangers and Supports for Electrical Systems and NFPA 70.
15. Raceways Seismic Restraints:
    a. Avoid raceway runs crossing building seismic joints. Use flexible connections where crossings cannot be avoided.
    b. Install rigid bracing and lateral restraints for suspended raceway runs per requirements in Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
16. Identify raceways per requirements in Section 26 0553 - Electrical Systems Identification.
17. Ground raceways per requirements in Section 26 0526 - Grounding and Bonding for Electrical Systems.
18. Flexible Conduit Connections: Use maximum of 72" of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
    a. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
19. Install PVC-coated raceways in areas with corrosive atmosphere as noted on plans.
20. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in "wet" or wash-down areas, per NFPA 70.

B. Boxes:
1. Install boxes to accommodate device indicated by symbol, in conformance with code requirements, number and size of conductors and splices and consistent with type of construction.
2. Install appropriate cover on surface-mounted boxes:
    a. Raised device covers on 4" square and 4-11/16" boxes and handy box covers on handy boxes, etc.
    b. Device covers that are square drawn or square cut on boxes in block.
    c. Round drawn device covers on boxes in lath and plaster walls or dry wall only.

d. Set front edge of device boxes flush with finished wall surfaces except on walls of non-combustible materials where boxes may have maximum set back of 1/4". Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

3. Set outlet boxes parallel to construction and independently attached to same.
4. Do not install back-to-back and through-the-wall boxes. Install with minimum 6" horizontal separation between closest edges of boxes. Install with minimum 24" separation in acoustic-rated walls.
5. Install multi-ganged boxes where 2 or more devices are in same location, unless otherwise noted.
6. Box Support:
   a. Mount boxes straight.
   b. Install horizontal bracing at top or bottom of box for 3 or more gang device boxes in stud walls.
   c. Install stud support one side, with short piece of stud, for up to 2 gang device boxes.
   d. Do not support boxes with tie-wire.
   e. For one and two gang box support, manufactured bracket supports shall be accepted alternate.
   f. Support boxes independently of raceways.
   g. Install adjustable steel channel fasteners for hung ceiling outlet box.
   h. Install stamped steel bridges to fasten flush-mounted outlet box between studs.
   i. Do not install boxes to ceiling support wires or other piping systems.
7. Install partitions in multi-ganged boxes where different types of devices are installed, or devices installed operate at different voltages.
8. Mount boxes in block walls at block joint nearest to indicated height.
9. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
10. When boxes are installed in fire-resistive walls and partitions, provide 24" horizontal separation between boxes on opposite sides of wall. In addition, limit penetrations to 16 square inches per penetration and not to exceed total of 100 square inches per 100 square feet of wall area.
11. Pull and junction boxes: Install as shown, or as necessary to facilitate pulling of wire and to limit number of bends within code requirements. Install above accessible ceilings and in unfinished areas.
12. Install boxes to be permanently accessible.
13. Do not intermix conductors from one system in same junction box or pull box unless shown or specifically authorized otherwise.
14. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
15. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726 - Wiring Devices.
16. Inaccessible Ceiling Areas: install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
17. Drawings do not necessarily show every outlet, pull or junction box required. Add required boxes, as necessary.

C. Expansion Fittings:

1. Install raceway expansion and deflection fittings in raceway runs imbedded in or penetrating concrete where movement perpendicular to axis of raceway may be encountered.
2. Install raceway expansion fittings complete with bonding jumpers in raceway runs, which cross expansion joints in structure and raceway runs mechanically attached to 2 separate structures.
3. Use couplings and flexible connection made up of 24" length of flexible metal conduit, where EMT runs across expansion joints in ceiling spaces.
4. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation.

D. Raceway Penetration Seals:

1. Exterior wall surfaces above grade: Install watertight seal around raceways. For concrete construction above ground level, cast raceway in wall or core drill wall and hard pack with mixture of equal parts of sand and cement. For other types of construction, use method acceptable to Architect.
2. Fire-rated construction: seal penetrations to maintain fire rating of construction penetrated. Refer to requirements in Section 26 0593 - Electrical Systems Firestopping.

E. Raceway Ceiling Fittings:

1. Install listed watertight seals to prevent passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of building, where raceway passes between areas of different temperatures such as into or out of cold rooms or freezers, where raceway enters room which at any time is low or high temperature room and where raceway enters room which at any time is subject to internal air pressures above or below normal.
2. Install watertight seals in interior of raceways passing through building roof, ground floor slab (when raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on end inside building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in flush steel box with blank coverplate to match finish of adjacent plates or surfaces.
3. Seal raceways entering or passing through areas that are "hazardous (classified) areas" as defined in NFPA 70.

F. Sleeve Installation for Electrical Penetrations:

1. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 - Electrical Systems Firestopping.
2. Concrete Slabs and Walls: install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. Rectangular Sleeve Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50" and no side greater than 16", thickness shall be 0.052".
   b. For sleeve cross-section rectangle perimeter equal to, or greater than, 50" and 1 or more sides equal to, or greater than, 16", thickness shall be 0.138".

5. Fire-Rated Assemblies: install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
6. Cut sleeves to length for mounting flush with both surfaces of walls.
7. Extend sleeves installed in floors 2" above finished floor level.
8. Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway unless sleeve seal is to be installed
9. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
10. Interior Penetrations of Non-Fire-Rated Walls and Floors: seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Maintenance of Joint Protection" for materials and installation.
11. Fire-Rated-Assembly Penetrations: maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0593 - Electrical Systems Firestopping.
12. Aboveground, Exterior-Wall Penetrations: seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annual clear space between pipe and sleeve for installing mechanical sleeve seals.

3.4 APPLICATION

A. Raceway uses permitted and not permitted per NFPA 70 requirements and as described below.

B. Rigid Metal Conduit (RMC) permitted to be installed as follows:
   1. Installations below grade and in or under concrete slabs
   2. All locations except corrosive atmospheres
   3. Hazardous locations
   4. Locations requiring mechanical protection

C. Intermediate Metallic Conduit (IMC) permitted to be installed as follows:
   1. Installation below grade and in or under concrete slabs
   2. All locations, except corrosive atmospheres
   3. Hazardous locations
   4. Locations requiring mechanical protection

D. Electrical Metallic Tubing (EMT) permitted to be installed as follows:
   1. Interior partitions
   2. Above suspended ceilings
   3. In concrete slabs
   4. 6 ft AFF in exposed areas of mechanical equipment rooms
   5. Sizes 2" and smaller except as approved

E. Flexible Metal Conduit (FMC) permitted to be installed as follows:
   1. Use flexible metal conduit not over 4 ft in length for final connections for:
      a. Vibrating equipment (including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment) in dry locations.
      b. Final connections to recessed luminaires in lengths not to exceed 6 ft.

2. No flexible metal conduit length restriction when using "Manufactured Wiring Systems."

F. Liquid Tight Flexible Metal Conduit (LFMC) permitted to be installed as follows:
   1. Use liquid tight flexible conduit, not over 4 ft in length, for final connections to:
      a. Vibrating equipment (including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment) in wet locations.
      b. Instruments and control devices.

3.5 RACEWAY WIRING METHODS

A. In or Under Slab on Grade: install rigid steel conduit, intermediate metal conduit install cast or nonmetallic metal boxes.

B. Outdoor Locations, Above Grade: install rigid steel conduit electrical metallic tubing; install cast metal or nonmetallic outlet, pull, and junction boxes.

C. Wet and Damp Locations: install rigid steel conduit electrical metallic tubing; install cast metal or nonmetallic outlet, junction, and pull boxes. Install flush mounting outlet box in finished areas.

D. Concealed Dry Locations: install rigid steel and conduit electrical metallic tubing; install sheet-metal boxes; install flush mounting outlet boxes in finished areas; install hinged enclosure for large pull boxes.

E. Exposed Dry Locations: install rigid steel conduit; install sheet-metal boxes; install flush mounting outlet box in finished areas; install hinged enclosure for large pull boxes.

F. Exposed Subject to Damage: install rigid steel.

3.6 FIELD QUALITY CONTROL

A. Inspect raceway, boxes, indoor service poles, and wireways for physical damage, proper alignment, supports and seismic restraints, where applicable.

B. Replace damaged component of raceway system, or install new raceway system.

C. Inspect components, wiring, connections and grounding.

3.7 REPAINTING

A. Repair damage to galvanized finishes with manufacturer-supplied zinc-rich paint kit. Leave remaining paint with Owner.

B. Remove damage to PVC or paint finishes with manufacturer-supplied touch-up coating. Leave remaining coating with Owner.

C. Wireways, indoor service poles: remove paint splatters and other marks from surface; touch-up chips, scratches, or marred finished to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.8 ADJUSTING

A. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.

B. Install knockout closures in unused openings in boxes.

C. Align adjacent wall-mounted outlet boxes for switches and similar devices.

D. Adjust outlet boxes to allow luminaires to be positioned as indicated on drawings.

3.9 CLEANING

A. Clean interior and exterior of boxes, wireways, and indoor poles to remove dust, debris and other material.

**END OF SECTION**

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SECTION 26 0553

ELECTRICAL SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 0533 - Raceway and Boxes for Electrical Systems

D. Section 26 2416.13 - Lighting and Appliance Panelboards

E. Section 26 2726 - Wiring Devices

F. Section 26 2913 - Enclosed Controllers

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 SUBMITTALS

A. Submit shop drawings for equipment provided under this Section.

B. Samples of each type of label and/or sign.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES

A. Stencil Paint:
   1. Oil-based, alkyd enamel, black unless otherwise noted.

B. Marker System:
   1. Acceptable Manufacturers: Brady USA, Ideal, Marking Services Inc. (MSI), Seton.
   2. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather-and chemical-resistant coating and matching wraparound adhesive tape for securing ends.
   3. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment.
   4. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies.

C. Laminated Plastic Nameplates:
   1. ASTM D 709, Type I, cellulose, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore.

2. Nameplates shall have 1/2" high lettering, except where space is limited letters may be 1/4" high.
3. Face of nameplate to be black and letters to be white, except emergency power equipment nameplates are to have white face with red letters.
4. Fasteners shall be small metal screws, pop rivets or contact-type with permanent adhesive.

PART 3 - EXECUTION

3.1 GENERAL

A. After painting is completed, identify equipment as indicated. Locate identification as conspicuously as possible except where such would distract from finished area.

3.2 IDENTIFICATION

A. Nameplates shall be securely attached to non-concealed junction box covers of the following:
   1. Electrical Distribution System
   2. Fire Sprinkler Supervision Control System

B. Engraved plastic nameplates shall be securely attached to:
   1. Panelboards
   2. Switchboards
   3. Motor Starters
   4. Each separately mounted circuit breaker or disconnect switch
   5. Each device in Main Distribution

C. Nameplates shall identify equipment or load controlled or function and shall be same as indicated on contract documents. Voltages shall be shown on panelboard nameplates.

D. Motor starter nameplates shall include motor designation and horsepower.

E. Submit identification to Architect for approval. Architect reserves the right to modify identifications prior to shop drawing approval.

F. Group conductors as to circuits and arrange in neat manner in pull boxes, cabinets and panelboards. Group, bind together with nylon ties and identify conductors as to feeder or branch circuit. Phase identification shall be consistent throughout system.

G. Identify each conductor of all systems at each panel, pull box and at each outlet with permanently attached, wrap around, adhesive markers.

H. Identification of junction boxes and conductors shall include panelboard, circuit number, phase, control circuit number or other appropriate number or letter that will expedite future tracing and trouble shooting.

**END OF SECTION**

SECTION 26 0593- ELECTRICAL SYSTEM FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 0533 - Raceway and Boxes for Electrical Systems

C. Section 26 0593 - Electrical System Firestopping

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements.

1.3 DESCRIPTION

A. Furnish and install work under this Section including the following:
   1. Penetrations through fire-resistance-rated floor, roof, walls and partitions including openings containing conduits, cables, cable bundles, cable tray and other penetrating items.
   2. Firestopping systems and installation shall provide fire rating equal to that of construction being penetrated.
   3. Proposed firestop materials and methods shall conform to applicable code requirements of authority having jurisdiction.

1.4 REFERENCE STANDARDS

A. UL 1479 - Fire Tests For Through-Penetration Firestops

B. UL 2079 - Tests For Fire Resistance of Building Joint Systems

1.5 SUBMITTALS

A. Submit Shop Drawings for equipment provided under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed firestopping systems that are similar in material, design and extent to that indicated for this Project and that have performed successfully.

B. A manufacturer's representative shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 3M, Hilti, Tremco, Nelson Firestop Products, Specified Technologies, Inc, or Rectorseal Corp.

2.2 MATERIALS

A. Use only firestop products that have been UL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.

B. Materials shall not contain flammable solvents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for opening configurations, penetrating items and other conditions affecting performance of firestopping.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PROJECT CONDITIONS

A. Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturer or when substrates are wet due to rain, frost, condensation or other causes.

B. Ventilate firestopping per manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

3.3 DELIVERY AND HANDLING

A. Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product, type and UL label where applicable.

B. Handle with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

3.4 PREPARATION

A. Clean out openings immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer.

B. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

C. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

3.5 INSTALLATION

A. Comply with manufacturer's installation instructions and drawings.

B. Install forming/backing materials and other accessories of types required to support fill materials during application as required. After installing fill materials, remove forming materials and other accessories not indicated as permanent components of firestop systems.

C. Avoid multiple penetrations of common fire barrier opening. When possible, seal each penetration in accordance with project details.

3.6 SEQUENCING AND SCHEDULING

A. Do not cover up firestopping installations that will become concealed behind other construction until authorities having jurisdiction, if required, have examined each installation.

B. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.7 CLEANING

A. Clean surfaces adjacent to sealed holes and joints free of excess firestop materials and soiling as work progresses.

**END OF SECTION**

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SECTION 26 0923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 5100 - Interior Lighting

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION OF SYSTEM

A. Provide devices such as wall box dimmers, wall and ceiling mounted occupancy sensors, ambient light sensors, sensor power packs, etc., as shown on drawings.

B. Openings shall be covered with devices and matching plates.

C. Devices of same type shall be from same manufacturer.

1.4 REFERENCE STANDARDS

A. UL20 - General Use Snap Switches.

B. UL773A - Non-Industrial Photoelectric Switches for Lighting Control.

C. NEMA WD 7 - Occupancy Motion Sensors.

1.5 SUBMITTALS

A. Submit shop drawings for equipment provided under this Section.

B. Device color samples.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Ceiling Sensors:
      a. Ultrasonic Occupancy Sensors: Hubbell, Unenco, Light-O-Matic, MyTech, Novitas Wattstopper (W Series)
      b. Ultrasonic Occupancy Sensors, Switched: MyTech
      c. Passive Infrared Occupancy Sensors: Hubbell, Lightolier (Insight Series), MyTech, Tork, Unenco, Wattstopper

d. Dual Technology Occupancy Sensors, PIR and Ultrasonic: Hubbell, MyTech, Unenco, Wattstopper (DT Series)

e. Dual Technology Occupancy Sensors, PIR and Microphonic Switched: MyTech

2. Power Packs: Light-O-Matic, Lightolier, Leviton, MyTech, Novitas, Tork, Unenco, Wattstopper
3. Photocells: Intermatic, Paragon, Tork
4. Timeclocks: Intermatic, Paragon, Tork

B. It is the responsibility of Electrical Contractor to ensure devices submitted meet or exceed functional intent and design quality standards.

2.2 FABRICATION AND MANUFACTURE

A. Devices shall be UL listed for loads and voltages as shown on drawings.

2.3 OCCUPANCY SENSORS

A. Occupancy Sensor shall:
1. Be ivory colored.
2. Operate with all lamp and ballast combinations, including magnetic, hybrid, and solid-state ballasts.
3. Have LED to indicate occupant detection.
4. Have adjustable time delays from 30 seconds to 15 minutes and adjustable sensitivity.

B. Ultrasonic circuit shall be:
1. Solid-state crystal controlled.
2. 32 kHz minimum.

C. Ceiling ultrasonic occupancy sensors shall:
1. Have 360° coverage with ceiling height of 12 ft.
2. Be low voltage wired in parallel to common power pack.
3. Incorporate by-pass switch to enable lighting to be turned on if sensor fails.

D. Passive infrared occupancy sensors shall:
1. Incorporate temperature compensated dual element sensor and multi element fresnel lens.
2. Have daylight filter to ensure sensor is insensitive to short-wave length waves emitted by sun.

E. Ceiling passive infrared occupancy sensors shall:
1. Have round, square, or long rectangular coverage patterns to match floor plan layout.
2. Operate within ceiling height of 12 ft.
3. Be low voltage wired in parallel to common power pack.

F. Dual technology occupancy sensors shall:
1. Include both ultrasonic and passive infrared sensors. Each sensing technology shall have independent sensitivity adjustments and LED to indicate detection.
2. Include both microphonic and passive infrared sensors. Each sensing technology shall have independent sensitivity adjustments and LED to indicate detection.
3. Be designed to be either wall or ceiling mounted as indicated on drawings.

4. Sense motion from both technologies to turn lighting on, but maintained detection from either technology will hold lighting on for set time delay.
5. Be low voltage wired to sensor power packs.
6. Contain isolated relay with normally open, normally closed, and common outputs for use with EMCS system, data logging, or other system control options.

G. Sensor power packs shall:
1. Be self-contained transformer relay modules.
2. Have dry contacts capable of switching 20 amp load at either 120VAC or 277VAC.
3. Provide 24VDC output capable of controlling ultrasonic or passive infrared occupancy sensors.

## 2.4 PHOTOCELLS

A. Photocells shall:
1. Be rated 2,000 watts tungsten at 120, 240, or 277 volts.
2. Have cadmium sulfide, 1" diameter cell.
3. Have SPST normally closed contacts.
4. Have delay of up to 2 minutes to prevent false switching.
5. Have 5-year warranty.

B. ON/OFF adjustment shall be done by moving light selector with range from 2 to 50 footcandles.

C. Operational temperature range shall be -40 to 140°F (-40 to +60°C).

D. Enclosure shall be die cast zinc, gasketed for maximum weatherproofing.

E. Enclosure shall include positioning lug on top.

F. Mounting shall be for 1/2" conduit nipple.

## 2.5 TIMECLOCKS

A. Timeclocks shall:
1. Be multi-purpose, 7-day, 365-day advance single and skip a day, combination 2-channel electronic time clock with SPDT switching configuration and astronomic dial.
2. Be rated for 30 VDC, 120 VAC, 250 VAC and 277 VAC.
3. Be capable of programming in AM/PM or 24-hour format by jumper selection, in one-minute resolution, using 2 buttons for basic settings.
4. Have 365-day and/or holiday selection capabilities, with 16 single date and 5 holiday selection options and user selectable daylight savings/standard time functions.
5. Have 72-hour memory backup with rechargeable battery and charger.
6. Be capable of manual override, ON and OFF to the next scheduled event, using one button for each channel.
7. Have operational temperature range of -40 to 150°F.

B. Contacts shall be rated 10 amp resistive at 120/250 VAC, 7.5 amps inductive at 120/250 VAC, 5 amps inductive at 30 VDC and up to 1/2 hp at 250 VAC.

C. Display shall be LED type.

D. Enclosure shall be rated for indoor or outdoor installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices at heights scheduled, and as indicated on drawings.

B. Install ceiling devices as shown on drawings and as recommended by device manufacturer.

C. Ceiling mounted occupancy sensors shall be located minimum of 6 ft from supply air diffusers.

D. Install devices plumb, level with finished surfaces and free from blemishes.

E. Verify device locations prior to rough in.

F. Control wiring shall be low voltage, Class II wiring, electrically isolated from power wiring by a Class II transformer.

G. Provide separate neutral conductor for each dimmer.

H. Wiring shall be in conduit.

I. Electrical Contractor shall be responsible for final adjustment and testing of all devices.

3.2 TESTING

A. Adjust occupancy sensors for a 30 minute time delay.

B. Verify proper operation of occupancy sensor switches and by-pass switches.

C. Adjust occupancy sensor sensitivity such that movement outside range of coverage shall not trigger sensor.

**END OF SECTION**

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SECTION 26 2200- LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 0526 - Grounding and Bonding for Electrical Systems

C. Section 26 0529 - Hangers and Supports for Electrical Systems

D. Section 25 0533 - Raceway and Boxes for Electrical Systems

E. Section 26 0553 - Electrical Systems Identification

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. This Section includes dry type distribution and buck-boost transformers rated 600 volts and less, with capacities up to 300 kVA.

1.4 REFERENCE STANDARDS

A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting

B. IEE C57.12.91 - Test Code for Dry Type Distribution and Power Transformers

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

D. NEMA ST 1 - Specialty Transformers (except General Purpose Type)

E. NEMA ST 20 - Dry-Type Transformers for General Applications

F. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers

G. NEMA TP 2 - Test Method for Measuring the Energy Consumption of Distribution Transformers

H. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency

I. NFPA 70 - National Electrical Code

J. UL 506 - Specialty Transformers

K. UL 1561 - Dry-Type General Purpose and Power Transformers

1.5 SUBMITTALS

A. Product Data:

1. Include rated nameplate data, capacities, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings:
   1. For each transformer size and type:
      a. Physical dimensions, including bolting templates, weight and center of gravity
      b. Loads, method of field assembly, components, and location and size of each field connection
      c. Wiring Diagrams: Power, signal, and control wiring
      d. kVA rating
      e. Primary taps
      f. Insulation class and temperature rise
      g. Efficiency values measured at 0, 25, 50, 75, and 100% load
      h. Impedance value - X/R and %Z
      i. Sound level
      j. "K" factor listing, where applicable

C. Submit 1/4" scale electrical room floor plans with transformer locations.

D. Manufacturer's Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

F. Output Settings Report: Record output voltages and tap settings.

G. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of busway routing.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.
      c. Include in emergency, operation and maintenance manuals.
      d. Include Manufacturer Seismic Qualification Certification, Installation Seismic Qualification Certification, Manufacturer's Ultra Quiet Transformers Sound Level Certification, where applicable, and Output Settings Report.

1.6 QUALITY ASSURANCE

A. Obtain transformers from one source and by single manufacturer.

B. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.

1.8 WARRANTY

A. Manufacturer shall provide standard 1-year written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D

B. General Electric

C. Cutler-Hammer

D. Siemens

2.2 DISTRIBUTION TRANSFORMERS

A. Fabrication:
   1. NEMA ST 20, UL 1561
   2. Factory assembled and tested
   3. Air-cooled, for 60 Hz service
   4. Two windings dry type
   5. Coils:
      a. Continuous wound construction and impregnated with non-hydroscopic, thermosetting varnish
      b. Conductors: Continuous windings without splices, except for taps, and encapsulated wire resin compound to seal out moisture and air
      c. Materials: Aluminum
      d. Separate primary and secondary
      e. Internal Connections: Braised or pressure type
   6. Cores: High-grade silicon steel, non-aging, with high magnetic permeability, low eddy current losses and low hysteresis. Magnetic flux densities below saturation point. Core laminations clamped with steel members, one leg per phase.
   7. Rubber vibration absorbing mounts to isolate base of enclosure from core and coil assembly.
   8. Transformer neutral visibly grounded to enclosures with flexible grounding conductor.

B. Enclosure:
   1. NEMA 250.

2. Type 2, unless otherwise indicated to comply with environmental conditions at installed location.
3. Code-gauge steel panel over core and coil.
4. Ventilated (air-cooled): Louvered openings for convection cooling.
5. Cooling and terminal chamber access with both sides and rear obstructed.
6. Manufacturer's lifting eyes or brackets.
7. Finish: Manufacturer's standard gray enamel over prime coat after being degreased, cleaned and phosphatized.

C. Ratings:
1. KVA Rating: 300 kVA maximum.
2. Primary Voltage: 480 volts, three phase, three wires.
3. Secondary Voltage: 208Y/120 volts, three phase, four wires
4. Insulation Class and Winding Temperature Rise:
   a. Transformers 25 kVA - 112.5 kVA: Class 220°C, with 115°C temperature rise above 40°C ambient temperature, capable of carrying 15% continuous overload without exceeding 150°C rise.
5. Top of Enclosure Temperature: Maximum 35°C above 40°C ambient temperature at warmest point at full load.
6. K-Factor Rating: UL 1561, as indicated.

D. Primary Taps:
1. Transformers rated 15KVA and larger: two 2.5% above and two 2.5% below normal full capacity, minimum of 4 taps.

E. Energy Efficiency:
1. Transformers rated 15KVA and larger, except K-rated, quiet type and ultra quiet type:
   a. NEMA TP 1, Class 1 efficiency level
   b. Manufacturer's test to NEMA TP 2
   c. NEMA TP 3 Energy Star label

F. Sound Levels:
1. NEMA ST 20, maximum average sound levels as follows:
   a. 45 dB for general-purpose transformer sizes less than 51kVA.
   b. 50 dB for general-purpose transformer sizes 51-150 kVA.
   c. 55 dB for general-purpose transformer sizes 151-300 kVA.
2. Minimum of 3 dB less than NEMA ST 20. Maximum average sound levels when factory tested according to IEEE C57.12.91 as follows:
   a. 42 dB for quiet type transformer sizes less than 51 kVA.
   b. 47 dB for quiet type transformer sizes 51-150 kVA.
   c. 52 dB for quiet type transformer sizes 151-300 kVA.
3. Maximum average sound levels, when factory tested according to IEEE C57.12.91, as follows:
   a. 35 dB for ultra quiet transformers, for sizes through 300 kVA.

G. Electrostatic shielding, where indicated: each winding with an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Coil leads and terminal strips arranged to minimize capacitive coupling between input and output terminals.
   2. Special terminal included for grounding the shield.
   3. Shield Effectiveness:
      a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over frequency range of 20 Hz to 1 MHz.
      b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
      c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

2.3 BUCK-BOOST TRANSFORMERS

A. Description: NEMA ST 1, UL 506, UL 1561, same as distribution transformers, except rated for continuous duty and with wiring terminals suitable for connection as autotransformer.

B. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Finish Color: gray enamel over prime coat.

2.4 LUGS

A. Manufacturer's primary and secondary bolted lugs: labeled for 75°C copper and aluminum conductors for ventilated enclosures.

B. Connections at sides near bottom, accessible from front of cabinet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.

B. Examine areas and surface to receive transformers for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify that space indicated for transformers' mounting meets code-required working clearances.

D. Notify Architect/Engineer of discrepancies prior to submittal of product data and shop drawings.

E. Verify that ground connections are in place and requirements in Section 26 0526 - Grounding and Bonding for Electrical Systems have been met.

F. Verify with manufacturer that "touch-up" paint kit is available for repainting.

3.2 INSTALLATION

A. Install transformers in accordance with ANSI/NECA 1.

B. Install level and plumb within 1/2 degree, and at least 6" from adjacent wall or structure to insure proper ventilation, in accordance with manufacturer's written instruction, and in compliance with recognized industry practices.

C. Transformer mounting, seismic restraints and vibration control:
   1. Mount transformers on floor.
   2. Floor mounting:
      a. Secure to floor via isolation pads between floor brackets (fabricated by manufacturer) and transformer.
      b. Mount on spring isolator.

D. Install engraved plastic nameplates under provisions of Section 26 0553 - Raceway and Boxes for Electrical Systems. Attach nameplate to transformer using small, corrosion-resistant metal screws or rivets. Do not use contact adhesive.
   1. Indicate kVA rating, voltage/phase rating, taps, insulation class and temperature rise, impedance value, sound level and K-factor listing.

E. Connect each transformer to rigid conduit system with maximum 36" of flexible liquid-tight metal conduit. Install conduit per requirements in Section 26 0533 - Raceway and Boxes for Electrical Systems.

F. Install transformer in dedicated electrical space per NFPA 70 and as shown on drawings. Coordinate with miscellaneous trades for equipment foreign to electrical installation to be outside of dedicated electrical space.

3.3 CONNECTIONS

A. Ground transformers according to Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Inspect transformers for physical damage, proper alignment, anchorage, grounding, connections, and installation.

B. Test transformers per requirements in Section 26 0800 - Commissioning of Electrical Systems and Section 26 0813 - Commissioning of Electrical Systems Test Tables 1-14.

C. Interpret test results in writing and submit to Engineer.

D. Output Settings Report: Prepare written report recording output voltages and tap settings and submit to Engineer.

3.5 REPAINTING

A. Remove paint splatters and other marks from surface of equipment.

B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.6 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

3.7 CLEANING

A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

**END OF SECTION**

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SECTION 26 2416.13- LIGHTING AND APPLIANCE PANELBOARDS

PART 1 - GENERAL

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 0526 - Grounding and Bonding for Electrical Systems

C. Section 26 0529 - Hangers and Supports for Electrical Systems

D. Section 26 0533 - Raceway and Boxes for Electrical Systems

E. Section 26 0553 - Identification for Electrical Systems

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. This Section includes circuit breaker type lighting and appliance branch circuit panelboards as indicated on drawings and as scheduled.

1.4 REFERENCE STANDARDS

A. NECA 407 - Recommended Practice for Installing and Maintaining Panelboards

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

C. NEMA AB 1 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures

D. NEMA PB 1 - Panelboards

E. NEMA PB 1.1 - General Instructions For Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

F. NFPA 70 - National Electrical Code

G. UL 50 - Cabinets and Boxes

H. UL 67 - Panelboards

I. UL 486A-486B - Wire Connectors

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

K. UL 869A - Reference Standard for Service Equipment

1.5 SUBMITTALS

A. Product Data:

1. Submit catalog data showing specified features of standard products. Extraneous catalog data must be eliminated.

B. Shop Drawings:
   1. Submit for review prior to manufacture. Include complete description, front view, dimensions, voltage, main bus ampacity, circuit breaker arrangement and sizes, short circuit current rating, and factory settings of individual protective devices.
   2. Submit 1/4" scale electrical room floor plans with panelboard locations.

C. Partial Submittals:
   1. Panelboards shall be submitted for review together. Partial submittals of panelboards are not acceptable and will be rejected.

D. Manufacturer's Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Test Reports:
   1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

F. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of panelboards and record actual circuiting arrangements.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      c. Include time-current curves, including selectable ranges for each type of overcurrent protective device.
      d. Include spare parts data listing, source, and current prices of replacement parts and supplies.
      e. Include Manufacturer's Seismic Qualification Certification and Installation Seismic Qualification Certification.

## 1.6 QUALITY ASSURANCE

A. Obtain panelboards, overcurrent protective devices, components, and accessories from one source and by single manufacturer.

B. Regulatory Requirements:
   1. Comply with NFPA 70.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Comply with NEMA PB 1.1 and manufacturer's written instructions.

1.8 WARRANTY

A. Manufacturer shall provide standard 1-year written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

1.9 MAINTENANCE

A. Extra Materials:
   1. Furnish Owner with two keys per panelboard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D

B. General Electric

C. Cutler Hammer

D. Siemens

2.2 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. NEMA PB 1, UL 67.

B. Fabrication:
   1. Factory assembled
   2. Door-in-door construction
   3. Incoming feeder lugs: copper conductors
   4. Multiple lugs to match number of conductors per phase
   5. Sub-feed (double) lugs, or feed-through lugs where indicated
   6. Filler plates
   7. Wiring terminals for field installed conductors: pressure wire connectors, except wire-binding screws for No. 10 AWG or smaller conductors

C. Panelboard Buses:
   1. Copper
   2. Ampere rating as scheduled
   3. Ground bus: uninsulated, bonded to panelboard cabinet
   4. Insulated neutral bus: 100% of phase bus rating

D. Molded-Case Circuit Breakers:
   1. NEMA AB 1, UL 489
   2. Bolt-on type, labeled for 75°C copper and aluminum conductors.
   3. Quick-make, quick-break, with thermal-magnetic trip.
   4. Common internal trip on multi-pole breakers. Handle-ties are not permitted.
   5. Ampere rating as scheduled
   6. Listed as Type SWD for lighting circuits

7. Listed as Type HACR for air conditioning equipment circuits
8. Bussing, device mounting hardware, and steel knockouts in dead front where "space" is indicated.
9. Tandem circuit breakers are not acceptable.
10. Ground fault equipment protection (GFEP), rated 30 mA trip, to provide equipment protection for branch circuits feeding electrical heat tracing, where indicated.
11. Ground fault circuit interrupter (GFCI), rated at 4-6 mA trip for protection of personnel, where indicated.

E. Cabinet
1. NEMA 250, UL 50.
2. NEMA Type 1, Type 3R (outdoor locations) enclosure.
3. Front (trim) surface mounted with door in front with concealed self-adjusting trim clamps, and complete with cylinder-type lock and catch.
4. Same height matching trim, where 2 cabinets are mounted adjacent to 1 another in finished areas.
5. Sections of panelboards have the same size, where oversize cabinets are required for 1 section of multi-section panelboard.
6. Boxes and fronts made of code-gauge galvanized steel.
7. Manufacturer's standard gray enamel finish over prime coat.

2.3 SERVICE ENTRANCE

A. UL 869A

B. Panelboards labeled as suitable for use as service entrance equipment where applicable and must include connection for bonding and grounding of neutral conductor

2.4 SHORT CIRCUIT CURRENT RATING

A. Each panelboard with minimum short circuit current rating as indicated on drawings

B. Panelboards marked with their maximum short circuit current rating at supply voltage

C. Panelboards: fully rated. Series-rated panelboards are not acceptable.

2.5 SPARE CONDUITS: SPARE CONDUITS PER REQUIREMENTS IN SECTION 26 0533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

PART 3 - EXECUTION

3.1 COORDINATION WITH MANUFACTURER

A. Instruct manufacturer about location of additional wiring gutter space when required, i.e. top, bottom, right, left, or combination.

B. Instruct manufacturer about location of main lugs or main circuit breaker, i.e. top or bottom feed based on incoming feeder entrance location.

C. Instruct manufacturer to provide multiple lugs where conductors in parallel or sub-feed (double) lugs or feed-through lugs are indicated.

D. Instruct manufacturer on size of cross-connection cables for panelboards fed via sub-feed (double) lugs or feed-through lugs. Make cable size with amperage equal to incoming feeder.

E. Verify that "touch-up" paint kit is available for repainting.

3.2 EXAMINATION

A. Verify that space indicated for panelboard mounting meets code-required working clearances.

B. Notify Architect/Engineer of discrepancies prior to submittal of product data and shop drawings.

3.3 INSTALLATION

A. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

B. Install panelboards plumb and rigid without distortion of box, in accordance with manufacturer's written instructions, and in compliance with recognized industry practices.

C. Panelboard mounting and seismic restraints:
   1. Fasten panelboards firmly to walls and structural surfaces, ensuring they are permanently and mechanically anchored.
   2. Anchor and fasten panelboards and their supports to building structural elements (wood, concrete, masonry, hollow walls and nonstructural building surfaces) by methods described in Section 26 0529 - Hangers and Supports for Electrical Systems
   3. Install two rows of steel slotted channel, with minimum of 4 attachment points, for each panelboard section.
   4. When not located directly on wall, provide support frame of steel slotted channel anchored to floor and ceiling structure.

D. Install top breaker handle a maximum of 6'-6" above finished floor.

E. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A - 486B.

F. Install as-built typewritten circuit directory in directory frame (to indicate installed circuit loads) mounted inside each panelboard door. Include description of connected loads, room number, room name, area, or item served for each branch circuit. Indicate motor names and horsepower as applicable. Cover circuit directory with clear plastic.

G. Install engraved plastic nameplates under provisions of Section 26 0553 - Identification for Electrical Systems. Attach nameplate to exterior of each panelboard using small metal screws or rivets. Do not use contact adhesive.
   1. Include panelboard name, amperage, voltage, phase, and number of wires.

H. Label spare circuits as SPARE. Leave spare breakers in OFF position.

I. Room numbers used shall be those used by Owner except as otherwise directed by Architect.

J. Install panelboard in dedicated electrical space per NFPA 70 and as shown on drawings. Coordinate with miscellaneous trades for equipment foreign to electrical installation to be outside of dedicated electrical space.

K. Install filler plates in unused spaces.

L. Install three 3/4" spare conduits stubbed into accessible ceiling space or space designated to be ceiling space in the future for all flush-mounted panelboards. Install conduits in accordance with requirements in Section 26 0533 - Raceway and Boxes for Electrical Systems.

M. Install three 3/4" spare conduits stubbed into ceiling space above and below for panelboards that serve loads on levels other than that where the panelboard is located. Install conduits in accordance with requirements in Section 26 0533 - Raceway and Boxes for Electrical Systems.

3.4 CONNECTIONS

A. Ground panelboards according to Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

3.5 FIELD QUALITY CONTROL

A. Inspect for physical damage, proper alignment, anchorage, and grounding.

B. Maintain proper phasing for multi-wire circuits.

C. Test main circuit breakers in accordance with requirements in Section 26 0800 - Commissioning of Electrical Systems and Section 26 0813 - Commissioning of Electrical Systems Tests Tables 1-14.

D. Interpret test results in writing and submit to Engineer.

E. Check phase-to-phase and phase-to-ground insulation resistance levels prior to energization of panelboards.

F. Check panelboards for electrical continuity of circuits and for short-circuits prior to energization.

G. Submit ammeter readings for panelboard feeders indicating normal operating load and phase balance.

3.6 REPAINTING

A. Remove paint splatters or other marks from surface of panelboards.

B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.7 ADJUSTING

A. Adjust fronts, covers, hinges, and locks.

3.8 CLEANING

A. Clean panelboard interiors and exteriors prior to final inspection. Remove paint splatters and other spots, dirt and debris.

**END OF SECTION**

SECTION 26 2726- WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0553 - Electrical Systems Identification.

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. This Section includes general-use snap switches, wall-box dimmers, fan speed controls, receptacles, hazardous (classified) location receptacles, pendant cord-connector devices, cord and plug sets and device cover plates.

1.4 REFERENCE STANDARDS

A. IEEE C62.41.2 – Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

B. IEEE C62.45 – Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.

C. NECA 1 – Good Workmanship in Electrical Contracting.

D. NFPA 70 – National Electrical Code.

E. NFPA 99 –Health Care Facilities.

F. NEMA FB 11 – Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.

G. NEMA WD-1 – General Color Requirements for Wiring Devices.

H. NEMA WD-6 – Wiring Devices - Dimensional Requirements.

I. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

J. UL 20 – General-Use Snap Switches.

K. UL 498 – Attachment Plugs and Receptacles.

L. UL 943 – Ground-Fault Circuit-Interrupters.

M. UL 1010 – Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.

N. UL 1436 – Outlet Circuit Testers and Similar Indicating Devices.

O. UL 1449 – Transient Voltage Surge Suppressors.

P. UL 1472 – Solid-State Dimming Controls.

Q. UL 1917 – Solid-State Fan Speed Controls.

1.5 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Manufacturer's Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

E. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations and ratings of wiring devices.
   2. Operation and Maintenance Data:
      a. Include in all manufacturers' packing label warnings and instruction manuals with labeling conditions.
      b. Include source and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

A. Obtain wiring devices from one source and by single manufacturer.

B. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory unopened packaging until ready for installation.

1.8 WARRANTY

A. The manufacturer shall provide a standard one-year warranty against defects in materials and workmanship for all products specified in this Section. The warranty period shall begin on the date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cooper Wiring Devices; a division of Cooper Industries, Inc.

B. Hubbell Incorporated; Wiring Device-Kellems.

C. Leviton Manufacturing Company, Inc.

D. Pass & Seymour/Legrand; Wiring Devices & Accessoreis.

2.2 GENERAL-USE SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches: Heavy-duty specification grade; back and side wired; flush or surface mounting; Body and Handle: thermoplastic with toggle handle; for connection to copper or copper-clad conductors:

1. Ratings:
   a. Voltage: 120-277 volts, AC.
   b. Current: 20 amperes.
2. Single pole.
3. Three-way.
4. Four-way.
5. Weatherproof: Toggle switch

2.3 RECEPTACLES

A. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

B. Receptacles: 125V, 20 A, heavy-duty specification grade; back and side wired; flush or surface mounted; straight blade; two pole, 3 wire grounding; thermoplastic body; duplexas indicated on drawings.

1. Ground Fault Circuit Interrupter (GFCI):
   a. Additional compliance with UL 943 Class A.
   b. Leakage current trip level: 4 to 6 mAmpere.
   c. Trip time: .025 seconds nominal.
   d. Non-feed through type
   e. Reverse line-load function to prevent GFCI from functioning if wired incorrectly.
   f. Indicator Light: Lighted when device is tripped.
2. Isolated Ground (IG):
   a. Ground strap isolated from mounting strap.
   b. Ground screw connected directly to ground contacts.
3. Tamper Resistant (TR):
   a. Requires insertion of object in both left and right contacts to energize.
   b. 2- or 3-prong plug.
4. Special Purpose Receptacles: Specification grade, rated for voltage, amperage and NEMA configuration as noted on drawings.

2.4 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configuration L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## 2.5 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
   2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.6 DEVICE COVER PLATES

A. Single and combination types to match corresponding wiring devices:
   1. Attachment: Metal screws with head color to match plate finish.
   2. Material for Finished Spaces: Steel with white baked enamel, suitable for filed painting
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with while-in-use hinged cover, and listed and labeled for use in "wet locations."

B. Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with weatherproof while-in-use hinged cover.

C. Lockable Cover:
   1. Hinged steel cover with cylinder lock.
   2. Keyed all the same.

D. Tamper Resistant (TR):
   1. Slide cover over receptacle.

## 2.7 FINISHES

A. Color:
   1. Switch handles, receptacle faceplates, and device cover plates: ivory except as follows:

# PART 3 - EXECUTION

## 3.1 COORDINATION

A. Special Purpose Receptacles: Coordinate final selections of NEMA configuration (locking, straight, blade, etc.) with configuration of plug on utilization equipment.

B. Receptacles for Owner-furnished equipment and equipment furnished under other divisions of these specifications: Match plug configurations.

C. Cord and Plug Sets: Match equipment requirements.

D. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the device cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.
5. Install wiring devices after all wall preparation, excluding painting, is complete. Install device cover plates after painting is complete.

3.2 EXAMINATION

A. Verify location of wiring devices with architectural interior elevation drawings, prior to rough-in.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.3 PREPARATION

A. Clean debris from outlet boxes.

3.4 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise scheduled or indicated on drawings. Indicated dimensions are to center of device.

B. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Do not place bare stranded conductors directly under device screws. Use crimp on fork terminals for device terminations.

C. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices plumb, level with finished surfaces and free from blemishes.
11. Install lighting switches vertically on latch side of door within 6" of frame edge.
12. Install devices above counters, 2" to the bottom of device above countertop or backsplash. Install all devices at same height above any one counter or fixed cabinet.
13. Install special purpose receptacles and switches according to shop and rough-in drawings furnished by trade(s) producing such equipment. Verify locations prior to rough-in.
14. Install weatherproof GFCI receptacles:
    a. Within 25'-0" of each roof mounted mechanical equipment
    b. Outdoors
    c. As indicated on drawings
15. Group adjacent switches under single, multigang wall plates.
16. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor. Grounding per requirements in Section 26 0526

D. Orientations:
1. Install ground pin of vertically mounted receptacles down.
2. Install switches with handle operating vertically, with "ON" position up.
3. Unless otherwise indicated or where space problem occurs, mount devices flush, with long dimension vertical.

E. Device Cover Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices:
1. Unless otherwise indicated or where space problem occurs, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

## 3.5 IDENTIFICATION

A. Comply with Section 26 0553.
1. Switches and Receptacles: Use hot, stamped or engraved machine printing with black-filled lettering on face of cover plate, and durable wire markers or tags inside outlet boxes.
    a. Receptacles: Label shall indicate receptacle voltage, phase, and amperage at top of cover plate, and panel and circuit number at bottom of cover plate.
    b. Switches: Label shall indicate switch voltage, phase, and amperage at top of cover plate, and panel, circuit number and switch designation at bottom of cover plate.

2. Engrave cover plates on all Owner-furnished equipment and equipment funished under other divisions of these specifications with panelboard, circuit number and "emergency" (where applicable) as specified in this section. This includes but is not limited to: headwalls, gas columns and booms, patient consoles, medical rail systems, custom casework with electrical devices, etc.

3.6 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Perform tests and prepare test reports:
   1. Test each receptacle device for proper polarity:
      a. Test every receptacle with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open. Rewire receptacles with faults and retest.
   2. Test each GFCI receptacle device for proper operation:
      a. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Apply the test to the receptacle. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shutoff power with 5/1000 of an ampere within $1/40^{th}$ of a second and retest.
   3. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
   4. Test Instruments: Use instruments that comply with UL 1436.
   5. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

E. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15 A Load: A value of 6 percent or higher is not acceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

F. Operational Tests: Demonstrate the operation of each switch with the systems fully energized and operating. Each switch shall be demonstrated three times.

G. Interpret test results in writing and submit to Engineer.

3.7 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

A. Remove excess plaster from interior of outlet boxes.

B. Clean devices and cover plates after painting is complete. Replace stained or improperly painted devices and cover plates.

**END OF SECTION**

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SECTION 26 2813- FUSES

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 2300 - Low-Voltage Switchgear

B. Section 26 2416.16 - Distribution Panelboards

C. Section 26 2816 - Enclosed Switches and Circuit Breakers

D. Section 26 2913 - Enclosed Controllers and Contactors

1.2 REFERENCE

A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and section under Division 01 General Requirements.

1.3 DESCRIPTION

A. This Section includes nonrenewable cartridge fuses, rated 600V and less, for use in low-voltage power distribution system and spare fuse cabinet.

1.4 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses

B. UL 248-1-Low Voltage Fuses - Part 1: General Requirements

C. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses

D. UL 248-5 - Low-Voltage Fuses - Part 5: Class G Fuses

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses

I. UL 512 - Fuseholders

1.5 SUBMITTALS

A. Product Data:
   1. Submit the following for each fuse type and size indicated:
      a. Manufacturer's technical data on features, performance, electrical characteristics, ratings, and dimensions
      b. Time-current curves, coordination charts and tables, and related data
      c. Let-through current curves for fuses with current-limiting characteristics
      d. Fuse size for each elevator disconnect switch

B. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual class, size, and location of fuses.

1.6 QUALITY ASSURANCE

A. Obtain fuses from one source and by single manufacturer.

B. Comply with NFPA 70 for components and installation.

1.7 MAINTENANCE

A. Extra Materials:
   1. Furnish to Owner quantity of spare fuses equal to 1% of total quantity of each fuse class and size installed, but not fewer than 3 of each fuse class and size.
   2. Furnish 1 fuse pullers for each size fuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bussmann

B. Ferraz Shawmut

C. Littelfuse

D. Edison Fusegear

2.2 CARTRIDGE FUSES

A. NEMA FU 1, UL 248-1

B. Characteristics: nonrenewable current-limiting cartridge fuse; current rating and class, as specified or indicated, and voltage rating consistent with circuit voltage.

C. Miscellaneous data:

| UL Standard | Class | Volts | Amperage | Interrupting Rating (Amperes RMS Sym.) |
|---|---|---|---|---|
| 248-4 | CC | 600 | 0-30 | 200,000 |
| 248-5 | G | 600 | 0-20 | 100,000 |
| 248-5 | G | 480 | 25-60 | 100,000 |
| 248-8 | J | 600 | 0-600 | 200,000 |
| 248-10 | L | 600 | 601-6000 | 200,000 |
| 248-12 | RK1 | 250 or 600 | 0-600 | 200,000 |
| 248-12 | RK5 | 250 or 600 | 0-600 | 200,000 |
| 248-15 | T | 300 | 0-1200 | 200,000 |
| 248-15 | T | 600 | 0-800 | 200,000 |

2.3 FUSEBLOCKS

A. UL 512

B. Thermoplastic base with UL flammability 94VO

C. Clip reinforcing springs - 100 amps and above

D. 200,000 A RMS Sym withstand rating

E. Copper or aluminum connections

2.4 TOUCH SAFE FUSEHOLDERS

A. UL 512

B. Thermoplastic base with UL flammability 94VO

C. Cover over fuses

D. Neon indicator lamp: "ON" when fuse opens

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

3.2 INSTALLATION

A. Verify proper fuse locations, sizes, and characteristics.

B. Install fuses in fusible devices (specified in Section 26 2816 - Enclosed Switches and Circuit Breakers and Section 26 2913 - Enclosed Controllers and Contactors) at job site.

C. Arrange fuses so manufacturer, class and size are readable without removing fuse.

D. Install typewritten labels on inside door of each fused device indicating fuse replacement information.

3.3 APPLICATION

A. Motor Branch Circuits: Class RK5.

3.4 CLEANING

A. Clean fuses and tighten connections prior to energization of equipment.

**END OF SECTION**