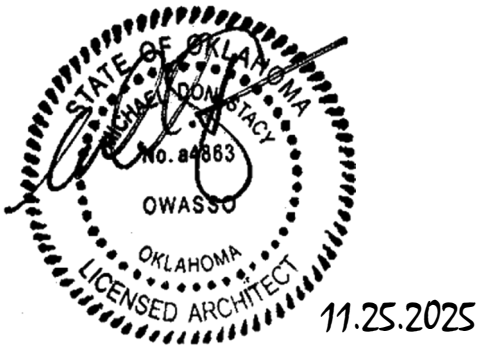
# Owasso
# Public Schools
## Owasso 8th Grade Addition

**Independent School District No. 11**
**Tulsa County**
**Owasso, Oklahoma**

**Architect: The Stacy Group**
**Project Number**
**2407**
**November 25, 2025**




**Volume 2 of 2**
**(Divisions 10 – 33)**

**Set No.:** _____

project manual

the.stacy.group
architecture.interiors
8091 N Owasso Expressway, Owasso, OK 74055
(918) 272-2622 fax: (918) 272-2633

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. Tackboards
   2. Tackboard Walls
   3. Markerboard

1.3 DEFINITIONS

A. Visual Display Boards: Markerboards and tackboards and tack assembly.

1.4 SUBMITTALS

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

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

   1. Show location of panel joints.
   2. Include sections of typical trim members.
   3. Show location of special-purpose graphics for visual display units.

C. Samples for Verification: For each type of visual display surface indicated and as follows:

   1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   2. Trim: 6-inch- long sections of each trim profile.
   3. Accessories: Full-size Sample of each type of accessory.
   4. Fabric Swatches of tack assemblies.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for surface-burning characteristics of vinyl fabrics.

E. Maintenance Data: For visual display surfaces to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of motor-operated, sliding visual display unit manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display surfaces and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Fire-Test-Response Characteristics: Provide fabrics with the surface-burning characteristics indicated, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

## 1.7 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

## 1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Surfaces lose original writing and erasing qualities.
    b. Surfaces become slick or shiny.
    c. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Basis-of-Design Product: The design for each visual display surface is based on the product specified. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

### 2.2 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, 1.7-to-2.5-mil- thick ground coat, and color cover coat; and concealed face coated with primer and 1.7-to-2.5-mil- thick ground coat.

1. Gloss-Finish Cover Coat: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser. Minimum 3.0-to-4.0-mil- thick cover coat. Cover and ground coats shall be fused to steel at manufacturer's standard firing temperatures but not less than 1475 deg F.

    a. Product: Claridge Corporation: LCS 24 Gauge Porcelain, Enamel Markerboard.

B. Hardboard: AHA A135.4, tempered.

C. Particleboard: ANSI A208.1, Grade 1-M-1.

D. Fiberboard: ANSI A208.2, Grade MD.

E. Cork Sheet: MS MIL-C-15116-C, Type II.

F. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

G. Vinyl Fabric: FS CCC-W-408, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame- spread index of 25 or less when tested according to ASTM E 84.

### 2.3 TACKBOARD ASSEMBLIES (TB4, TB8)

A. Available Manufacturers:

1. Claridge Products & Equipment, Inc.
2. Platinum Visual Systems; a division of ABC School Equipment, Inc.

B. Vinyl-Fabric-Faced Tack Assembly: 1/8-inch- thick, vinyl-fabric-faced cork sheet factory laminated to 3/8-inch- thick fiberboard backing. Finish: per drawings color as indicated on Finish Legend.

2.5 TACKBOARD WALLS (TBW12)

A. Woven Polyethylene Xorel-Fabric-Faced Tack Assembly (For use with Tack Wall): 1/8-inch-thick, Xorel-fabric-faced cork sheet factory laminated to 1/2-inch- thick hardboard backing.

1. Available Manufacturers:
   a. Claridge Products & Equipment, Inc., or Architect Approved Equal.

2. Series: 3104EW
3. Panel Sizes:
   a. Sizes Vary. Refer to Drawings.
   b. 4’-0”W x 6’-0”H - Butt join (4) equal panels to achieve 12’-0”W.
4. Panels Seam: Butt jointed together when panels are grouped together.
5. Fabric: Woven Polyethylene Xorel or as indicated in Specialties Schedule in Drawings.
5. Panel Edge Treatment: Fabric wrapped edge
   a. When fabric is released from face of board for field cutting; fabric shall be wrapped and stapled with commercial staples on backside of fiberboard backing prior to installation. Loose fabric at edges will not be accepted.
6. Assembly Edge Trim: #1015/1016 **(no exceptions)** Clear satin aluminum trim at perimeter of entire panel assembly, refer to interior elevations.
   a. To be provided on perimeter of entire panel assembly.
7. Refer to drawings for panel sizes.

2.4 MARKERBOARD ASSEMBLIES (MB8)

A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.013-inch- thick, porcelain-enamel face sheet with high-gloss finish.

1. Available Manufacturers:
   a. Claridge Products & Equipment, Inc.
   b. Platinum Visual Systems; a division of ABC School Equipment, Inc.
   c. American Visual Display Products, LLC

2. Manufacturer's Standard Particleboard Core: Minimum 1/2 inch thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.6 MARKERBOARD ACCESSORIES

A. Aluminum Frames & Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated.

1. Factory-Applied Trim: Manufacturer’s standard.

B. Map Rail: Provide the following accessories:

1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
2. End Stops: Located at each end of map rail.
3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of map rail or fraction thereof.
4. Flag Holder: Two for each classroom.

B. Chalktray: Manufacturer's standard, continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

2. Refer to documents for markerboards that will not receive chalktrays.

## 2.5 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards, unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect and as indicated on approved Shop Drawings.
2. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
3. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

## 2.9 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

### 3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Mounting Height: As indicated in Drawings.

### 3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

### 3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

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. Plaques.
2. Dimensional characters.
3. Panel signs.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
2. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.3 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.4 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Provide message list, typestyles, and graphic elements, including tactile characters and Braille, and layout for each sign.
3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers. Furnish full-size rubbings for metal plaques

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following if not listed in Drawings:

1. Aluminum.
2. Acrylic sheet.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:

1. Plaque Casting: 6 inches square including border.

2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).
3. Aluminum: For each form, finish, and color, on 6-inch- long sections of extrusions and squares of sheet at least 4 by 4 inches.
4. Acrylic Sheet: 8 by 10 inches for each color required.
5. Panel Signs: Not less than 12 inches square.
6. Accessories: Manufacturer's full-size unit.

E. Sign Schedule: Use same designations indicated on Signage Schedule in Drawings.

F. Qualification Data: For Installer and fabricator.

G. Maintenance Data: For signs to include in maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

D. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect.

E. Signage required to be accessible to people with disabilities must comply with requirements in ADA-ABA Accessibility Guidelines and with requirements of authorities having jurisdiction, whichever are more stringent. Verify local requirements and insert additional requirements below.

F. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of metal and polymer finishes beyond normal weathering.
b. Deterioration of embedded graphic image colors and sign lamination.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing) UV Stable & Outdoor Weatherable such as Romark.

1. Transparent Sheet: Where sheet material is indicated as “clear”, provide colorless sheet with matte finish, with light transmittance of 92 percent, when tested according to the requirements of ASTM D 1003.

2. Opaque Sheet: Where sheet material is indicated as “opaque”, provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer’s standards.

B. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and inserts for exterior installation and elsewhere as required for corrosion resistance.

2.2 PLAQUES

A. Basis-of-Design Product: Subject to compliance with requirements, provide A.R.K. Ramos as indicated in Drawings or a comparable product by one of the following:

1. Advance Corporation; Braille-Tac Division.
2. A. R. K. Ramos.
3. Gemini Incorporated.
4. Matthews International Corporation; Bronze Division.
5. Metal Arts; Div. of L&H Mfg. Co.
6. Mills Manufacturing Company.
7. Nelson-Harkins Industries.

B. Cast Plaques: Provide castings free of pits, scale, sand holes, and other defects, as follows:

1. Plaque Material: Aluminum.
2. Background Texture: Manufacturer's standard matte texture.
3. Border Style: Double-raised line border as indicated in Drawings.
4. Mounting: Concealed studs, noncorroding for the sign material or substrates encountered.

C. Plaque Schedule: Refer to Signage Schedule in Drawings.

2.3 DIMENSIONAL CHARACTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. ACE Sign Systems, Inc.
2. A. R. K. Ramos.
3. ASI-Modulex, Inc.
4. Bayuk Graphic Systems, Inc.
5. Gemini Incorporated.
6. Metal Arts; Div. of L&H Mfg. Co.
7. Mohawk Sign Systems.

B. Cast Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.

1. Character Material: Aluminum.
2. Thickness: As indicated in Drawings.
3. Color(s): As indicated in Drawings.
4. Mounting: Concealed studs, noncorroding for sign material or substrates encountered.

C. Aluminum Extrusions: Comply with the following requirements:

1. Finish: As indicated in Drawings.
2. Thickness: As indicated in Drawings.
3. Mounting: Concealed studs, noncorroding for sign material or substrates encountered.

D. Cutout Characters: Provide laser cut characters with square-cut, smooth, eased edges. Comply with the following requirements:

1. Acrylic: .25 inch to .50 inch thick.
   a. Color: As indicated in Drawings.

E. Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories. Comply with the following requirements:

1. Aluminum Sheet: Not less than 0.090 inch thick.
   a. Finish: As indicated in Drawings.

2. Steel Sheet: Painted, not less than 0.050 inch thick for face and 0.031 inch thick for returns.
   a. Color: As indicated in Drawings.

F. Cutout Characters: Provide laser cut characters with square-cut, smooth, eased edges. Comply with the following requirements:

1. Acrylic: .25 inch to .50 inch thick.
   a. Color: As indicated in Drawings.

G. Dimensional Character Sign Schedule: Refer to Signage Schedule in Drawings.

2.4 PANEL SIGNS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bayuk Graphic Systems Laminated ADA Product Line – LS Series or a comparable product by one of the following:

1. ACE Sign Systems, Inc.
2. ASI Sign Systems.
3. Best Sign Systems Inc.
4. Bayuk Graphic Systems, Inc.
5. Gemini Incorporated.
6. Innerface Sign Systems, Inc.
7. InPro Corporation
8. Mohawk Sign Systems

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. Acrylic Sheet:

a. Face panel: Non-glare; 1/8” thick.
b. Back panel: Opaque color; 1/16” thick.
c. Signs with removable inserts will have 3/16” back panel, with a machined slot to accept inserts of 1/16” thickness behind a clear window.
d. Where placed on windows, install matching back panel vinyl on window and attach panel directly over the vinyl. No back opaque panel required on glass.

2. Background Color(s):
a. A minimum of two (2) coats of high quality interior/exterior industrial grade alkyd enamel.
b. Two colors as selected from manufacturer’s full range as indicated in Drawings.
c. Signs with removable inserts will have 3/16” back panel, with a machined slot to accept inserts of 1/16” thickness behind a clear window.

3. Laminated Sheet: Laminate using very high bond adhesive under high pressure along the entire perimeter of panel. All panel edges routed to a smooth finish.
4. Edge Condition: Square cut.
5. Corner Condition: Rounded to ½” radius or as indicated in Drawings.
6. Mounting: Unframed.

a. Wall mounted with tamper proof screws at certain locations and others double stick tape.
b. Manufacturer's standard anchors for substrates encountered.

C. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.

D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.

2. Raised-Copy Thickness: Not less than 1/32 inch.
3. Added-on and/or engraved characters are unacceptable.

E. Panel Sign Schedule: As indicated on Signage Schedule in Drawings.

## 2.5 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## 2.6 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

## 2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over manufacturer’s standard mechanical finish, complying with AAMA 611.

B. Color Anodic Finish: Manufacturer's standard Class 1 integrally colored or electrolytically deposited color anodic coating, 0.018 mm or thicker, in finish indicated in Drawings applied over manufacturer’s standard mechanical finish, complying with AAMA 611.

C. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as

specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

2.9 ACRYLIC SHEET FINISHES

A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for years for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, are sized and located to accommodate signs.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
1. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
2. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
3. Two-Face Tape (For acrylic lettering applied to glass surfaces): Mount signs to smooth, nonporous surfaces.

C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

1. Flush Mounting: Mount characters with backs in contact with wall surface.

2. Projected Mounting: Mount characters at projection distance from wall surface indicated.
3. Concealed Mounting: Concealed threaded stud mount set in predrilled holed filled with quick-setting cement or adhesive as appropriated for substrate material.

D. Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.

1. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

## 3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

B. END OF SECTION

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 solid-polymer units as follows:

1. Toilet Enclosures: Floor-mounted, overhead-braced w/pilaster supports.
2. Urinal Screens: Floor-mounted, overhead-braced w/pilaster supports.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for blocking.
2. Division 10 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

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

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

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

C. Samples for Initial Selection: For each type of unit indicated.

D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

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

1.5 WARRANTY

A. Provide manufacturer’s 25 year warranty against breakage, corrosion, and delamination under normal conditions.

1.6 PROJECT CONDITIONS

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

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Accurate Partitions Corporation.
2. Bradley Corporation; Mills Partitions.
3. Hiny Hiders; a division of Scranton Products.
4. General Partitions Mfg. Corp.

B. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with 1/4-inch eased edges, and with homogenous color and pattern throughout thickness of material.

1. Doors and Dividing Panels: 55 -inches high, mounted 14 -inches above finish floor.

2. Pilasters: 82 -inches high, fastened to pilaster sleeves with stainless steel tamper resistant Torx head sex bolt.

a. Urinal screens shall receive a 4” wide pilaster at leading edge of urinal divider.

3. Color and Pattern: One color and pattern in each room as indicated by Architect on Specialties Schedule in Drawings. Successful bidder must be able to match color specified and account for lead times associated with custom color. Architect will select from Manufacturer’s full range of standard colors and patterns if not specified in Drawings.

C. Pilaster Sleeves: Manufacturer’s standard stainless steel, secured to pilaster with stainless steel tamper resistant Torx head sex bolt.

A. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard extruded aluminum “T” wall bracket with 5 tamper resistant barrel nuts and shoulder screws through-bolted in each flange.

B. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

C. Headrail: Heavy-duty extruded aluminum, anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant Torx head sex bolt and at top of pilaster with stainless steel tamper resistant Torx head screws.

D. Headrail Brackets: 20 gage stainless steel, satin finish, secured to wall with stainless steel tamper resistant Torx head screws.

## 2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.

A. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

B. Support Posts for Urinal Screens: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick by 4” wide, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material with pilaster shoes of manufacturer’s standard design, stainless steel.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

## 2.3 FABRICATION

A. Floor-Anchored Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Provide anchoring assemblies complete with threaded rods, lock washer, and leveling adjustment nuts at pilaster for structural connection to floor. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Doors and Dividing Panels: 55- inches high, mounted 14- inches above finished floor.

C. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer’s standard aluminum full length hinge, self-closing type.
2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
    a. Coat hook shall be mounted at 54” a.f.f. for educational facilities serving grades 6 and up.

b. Coat hook shall be mounted at 48” a.f.f. for education facilities serving grades Pre-K thru grade 5.

4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with continuous wall bracket.

a. Locate brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

1. Urinal Screens are also overhead-braced units with a pilaster set at face of urinal screen.

C. Evidence of cutting, drilling or patching are not acceptable.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set spring loaded hinges on doors to “slow swing return” to prevent door from slamming to fully closed position.

END OF SECTION

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. Corner guards.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.

B. Shop Drawings: For each impact-resistant wall-protection unit showing locations and extent. Include sections, details, and attachments to other work.

   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.

   1. Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
   2. Impact-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall-protection units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

## 1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot- (1.2-m-) long units.
   2. Impact Resistant Wallcovering: Full-size plastic sheets of maximum length and width equal to 1 percent of each type, color, and texture of units installed.

B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Basis-of-Design Product: The design for each impact-resistant wall-protection unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

A. Extruded Rigid Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; thickness as indicated.

   1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.
   2. Chemical and Stain Resistance: Tested according to ASTM D 543.
   3. Self-extinguishing when tested according to ASTM D 635.
   4. Flame-Spread Index: 25 or less.
   5. Smoke-Developed Index: 450 or less.

B. Plastic Sheet Wall Covering Material: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, semirigid, high-impact-resistant PVC or acrylic-modified vinyl plastic sheet with integral color throughout; thickness as indicated.

   1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.
   2. Chemical and Stain Resistance: Tested according to ASTM D 543.
   3. Self-extinguishing when tested according to ASTM D 635.
   4. Flame-Spread Index: 25 or less.
   5. Smoke-Developed Index: 450 or less.

C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.

D. Stainless-Steel Sheet: ASTM A 240/A 240M.

E. Fasteners: Aluminum, nonmagnetic stainless-steel, or other non-corrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

F. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Gypsum Board and Panel Adhesives: 50 g/L.
b. Multipurpose Construction Adhesives: 70 g/L.
c. Contact Adhesive: 250 g/L.

## 2.3 CORNER GUARDS

A. Surface-Mounted, Resilient, Plastic Corner Guards (CG1): Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: CS Acrovyn SSM-20 Series or a comparable product by one of the following:

2. Available Manufacturers:
a. ARDEN Architectural Specialties, Inc.
b. Balco, Inc.
c. Construction Specialties, Inc.
d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
e. Korogard Wall Protection Systems; Division of RJF International Corporation.

3. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; in dimensions and profiles indicated on Drawings.

4. Retainer: Minimum 0.060-inch- thick, 1-piece, extruded aluminum.

5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover. Inside corners to be mitered.

6. Color and Texture: As indicated on Specialties Schedule in Drawings.

## 2.4 FABRICATION

A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.

1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.

2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

a. Provide anchoring devices to withstand imposed loads.
b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
c. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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. Public-use washroom accessories.
2. Custodial accessories.

B. Owner-Furnished Material: As indicated on Specialties Schedule in Drawings.

C. Related Sections include the following:

1. Division 09 Section "Tiling" for ceramic toilet and bath accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 COORDINATION

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

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

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirement of the Contract Documents.

B. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

E. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE TOILET AND WASHROOM ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated in Specialties Schedule. Subject to compliance with requirements, provide the named product or a comparable product to be approved by Architect.
1. Bradley Corporation
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.

2.3 CUSTODIAL ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated in Specialties Schedule. Subject to compliance with requirements, provide the named product or a comparable product to be approved by Architect.
1. Bradley Corporation
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Mirror Unit Hangers: Provide mirror unit mounting system that permits rigid, tamper – and theft-resistant installation, as follow:
   1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

C. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

C. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb and square, according to manufacturer’s written instructions for substrate, indicated at locations indicated on Floor Plan.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Defibrillator cabinets.
2. Accessories.

B. Related Requirements:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
3. Section 01 77 00 - Closeout Procedures: For administrative and procedural requirements for completion of the Work.

1.02 REFERENCES

A. Reference Standards:

1. American Heart Association (AHA):

a. American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care - current Edition.

2. ASTM International (ASTM):

a. ASTM E814-11a, Standard Test Method for Fire Tests of Penetration Firestop Systems.

3. International Code Council (ICC):

a. International Building Code (IBC) - 2018 Edition.

4. Intertek Testing Services/Warnock-Hersey International (ITS/WHI)

1.03 ACTION SUBMITTALS

A. Submit in accordance with Section 01 33 00:

1. Product Data:

a. Cabinets: Materials description for defibrillator cabinets include roughing-in dimensions, details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, door style and materials.
b. Installation instructions for each product specified.

2. Shop Drawings:

a. Small-scale plans showing locations of defibrillator cabinets.
b. Schedules showing each type of cabinet to ensure proper fit and function.
c. Indicate installation procedures and accessories required for a complete installation.

3. Samples:

a. Defibrillator Cabinet Door and Trim Finishes: For each type of exposed finish

required, prepared on samples of size indicated below:

1) Size: 6 inches (150 mm) square.

1.04 QUALITY ASSURANCE

A. Comply with standards referenced in Article 1.02 - REFERENCES.
B. Provide cabinets and accessories produced by a single manufacturer.
C. Fire-Rated, Defibrillator Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect defibrillator cabinets and related materials using means and methods that will prevent damage, deterioration, or loss.

1. Deliver components in manufacturer's original packaging, properly labeled for identification.

PART 2 - PRODUCTS

2.01 DEFIBRILLATOR CABINET MANUFACTURERS

A. Acceptable Manufacturers:
J. L. Industries, Inc., a division of Activar Construction Products Group
9702 Newton Av S
Bloomington, MN 55431

(800) 554-6077
(952) 835-6850
(952) 835-2218 (FAX)

www.activarcpg.com
sales@activarcpg.com

B. Substitutions: Manufacturers seeking approval of their products are required to comply with the Owner's Instructions to Bidders, generally contained in Section 016000 Product Requirements.

2.02 1400 LIFESTART SERIES AED CABINETS

A. Cabinet with Steel Trim and Door: Basis of Design: 1400 Lifestart™ Series

1. Cabinet Style: Semi-recessed.

2. Components:

a. Tub: Cold-rolled steel.

1) Finish: Factory-applied powder coat paint finish.

a) Color: To match fire protection specialties cabinets

b. Door and Trim Construction: Cold-rolled steel; flush doors with 5/8 inch (15.88 mm) door stop attached by continuous hinge and equipped with zinc-plated with roller catch.

1) Finish: Factory-applied powder coat paint finish.

a) Color: To match fire protection specialties cabinets

2) Door Style:

a.) Style G12 Full Glazing; Acrylic, SAF-T-LOK™, Pull & AED Graphics

c. Trim Style and Depth:

1) Semi-Recessed Cabinet:

a) Rolled Edge: 3 inch (76.20 mm).

2) Trim Dimensions: 1-3/4 inch (44.45 mm) face trim on door and frame.

3. Fire-Rating: Nonfire-rated

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets will be installed, and blocking where surface mounted cabinets will be installed.

1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for defibrillator cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
2. Securely fasten cabinets to structure, square and plumb, to comply with manufacturer=s instructions.
3. Maintain fire ratings where cabinets are recessed into fire-rated wall systems.

B. Wall Signs:

1. Location: Where shown or directed.
2. Apply on walls after field painting is completed and has been accepted.

C. Cabinet Lettering:

1. Location: Face of glass surface.
2. Apply lettering on factory-finished (no further painting specified) cabinets either at the factory or just prior to Substantial Completion.

3.03 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as defibrillator cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by cabinet manufacturer.

E. Replace cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets for the following:

    a. Portable fire extinguishers.

3. Fire-protection accessories.

B. Related Sections include the following:

1. Division 7 Section "Fire-stopping" for fire stopping sealants at fire-rated cabinets.

### 1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
3. Show location of knockouts for hose valves.

B. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Size: 4-by-4-inch square Samples.

### 1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide extinguishers listed and labeled by FM.

1.4 COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers are accommodated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Portable Fire Extinguishers:

a. Larsens Manufacturing Company.
b. General Fire Extinguisher Corporation.
c. J.L. Industries, Inc.
d. Kidde: Walter Kidde, The Fire Extinguisher Co.
e. Modern Metal Products; Div. of Technico.

2. Fire-Protection Cabinets:

a. Larsen’s Manufacturing Company.
b. General Accessory Manufacturing Co.
c. J.L. Industries, Inc.
d. Modern Metal Products; Div. of Technico.

2.2 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled-steel container. MP10, Larsens

C. Wet Chemical Type: UL-rated 2A:1B:C:K, 6 liter nominal capacity. WC-6L, Larsens
1. Wet-Chemical Type to be used in all Kitchen/Concession conditions.

2.3 FIRE-PROTECTION CABINETS

A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Fire Extinguisher Cabinets: **Provide Semi-Recessed cabinets at all 8" cmu and 3-5/8" metal stud walls.**
   a. Non Rated Wall: Metal, Center Glass Break, 2409-6R, Larsens with Larsen-Loc.
   b. Rated Wall : Metal, Center Glass Break, FS2409-6R, Larsens with Larsen-Loc.
   c. 2712 Series Cabinet with Larsen-Loc required for WC-6L extinguishers.
   d. Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
   e. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material.
   f. Provide factory-drilled mounting holes.

2. Glass: Provide clear acrylic glazing.

3. Door Style: Vertical Duo

## 2.4 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.

1. Provide brackets for extinguishers not located in cabinets.
2. Provide brackets for extinguishers located in cabinets.

B. Door Locks: Larsen-Loc.

C. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

2. Include lettering on cabinets with Larsen-Loc, "IN CASE OF FIRE ONLY- PULL FIRMLY ON HANDLE"

## 2.5 COLORS AND TEXTURES

A. Colors and Textures: White

## 2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves, hose racks, and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semi recessed cabinets are to be installed.

C. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
2. Fasten mounting brackets to structure and cabinets, square and plumb.
3. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

PREMANUFACTURED CANOPIES SECTION 107060

## PART 1 - GENERAL

1.1 Description of Work

A. Work in this section includes furnishing and installation of extruded aluminum overhead cantilever supported canopies as manufactured by Mapes Industries Inc.

B. Related Items and Considerations

1. Flashing of various designs may be required. Supplied by the installer.
2. Determine wall construction, make-up and thickness.
3. Ensure adequate wall condition to carry canopy loads where required.
4. Consider water drainage away from canopy where necessary.
5. Any necessary removal or relocation of existing structures, obstructions or materials.

1.2 Quality Assurance

A. Products meeting these specifications established standard of quality required as manufactured by Mapes Industries, Inc.

1.3 Field Measurement

A. Confirm dimensions prior to preparation of shop drawings when possible.

B. If requested, supply manufacturer's standard literature and specifications for canopies.

C. Submit shop drawings and calculations showing structural component locations/positions, material dimensions and details of construction and assembly. Shop drawings and calculations shall be signed and sealed by an engineer licensed in the project state.

1.4 Performance Requirements

A. Canopy must conform to local building codes.

B. The canopy and canopy post foundations shall resist dead load, live load, snow load, and wind load, in combinations as required by the local building code.

C. Support beams shall be spaced not more than 4'-0" O.C. and shall connect directly to structural substrate (not masonry/brick veneer or metal stud framing). Connection to structural substrate is to be designed by the canopy manufacturer engineer. Design reactions from the connections to the structural substrate shall be specified by the canopy engineer on the canopy.

1.5 Deliver, Storage, Handling

A. Deliver and store all canopy components in protected areas.

## PART 2 - PRODUCTS

2.1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

A. Mapes Canopies Super Lumideck Flast Soffit Canopy – Or preapproved equal

B. Avadek

C. Peachtree

2.2 Materials

A. Decking shall consist of 3" extruded flat soffit .078 decking.

B. Fascia

1. C1: standard extruded 16" J style.

C. Cantilever supported brackets shall be standard finish

D. Decking and fascia shall be extruded aluminum, alloy 6063-6, in profile and thickness shown in current Mapes brochures.

2.3 Finishes

A. Finish type shall be 2-coat Kynar color. Color: Black

2.4 Fabrication

A. All Mapes Super Lumideck extruded aluminum canopies are shipped with the materials precut to size for field assembly.

B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.

C. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Front Scupper.

PART 3 - EXECUTION

3.1 Inspection

A. Confirm that surrounding area is ready for the canopy installation.

B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.

C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

3.2 Installation

A. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection.

3.3 After installation, entire system shall be left in a clean condition.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-formed Panels: For enclosing roof top mechanical equipment.
   1. Thermoplastic.

B. Aluminum Support Framing: For direct attachment of screening panels to mechanical equipment; no base or curb required unless shown otherwise on drawings.

C. Sliding panels to permit easy access to mechanical equipment for servicing.

D. Not Included in This Specification:
   1. Touch-up painting required for scratches and screw heads.
   2. Field painting of prime painted screens.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM B 221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.

B. The Aluminum Association, Inc. (AA):
   1. AA ADM-1516166 - Aluminum Design Manual.

C. American Society of Civil Engineers (ASCE):
   1. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data:
   1. Manufacturer's data sheets on each product to be used.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Typical installation methods.
   5. Sufficient data and detail to indicate compliance with these specifications.

C. Verification Samples: Two representative units of each panel type.
   1. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Custom color samples available upon purchase.

D. Shop Drawings: Indicate layout heights, component connection details, and details of interface with adjacent construction.
   1. Roof top mechanical equipment to be enclosed.

E. Certification: Manufacturer's Certificate of Compliance certifying that panels supplied meet or exceed requirements specified.

F. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of one year documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.5 PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.
   1. Notify Architect four (4) calendar days in advance of scheduled meeting date.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage and Handling: Protect materials and finishes during handling and installation to prevent damage.

C. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 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 recommended limits.

B. Field Measurements: Take measurements of supporting paving, footings, or piers. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.8 COORDINATION

A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.
   1. Request information on sizes and options required from the Contractor.

B. Submit shop drawings to the Contractor and obtain written approval of shop drawing from the Contractor prior to fabrication.

1.9 WARRANTY

A. If any part of the rooftop equipment screen fails because of a manufacturing defect within 3 years from the date of substantial completion, the manufacturer will furnish without charge the required replacement parts. Any local transportation, related service labor or diagnostic call charges are not included.

B. This warranty does not cover failure of your rooftop equipment screen if the Owner damages it, or if the failure is caused by improper installation. In no event shall the Warrantor be liable for incidental or consequential damages.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: CityScapes International Inc.

B. Substitutions: Preapproved equal

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

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Owasso, Oklahoma.

B. Design Criteria:
1. Rooftop Equipment Screens:
   a. The manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist snow, wind, suction, and uplift loading at any point without damage or permanent set.
   b. Framing shall be designed in accordance with the Aluminum Design Manual to resist the following loading:
      1) ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.
   c. Default Clear Space Between Equipment and Screen: 36 inch (914 mm) nominal.
   d. Standard Truss Sizes: 36 and 48 inch (1219 mm).
   e. Screen Heights: 35, 52, and 70 inches (889, 1321, 1778 mm) and may be stacked as needed.
   f. Corners may have one panel mounted at 45 degrees.
   g. Screens may partially surround units.
   h. Trusses: Should be spaced no further than 96 inches (2438 mm) along cabinet perimeter.
   i. Screens Mounted to Steel Posts: Posts must be set no further than 96 inches (2438 mm) on center.
2. Design Requirements to be Supplied to Manufacturer:
   a. Obstructions above unit base rail elevation and within 72 inches (1829 mm) of unit must be identified.
   b. Access panels, access doors, vent hoods, power disconnects, etc. must be accounted for in design; clearly noted on unit cut sheets or roof plans provided to Manufacturer.
   c. Equipment Obstruction Details Provided to Cityscapes: Such as door swings, horizontal ducting, or piping may be made to run between top and bottom rails. Contact Manufacturer for custom solutions.
   d. Post Mounting Systems: By others. Must have all steel sizing provided.
3. Limitations:
   a. Screens may be designed 22 to 60 inches (559 to 1524 mm) clear, as decided necessary by Manufacturer.
      1) Requests for special clearances should be noted.
   b. Screen Heights:
      1) Cannot exceed 8 inches (203 mm) more than cabinet height.
      2) Units may have varying screen heights if needed to clear obstructions such as parapet walls.
   c. Top Trim: May be added to cover as much of the unit above attachment points.
   d. Screen Supports: To be attached below any drip edges.
   e. Removable Screen Sections:
      1) May be used for large maintenance clearances under special conditions:

2) Removable Sections:
a) Fit between two trusses.
b) Are not adjacent to one another; two trusses either side of section.
c) Are not placed on the ends of partially sided systems.

f. Units May be Nested Together If:
1) Cabinets are no further than 96 inches (2438 mm) apart.
2) Units have similar cabinet and curb heights.
3) Units are not on isolation/vibration curbs.

g. If nested look is desired but not possible from one of the reasons above, independent screens can be sized to fit together with small gaps.

2.3 MATERIALS

A. Thermoformed Plastic Panels: Fabricated from rigid medium impact thermo-formed ABS (Acrylic Butylene Styrene) sheets.
1. Minimum thickness: 3/16 inch (5 mm).

B. Framing: Aluminum Plate, Shapes and Bar: ASTM B 221, alloy 6061-T5 or 6063-T5.

C. Threaded Fasteners: Screws, bolts, nut, and washers to be Stainless steel.
1. Corner Assembly Fasteners: No. 12-14 x 1-1/4 inches (32 mm) stainless steel self-drilling screws.
a. Length: As required to develop full holding capacity of screw when fastened to Mechanical Equipment.
2. Provide lock washer or other locking device at all bolted connections.

2.4 FABRICATION

A. Provide factory-formed panel systems with continuous interlocking panel connections and indicated or necessary components: Form all components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings.

B. Fabricate all panels to slide horizontally to allow access to unit access panels behind.

C. Panel Style, Design, and Trim:
1. Panel Style: Vertical.
2. Panel Design: AcryliCap. Louver.
3. Decorative Top Trim Profile: Band.

D. Trim and Closures: Material: Aluminum. Thickness: 0.050 to 0.25 inches (1.27 to 6.35 mm),
1. Finish: Manufacturers standard coating system, unless shown otherwise on drawings.

E. Framing: Fabricate and assemble components in largest practical sizes, for delivery to Project site.
1. Corner Assemblies: Construct to required shape with joints tightly fitted.
2. Components Required Framing Anchorage: Fabricate anchors and related components of material and finish as required, or as specifically noted.

2.5 FINISHES

A. Aluminum Framing: Mill finish.

B. Panel Coating: Manufacturer's standard powder coating system, factory applied.
1. Color: Selected from full range of manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.
   1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
   2. Beginning erection constitutes installer's acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.3 INSTALLATION

A. Install units in accordance with the manufacturer's instructions and approved shop drawings. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for a complete installation.

B. Fasten structural supports to HVAC units without damaging the operation of the unit.
   1. Provide corner and mid-span assemblies as required by approved shop drawings so that the panels are supported uniformly.
   2. Fastening bottom rail using bolts to permit ease of access to HVAC units.

C. Insert panels into structural supports, except where fixed attachment points are indicated. Butt panels to adjacent panels for uniform fit. Fasten fixed panels in accordance with the shop drawings.

D. Metal Separation: Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.

E. Do not cut or abrade finishes which cannot be restored. Return items with such finishes to shop for required alterations.

3.4 ERECTION TOLERANCES

A. Maximum misalignment from true position: 1/4 inch (6 mm).

3.5 CLEANING AND PROTECTION

A. Remove all protective masking from material immediately after installation.

B. Protection:
   1. Ensure that the finishes and structure of installed systems are not damaged by subsequent construction activities.
   2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.

C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.
   1. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

# SECTION 11 40 00 - KITCHEN EQUIPMENT

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the contract, including general and supplementary conditions and general documents, apply to the work specified in this section.

### 1.2 SCOPE OF WORK

A. Include all labor, materials, and freight required to deliver, install, set in place, level, hang hood(s), erect walk in(s), run refrigeration line(s), etc. for the equipment specified in this section.

### 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Recessed and raised floor areas including reinforced concrete wearing bed and specified floor material with coved corner bases inside walk-ins by Division 03 00 00.

B. Millwork not specified in this section is to be provided under Division 06 00 00.

C. Rough-in, final connection, indirect drains, drain traps, grease traps, steam traps, PVC for drink lines, strainers, water coolers, hand sinks, mop sinks, tailpieces, valves, stops, shut off valves, pipes, line strainers, atmospheric vents, pipe fittings, ventilators, duct work, exhaust and supply fans, disconnection and reconnection of existing equipment and all materials not specified in this section are to be provided and installed by Division 22 00 00 and Division 23 00 00.

D. Rough-in, final connection, lines, disconnect switches, safety cut off, fittings, outlets, convenience outlets, pull boxes, wiring, conduit, junction boxes, fuse boxes, control panels, starters, shunt trip breakers (required for the shut off of all electrical outlets under the ventilator and shut off of ventilator fan(s) in the event the fire suppression systems is activated), contactors, disposer and walk-in control wiring, inter connection of fire suppression system with building alarm, disconnection and reconnection of existing equipment and all materials not specified in this section are to be provided and installed by Division 26 00 00, Division 27 00 00 and Division 28 00 00.

### 1.4 FEES, LICENSES, INSPECTION, PERMITS AND TAXES

A. Pay all fees, licenses, inspections, permits and taxes required by state and local authorities for the equipment specified in this section and furnish receipts for same.

### 1.5 JURISDICTIONS, TRADE AGREEMENTS AND RESTRICTIONS

A. Portions of this work may be sub-contracted to those qualified to do such work as may be required because of jurisdictional trade agreements and restrictions.

### 1.6 QUALITY ASSURANCE

A. Submit evidence to the owner, architect and consultant of qualifications listed below:

1. Successful completion of projects of comparable size and scope.
2. Maintain a staff experienced in the installation of Kitchen Equipment and the preparation of professional drawings and brochures.

1.7 SUBSTITUTIONS

A. It is the purpose of these plans and specifications to purchase for the owner equipment that conform to the best existing policies of the commercial kitchen equipment Industry. These items have been selected as preferred items as a result of past experiences, functional design, construction, material, maintenance and repair. If a contractor elects to quote on substitutions not specified, they will be permitted to do so provided that they list these substitutions on a separate form (do not use alternates in the base bid unless pre approved) outlining them as additions or deductions to the specified brand. Any contractor offering a substitution shall accompany the bid with complete construction details, and specification sheets.

B. If a proposed substitution is accepted the kitchen equipment contractor shall provide and pay for all changes to, space, structure, utilities, construction, professional services, modify other items, provide rough in drawings, specifications, etc. that may be required.

1.8 INTERPRETATION OF DOCUMENT

A. The specifications and drawings are complementary and what is called for by one shall be binding as if called for by both. Contractors shall examine the full set plans and specifications to be fully satisfied as to the conditions of the project. No allowance shall be subsequently made to the contractor by reason of error on his part or obvious oversight not called to the attention of the Owner, Architect, General Contractor and Consultant.

B. Questions regarding specifications and drawings will be responded to by written addendum only.

1.9 WARRANTIES

A. Warranties for parts and labor in writing for all new Kitchen Equipment for a period of one year from date of acceptance.

B. Refrigeration system compressors shall be warranted for an additional four years by the manufacturer.

C. Provide at no cost to owner, refrigeration service including freon, mileage, parts and labor to all refrigeration equipment within 24 hours of notification for one year from date of acceptance.

1.10 REGULATIONS AND CODES

A. Comply with all applicable laws, statues, building codes, regulations of state, local, public authorities and comply with the following:

1. National Sanitation Foundation.
2. National Fire Protection Association.
3. Underwriter’s Laboratories, Inc.
4. Department of Energy’s 2017 Energy Efficiency Standards.

5. 2016 Paris Climate Agreement.
6. 2009 Federal Energy Saving Standards.
7. Factory Mutual.
8. Building Official and Code Administrators.
9. National Electrical Code.
10. American Gas Association Labs.
11. Occupational Safety and Health Act.
12. National Electrical Manufactures Association.
13. Americans with Disabilities Act.
14. American National Standards Institute.
15. American Society of Mechanical Engineers.

1.11 SUBMITTALS

A. Kitchen equipment contractor shall review rough-in drawings provided and notify the Architect, Consultant and Construction Manager or General Contractor in writing with in 15 days of any utility changes required for the equipment. Submit in thirty days dimensioned drawings showing all Kitchen Equipment items with itemized schedules, mechanical rough-in, electrical rough-in and critical conditions plan.

B. Submit in thirty days dimensioned drawings showing complete construction details of all fabricated equipment.

C. Submit in thirty days brochures of regularly manufactured items with project label, project cover sheet, item cover sheet, and specification sheet.

D. Submit number and type drawings as requested by the owner, architect, consultant and general contractor.

E. Submit in thirty days material samples with manufacturer’s name plate and item number for review to the Owner, Architect, Consultant and Construction Manager or General Contractor.

F. Submit prior to kitchen equipment demonstration operation/instruction manuals with item cover sheet (indicate on item cover sheet for the kitchen equipment, make, model number, serial number and local service agency with address and phone number for the project location) and copy of manufacturer’s operation and instruction manual.

G. Provide pictures of completed punch list deficiencies to Contractor, Architect Owner and Consultant for review after all punch list work has been completed.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver any Kitchen Equipment to the project until advised and building is weather and vandal safe.

1.13 JOB CONDITIONS

A. Before ordering Kitchen Equipment and starting work verify measurements at job site. Be responsible for fitting Kitchen Equipment into space provided. No extra charge or compensation will be allowed for minimal difference between dimensions indicated and actual field dimensions.

B. Verify that Kitchen Equipment will fit through openings provided.

C. Prior to ordering Kitchen Equipment verify all mechanical and electrical utilities available at the project site and coordinate.

1.14 SCHEDULING

A. Coordinate and schedule delivery and installation of Kitchen Equipment so as not to impede project construction schedule. Coordinate number of days required for equipment installation with owner and general contractor.

## PART 2 – PRODUCT

2.1 MATERIALS

A. United States standard gauge 18-8, type 302, not over .012% maximum carbon stainless steel with a number 4 finish.

B. Armco Galvanized Steel.

2.2 MANUFACTURED EQUIPMENT.

1. Standard finishes and accessories unless specifically deleted. Options shall be by same manufacturer.

1. Follow the manufactures installation instructions.

2. All equipment for high altitude operation, elevation approximately 7200 feet above sea level.

2.3 FABRICATION

A. General

1. Provide fabricated Kitchen Equipment as specified.

2. Fabricated by one manufacture with consistent construction for like items.

3. Grind all welds of stainless steel smooth and polish to a number 4 finish.

4. Use concealed type bolts to fasten trim to paneling and body of equipment, and secure to exposed sheet metal surface.

5. Use stainless steel bolts and screws.

6. Where threads of bolts and screws occur on inside of fixtures, are visible, or might come in contact with a wiping cloth, cover screw with washer and stainless steel acorn nut.

7. Do not use rivets to fasten body paneling together.

8. Sound deadening

a. Provide Schnee Butyl-Sealant ½” wide rope as a sound deadening material between all metal surfaces and tighten bolts for maximum compression of sealant.

9. Painting
   a. Non-stainless steel finishes painted two coats of hammer tone gray, air-dried.
   b. Oven baked finishes for 2 hours at a minimum temperature of 300º F.

10. Stainless Steel Tops
    a. 14 gauge stainless steel tops with one piece fully welded construction. Free edges turned down 2" and back on slight angle ½" with corners fully welded, ½" high marine edge with fully welded corners or as detailed, indicated and specified.
    b. Where tops fit adjacent to equipment, walls and columns cove up to specified height and back on 45º angle or as specified forming a back splash and Zee clip to wall, unexposed. Enclose ends of back splashes, extending full length of fixture including rolls.
    c. Reinforce underside of tops with fully welded 14 gauge stainless steel angle and channel framework of suitable size and at locations as required to hold top flat and support heavy loads without deflection. Provide two hat channels to support drawer assemblies, enclosed bases and leg/gusset as required.
    d. Provide cross members at 30" on centers maximum. No bolts or pop rivets in tops.

11. Field Joints
    a. Fully weld grind smooth and polish to a number 4 finish. Field joints in bases pull tight and cover with pilaster of same material as base. Minimum field joints required for access into building.

12. Coved Corners
    a. Vertical and horizontal corners coved on a ¾" radius and cove at intersections.

13. Enclosed Bases
    a. 18 gauge stainless steel formed flat approximately 1" on bottom then formed up to the underside of the top then formed flat approximately 1" to the inside of the cabinet and formed down approximately ½" to create a rigid structure with all seams fully welded, ground smooth and polished. Front rails, mullions, and other components to provide appearance of one piece construction fully welded seamless with no open cracks or ledges.

14. Enclosed Bases
    a. 18 gauge stainless steel U channel filler behind mullions weld in place grind smooth and polish.

15. Legs & Cross rails
    a. 1 5/8" outside diameter, 16 gauge stainless steel tubing, fully welded at cross rails, ground smooth, and polished.

b. Fit leg with adjustable stainless steel bullet or flange foot with holes secured to floor with non corrosive anchors.

c. Open base legs fit at top with stainless steel gusset welded 360 degrees to underbracing.

16. Under shelves

a. 18 gauge stainless steel shelves in enclosed bases, turn rear and ends up with a hug edge, fully weld corners grind smooth and polish. Flush shelf with base fully weld, grind smooth and polish.

b. 18 gauge stainless steel shelves in open based, free sides turn down 2” and back ½ “, at wall or tall equipment turn up 2” with corners notched and fully welded to legs, grind smooth and polish.

17. Casters

a. NSF, 5” diameter, stainless steel , polyurethane, all swivel, top operated foot brake, zerk grease fitting, and each to support 300 pound load.

18. Drawers

a. Component Hardware S90-0020*M126 with four sided 14 gauge stainless steel frame fully welded corners, flange top in, and bolt to hat channels. S90-0015*M126 for smaller spaces.

b. Provide cylinder locks when specified in itemized specifications, all keyed alike.

19. Sinks and Drain boards

a. 14 gauge stainless steel fully welded construction with all corners coved on ¾” radius.

b. Double wall partitions between sink compartments.

c. Slope drain boards to sink compartment.

d. Crease bottom of sink for proper drainage.

e. Drain boards constructed integral with sink compartments.

f. Fisher 22411*M126 drain with 14 gauge stainless steel bracket.

g. T & S B-231-CR*M126 faucet.

20. Over Shelves

a. 18 gauge stainless steel fully welded construction, form as specified for tops, provide stainless steel underbracing as required to support shelf without deflection turn up 2” at wall and equipment.

b. Table mounted shelves mounted on 1” tubing, 16 gauge stainless steel tubing fully welded to top or back splash.

c. Wall mount shelves on 14 gauge stainless steel brackets attached to wall with stainless steel screws.

## 2.4 SCHEDULE OF EQUIPMENT

A. New kitchen equipment furnished under this contract the Kitchen Equipment Contractor shall provide the following:

1. Furnish and install items with all standard options and features unless specifically modified or deleted.
2. Assembly and installation according to manufacture's instructions and details.
3. Assembly and installation according to any and all applicable building codes.
4. Onsite coordination with other trades for the final utility connections.
5. Startup, testing and calibration by the manufacture's authorized service agencies.
6. Onsite demonstration by the manufacture's representative.
7. All items shall include a one year onsite parts, service and labor warranty.
8. All items with refrigeration systems shall include a five year compressor warranty.
9. Refrigerant(s) and refrigeration system(s) shall comply with all current local, state, national and federal government energy efficiency and energy saving standards.

B. Item 1, 1A, 1B, 1C, 1D and 1E - Walk in cooler / freezer and refrigeration systems - One required

1. Thermo-kool Industries.
2. Fabricated according to details, drawings and specifications.
3. Provide the following:
   a. THE BUILDING RECESS OR FLOOR MUST BE LEVELED BY THE KITCHEN EQUIPMENT CONTRACTOR OR WALK IN INSTALLER WITH SELF LEVELING CONCRETE FAILURE TO PROPERLY LEVEL THE AREA WILL VOID THE WALK IN MANUFACTURERS WARRANTY.
   b. SILICONE MAY NOT BE USED INSIDE THE WALK IN TO SEAL INTERNAL SEAMS
   c. After complete installation, (including electrical conduits, drains and refrigeration piping and all air tight sealing) prior to refrigeration system start up, Kitchen Equipment Contractor shall blower door test the walk in compartments for ambient air infiltration according to all standards and methods specified in the current ATTMA TSL2 (The Air Tightness Testing and Measuring Association TSL2) for non dwellings. Compartment(s) shall meet or exceed the air leakage standards between normal 0.35 and best practice 0.20 for walk ins (cold stores). Temporarily seal air tight drains, pressure relief ports, etc. Test seams, penetrations, etc. for air leaks with a hand held fog generator, mark any air leaks with non staining bright peel off tape, repair any air leaks

found with the fog generator, this may require disassembly, resealing and reassembly. Retest for air leaks until none are detected during the fog test. Test administrator, methods, procedures, testing equipment, written reports and include copy of testing equipment printouts shall be provided according to ATTMA TSL2. Test administrator shall be factory trained and certified to operate blower door testing equipment. Testing equipment shall be calibrated before testing. Door opening(s) larger than 34“ x 76” will require the Kitchen Equipment Contractor to temporarily reduce the size of the opening with a enclosure that is compatible with the testing equipment and that can withstand the pressure generated during the test. One year onsite parts, service, labor and air leak warranty.

d. Kitchen equipment contractor shall seal all floor, wall and ceiling panel seams and joints airtight with two (2) continuous 3/8” beads of Kason 3701 butyl sealant apply with a battery operated caulk gun. BUTYL SHALL BE UNEXPOSED, DO NOT APPLY BUTYL TO EXTERIOR.

e. KITCHEN EQUIPMENT CONTRACTOR SHALL KEEP WALK IN PENETRATIONS TO A MINIMUM.

f. Kitchen equipment contractor shall furnish and seal airtight all penetrations in the walk in panels for all trades with spray polyurethane insulating foam sealant (rigid or closed cell) the thickness of the panel without any voids, allow sealant to fully cure, trim excess and seal the exposed urethane foam on both sides of the panel watertight with silver NSF food grade 100% silicone sealant.

g. Kitchen equipment contractor shall furnish, install, coordinate size and location with the electrician NEMA 4 (non metallic) PVC electrical components, conduits, junction boxes, etc. for walk in panel electrical penetrations. Seal airtight around the outside of the conduit with spray polyurethane insulating foam sealant the thickness of the panel without any voids. Seal airtight inside of the conduit around the wires the thickness of the panel without any voids.

h. All electrical components inside the walk in shall be watertight.

i. Disconnects used inside the walk ins for evaporators fans and evaporator electric defrost heaters shall be NEMA 4 rated.

j. Kitchen Equipment Contractor shall furnish, install and seal airtight with spray polyurethane insulating foam sealant all penetrations required for the walk ins, KEC SHALL KEEP WALK IN PENETRATIONS TO A MINIMUM.

k. Kitchen equipment contractor shall provide a Thermo-kool Industries factory trained and certified person onsite to supervise the complete assembly and installation of the walk in system. Provide name of factory trained and certified person in submittal documents for verification.

l. Kitchen equipment contractor shall level the floor or recess provided for the walk in, as required, with self leveling concrete allow to fully cure according to manufactures instructions before installing walk in. SAND NOT ALLOWED FOR LEVELING.

m. NSF certified construction and components. Bear NFS seal.

n. Non standard size as required to fit the space. Wall and ceiling panels shall be built in 1” increments up to 46” wide. Corner panels shall be 90 degree angle, 12” x 12”. All like panels shall be fully interchangeable.

o. Field verify and coordinate all measurements prior to release for fabrication.

p. 0.040 embossed aluminum exposed exterior.

q. 26 gauge stucco embossed galvanized unexposed, exterior.

r. 0.040 embossed aluminum interior.

s. Trim openings on sides (at walls) with matching exterior material angles neatly attached with stainless steel screws.

t. Trim openings on top (at free sides) with matching exterior material, lift off, removable, enclosure panels, attach trim with stainless steel screws.

u. 4” thick zero ozone depleting urethane insulation foamed in place and bonded to interior surfaces of panels. All panels R-32.

v. The perimeter frame of all panels shall be formed with a rigid structural high density urethane insulation forming tongues and grooves (soft edge foam panel construction is not allowed). Cam locks shall be formed into the perimeter frame for easy assembly and disassembly.

w. Panels shall be constructed without interior metal, straps or wood.

x. Insta-Loks cam locks, three per wall, maximum 43” on centers for taller walls. Insta-Loks cam locks in ceiling panels maximum 36” on centers.

y. 8’-6” high above building finished floor.

z. Set in 8” deep recess in building floor. 4” concrete by GC.

aa. Exterior walk in walls shall be installed 2” off all building walls.

bb. Kitchen equipment contractor shall furnish and install below the walk in floor panels and up all sides of the recess 15 mil polyethylene sheeting with all seams sealed watertight with tape.

cc. Foamed in place diamond aluminum tread floor panels. Structural floor 4” insulated floor panels with structural members, ¾” plywood adhered to the floor material, floor structure to support minimum 4,000 pounds per square foot.

dd. 36” wide X 78” high doors with 14” x 24” view port and heated, triple pane safety glass, each door.

ee. 14 gauge stainless steel thresholds shall have a 45 degree angle on both sides of the door opening, field verify measurements.

ff. Thermostatically controlled heated door jamb and threshold for cooler and freezer doors.

gg. Kason 1238C chrome polished latch (handle) with cylinder lock and interior glow in the dark twist off safety release, each door.

hh. Kason 1094 chrome polished hydraulic closer, each door.

ii. One Kason 1830, 120/1, heated pressure relief port in the wall between the cooler and freezer.

jj. One Kason 1830, 120/1, heated pressure relief port in the cooler door panel.

kk. Two Kason 1346 chrome polished performer adjustable spring loaded hinges, each door.

ll. Two Kason 1230 door foot treadle, each door.

mm. Kason Thermalflex vinyl strip door curtains, each door.

nn. Flush mounted 4700HL multi monitor(s) or equal with built in battery back up or equal, PC connect kit, flush mounted MD-1 motion detectors, flush mounted IP-1 illuminated push button panic switches and MC-1 magnetic door contacts pre wired into each door panel.

oo. Kason 1806 LED lights with frosted high impact lexan globe and LED bulbs centered over each door.

pp. Eiko VTS-5CS-40K-U (09712) 48” led light with 50,000 life hours, 120-277/1, 40 watts, 5200 lumen. Kitchen Equipment Contractor shall secure fixtures to the ceiling, unexposed, with stainless steel hardware. DO NOT PENETRATE EXTERIOR OF WALK IN CEILING PANELS TO INSTALL FIXTURES. Two in cooler and Two in freezer.

qq. KE2 Therm Solutions evap OEM controllers with recessed basic displays for all evaporator coils. KE2 electronic expansion valves for all evaporator coils. 8 port switch. EM plus wireless router. Cat5e data cables. Set up to KE2 smart access program with computers and devices. Complete installation/set up and fully operational wireless remote temperature motoring system. NOTE: COORDINATE INSTALLATION OF SYSTEM WITH IT DEPARTMENT. By refrigeration system supplier.

rr. Scroll compressors.

ss. Systems rated 105 degree for ambient outside air temperature.

tt. R454A refrigerant for both refrigeration systems. A2L compliant.

uu. 2 horse power (15,360 btu) and sized to maintain +35 degree temperature, pre wired preassembled remote cooler condensing unit, 208/3 with outside weatherproof cover, expansion valve, dryer, sight glass, temperature control, pump down solenoid valve, pressure control, suction line vibration eliminator, coil mounting kit, crankcase heater, headmaster valve, etc. Electronic expansion valves. Evaporator coil, 120/1. TK or equal by RDT. Coldzone will not be accepted. Temperature monitoring system above and stands by TK or RDT.

vv. 5 horse power (16,280 btu) and sized to maintain -10 degree temperature, pre wired preassembled remote freezer condensing unit, 208/3 with outside weatherproof cover, expansion valve, dryer, sight glass, temperature control, pump down solenoid valve, freezer time clock (when required), pressure control, suction line vibration eliminator, coil mounting kit, crankcase heater,

headmaster valve, etc. Electronic expansion valves. Evaporator coil, 208/1, drain line heat tape. TK or equal by RDT. Coldzone will not be accepted. Temperature monitoring system above and stands by TK or RDT.

ww. Kitchen equipment contractor shall furnish and install copper refrigeration lines from evaporator coils to condenser properly sized for length of run, suction lines insulated with 1" UV rated arma flex, liquid lines insulated with ½" UV rated arma flex, seal all arma flex seams water tight. Seal building penetrations air tight with insulation covered with building color exterior matched trim or 14 gauge stainless steel trim.

xx. Support refrigeration lines from structure and run refrigeration lines in chase(s) where required from condenser to evaporator coil.

yy. Refrigeration lines shall be wrapped with white Speedline or equal 0.020 mil. UV rated cut and curl PVC jacketing with SSL self seal lap with all seams sealed water tight with PVC liquid adhesive.

zz. Electrical contractor to furnish and install NEMA 4 electrical disconnect for the cooler and or freezer evaporator coil fans and in the freezer a NEMA 4 electrical disconnect for the evaporator coil defrost heater.

aaa. Kitchen equipment contractor shall hang evaporator coils with nylon (only non metallic) all thread rod and stainless steel nuts and washers, seal penetrations air tight.

bbb. Raychem H622, 208/1 (H612, 120/1), wet location winter guard self regulating drain line heat tape(s) with connection kits and H912 gel fill end seal kits. One piece tape with no tees or splices. Heat tape of sufficient length and installed to prevent freezing of walk in drain pipes.

ccc. Set condensers air intake side 48" minimum from walls, etc. and 48" minimum exhaust side from walls, etc. Set ends 36" minimum from other condensers, walls, etc. Do not set condensers in the exhaust path of any other heat generating equipment.

ddd. Fabricated 24" high fully welded all stainless steel rack or wall mounting frame for each condensing to set on with 14 gauge stainless steel solid top, 12 gauge stainless steel angle channels and legs with tabs at bottom for securing rack to mounting location with non corrosive anchors at each corner.

eee. Roof/curb mounted set units on treated 4" x 4" runners. Secure condenser frame to rack or 4" x 4" runners with non corrosive anchors at four corners. Provide a layer of Duro-last DL-40 vinyl 40 mil material between the roof and the 4" x 4" runners when the 4" x 4" runners set on roof.

fff. Kitchen equipment contractor shall furnish and install 3/4" hard copper drain lines from evaporator coils to floor drain, slope 1/2" to 12" minimum, fully insulated with ¾" arma-flex insulation, provide clean out tees with plugs and P traps to prevent the back flow of air into freezer from the cooler, or exterior, and from the kitchen into the cooler. Drain pipe to exit the walk in approximately 12" above finished floor, seal penetrations air tight between compartments and cooler and exterior.

ggg. Provide all components required for the complete and proper operation of the walk-in cooler and freezer for the location, region, climate, altitude, etc. of the installation.

hhh. 3/16" diamond thread aluminum kick plate 36" high on interior and exterior of each door.

iii. 3/16" diamond thread aluminum kick plate 36" high on interior and exterior of the door panels, notch above floor base material as required.

jjj. 3/16" diamond thread aluminum kick plate 36" high at exposed exterior, stop kick plate 4" from walls to allow space for installation of angle trim.

kkk. Kitchen equipment contractor shall seal all floor, wall and ceiling panel seams and joints airtight with two (2) continuous 3/8" beads of Kason 3701 butyl sealant apply with a battery operated caulk gun. BUTYL SHALL BE UNEXPOSED, DO NOT APPLY BUTYL TO EXTERIOR.

lll. The walk in and refrigeration systems shall be set in the location shown on the kitchen plans. The kitchen equipment contractor will be required to disassemble, move and reinstall the walk-in and refrigeration systems if not set how and where shown.

mmm. Internal and or external structure and all hardware required to support, fully assemble and install walk in the location shown on the plans.

nnn. Kitchen equipment contractor shall provide and seal air tight all penetrations in the walk in panels for all trades, coordinate.

ooo. Kitchen equipment contractor shall fully insulate all fire sprinkler pipes as required to prevent condensation, water and ice and from forming on the pipe and dripping inside and or on to the exterior top of the walk in.

ppp. Kitchen equipment contractor shall furnish, install, coordinate size and location with the electrician of NEMA 4 PVC (only non metallic) electrical components for walk in panel electrical penetrations. Seal around the outside of the conduit airtight. Seal airtight inside of conduit around wires 4" thick from one side of the panel to the other.

qqq. KITCHEN EQUIPMENT CONTRACTOR SHALL KEEP WALK IN PENETRATIONS TO A MINIMUM.

rrr. All electrical components inside the walk in shall be watertight.

sss. Preassemble walk in at factory for a complete quality control inspection.

C. Item 2 – Walk in shelving – Fifteen required

1. Metro metroseal 3, super erecta.
2. Provide the following:
   a. One unit with Four 21" x 36" wire shelves and four 63" high post, each unit.

b. Four units with four 21” x 60” wire shelves and four 63” high post, each unit. Below the evaporator coils.
c. Ten units with five 21” x 60” wire shelves and four 74” high post, each unit.
d. Field verify space and adjust sizes to fit as required.
e. Assemble onsite verify and coordinate shelf spacing with owner.

D. Item 3 – Dry storage shelving – Six required
1. Metro metroseal 3, super erecta.
2. Provide the following:
a. Six units with five 24” x 60” wire shelves and four 74” high post, each unit.
b. Field verify space and adjust sizes to fit as required.
c. Assemble onsite verify and coordinate shelf spacing with owner.

E. Item 4 – Dunnage rack – Four required
1. Two New Age 2009.
2. Two New Age 2008.

F. Item 5 – Can rack – One required
1. New Age 1250CK.

G. Item 6 – Drying rack – Five required
1. Metro PR48VX4-XDR, each unit.

H. Item 7 – Preparation table – Two required
1. Fabricated according to details, drawings and specifications.
2. Provide the following:
a. 14 gauge stainless steel one piece coved corner top.
b. Marine edge where shown 35 ½” to top.
c. 36” high to top of marine edge.
d. 8” high splash at rear from top of marine edge, 8 ½” high from top.
e. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.

f. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME.

g. Copper flashed weld studs capped with stainless steel acorn nuts.

h. ¾" tacky tape between all metal surfaces, installed to create a vermin proof seal.

i. Stainless steel gussets fully welded 360 degrees to channels.

j. 1 5/8" 16 gauge stainless steel tubing legs.

k. 1 5/8" 16 gauge stainless steel tubing crossrails fully welded 360 degrees to legs.

l. Stainless steel adjustable bullet feet.

m. Stainless steel flanged feet at four corners with two holes, secure to floor with two non corrosive anchors.

n. Weld in partition or NO SPLIT BOWLS allowed between bowls.

o. Two 20" X 20" X 10" deep 14 gauge stainless steel coved corner sinks, each unit.

p. One T & S B-0184-CR faucet with ceramic cartridges, each unit.

q. Fisher 22411 lever handle drain(s) with overflow with 14 gauge stainless steel handle bracket secure to sink bottom with weld studs and stainless steel acorn nuts, hole in bracket 1/8" maximum larger (LARGE HOLE OR ELONGATED SLOT IS NOT ALLOWED) than handle diameter. MODIFIED drain handle length (reduce or extend) to make the drain handle flush with the face of the sink bowl.

r. One Component Hardware S90-0020-N drawer with 14 gauge stainless steel four sided fully welded seamless frame, each unit. Install with stainless steel screws. Frame is removable from channels and drawer. DO NOT OMIT OR DELETE ANY CHANNELS. 15" drawer for smaller spaces, typical.

s. 16 gauge stainless steel removable overshelf mounted on 1 5/8" outside diameter tubing supports through splash to brackets welded to legs, 2" X 3/16" stainless steel band fully weld to brackets full length and stainless steel double sided pot hooks 8" on centers. Mount 60" above finished floor (66" at pot sink/dishtable), verify height with mini pre rinse faucet and owner. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.

t. Channels shall be welded to each other with a 1"x1" x 4" x 1"x 1" continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

u. Center legs 3" maximum from edge of tops, inside of rolls and backsplash surfaces.

v. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

w. Z clip splash to wall, unexposed where walls are present.

x. Chicago 305-VBRCF, or T&S equal, hose bib and rack, mounted to 14 gauge stainless steel bracket secure bracket to underside of top, each unit.

I. Item 8 – Work table – One required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top. 36" high.
   b. Top turned down 1½" and back ½" on a slight angle on all free sides.
   c. 8" High splash at walls. Z clip splash to wall, unexposed where walls are present.
   d. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.
   e. Copper flashed weld studs capped with stainless steel acorn nuts.
   f. ¾" tacky tape between all metal surfaces, installed to create a vermin proof seal.
   g. 16 gauge stainless steel removable overshelf mounted on 1 5/8" outside diameter tubing supports through splash to brackets welded to legs, 2" X 3/16" stainless steel band fully weld to brackets full length and stainless steel double sided pot hooks 8" on centers. Mount 60" above finished floor (66" at pot sink/dishtable), verify height with mini pre rinse faucet and owner. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.
   h. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME
   i. Two Component Hardware S90-0020-N drawer with 14 gauge stainless steel four sided fully welded seamless frame. Install with stainless steel screws. Frame is removable from channels and drawer. DO NOT OMIT OR DELETE ANY CHANNELS. 15" drawer for smaller spaces, typical.
   j. Stainless steel gussets fully welded 360 degrees to channels.
   k. 1 5/8" 16 gauge stainless steel tubing legs.
   l. Stainless steel adjustable bullet feet.
   m. Channels shall be welded to each other with a 1"x1" x 4" x 1"x 1" continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.
   n. Center legs 3" maximum from edge of tops, inside of rolls and backsplash surfaces.
   o. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

J. Item 9 – Preparation table – Two required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top. 36” high to top.
   b. Top turned down 1½” and back ½” on a slight angle on all free sides.
   c. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.
   d. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME.
   e. Copper flashed weld studs capped with stainless steel acorn nuts.
   f. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.
   g. Stainless steel gussets fully welded 360 degrees to channels.
   h. 1 5/8” 16 gauge stainless steel tubing legs.
   i. 1 5/8” 16 gauge stainless steel tubing crossrails fully welded 360 degrees to legs.
   j. Stainless steel adjustable bullet feet.
   k. Stainless steel flanged feet with two holes, secure to floor with two non-corrosive anchors. Wall table at corner legs, island table at four corners and dish tables at all front legs.
   l. One 20” X 20” X 10” deep 14 gauge stainless steel coved corner sinks, each unit.
   m. One T & S B-0221-CR faucet with ceramic cartridges, each unit.
   n. Fisher 22411 lever handle drain(s) with overflow with 14 gauge stainless steel handle bracket secure to sink bottom with weld studs and stainless steel acorn nuts, hole in bracket 1/8” maximum larger (LARGE HOLE OR ELONGATED SLOT IS NOT ALLOWED) than handle diameter. MODIFIED drain handle length (reduce or extend) to make the drain handle flush with the face of the sink bowl.
   o. Two Component Hardware S90-0020-N drawer with 14 gauge stainless steel four sided fully welded seamless frame, each unit. Install with stainless steel screws. Frame is removable from channels and drawer. DO NOT OMIT OR DELETE ANY CHANNELS.

p. 2” X 1/4” stainless steel three band fully welded pot rack mounted on 1 5/8” stainless steel tubing supports (7’-6” high) secured to undershelf with stainless steel hardware, penetrate top with stainless steel gusset inverted and fully welded to top and stainless steel double sided pot hooks 8” on center, 16 gauge stainless steel adjustable overshelf with 14 gauge stainless steel brackets fully welded to sockets, mounted on 5” stainless steel sockets with set screws, free sides turned down 1 ½” and back ½” on a slight angle. Each unit

q. Mount Item 60 – Manual can opener, to this item where shown on plans with sll stainless steel hardware, each unit.

r. Channels shall be welded to each other with a 1”x1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

s. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.

t. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

K. Item 10 – Number not used.

L. Item 11 – Number not used.

M. Item 12 – Bun pan rack – Fifteen required

1. New age 1650 or Cres Cor 207-UA-13A.
2. Provide the following
   a. Six future.

N. Item 13 – Preparation table – One required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top.
   b. 36” high to top.
   c. Top turned down 1½” and back ½” on a slight angle on all free sides.
   d. 8” High splash at walls. Z clip splash to wall, unexposed where walls are present.
   e. 18 gauge stainless steel undershelf where space allows, notched and fully welded to legs. Free sides turned down 1 ½” and back 1/2” on a slight angle and turn up 2” at walls.

f. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME.

g. Copper flashed weld studs capped with stainless steel acorn nuts.

h. ¾" tacky tape between all metal surfaces.

i. Stainless steel gussets fully welded 360 degrees to channels.

j. 1 5/8" 16 gauge stainless steel tubing legs.

k. Stainless steel adjustable bullet feet.

l. Stainless steel flanged feet at front corners with two holes, secure to floor with two non corrosive anchors.

m. One 20" X 20" X 10" deep 14 gauge stainless steel coved corner sinks.

n. One T & S B-0231-CR faucet with ceramic cartridges.

o. Fisher 22411 lever handle drain(s) with overflow with 14 gauge stainless steel handle bracket secure to sink bottom with weld studs and stainless steel acorn nuts, hole in bracket 1/8" maximum larger (LARGE HOLE OR ELONGATED SLOT IS NOT ALLOWED) than handle diameter. MODIFIED drain handle length (reduce or extend) to make the drain handle flush with the face of the sink bowl.

p. Two Component Hardware S90-0020-N drawer with 14 gauge stainless steel four sided fully welded seamless frame. Install with stainless steel screws. Frame is removable from channels and drawer. DO NOT OMIT OR DELETE ANY CHANNELS.

q. One Component Hardware S90-0020-N drawer with 14 gauge stainless steel four sided fully welded seamless frame. Install with stainless steel screws. Frame is removable from channels and drawer. DO NOT OMIT OR DELETE ANY CHANNELS.

r. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

s. 16 gauge stainless steel removable overshelf mounted on 1 5/8" outside diameter tubing supports through splash to brackets welded to legs, 2" X 3/16" stainless steel band fully weld to brackets full length and stainless steel double sided pot hooks 8" on centers. Mount 60" above finished floor (66" at pot sink/dishtable), verify height with mini pre rinse faucet and owner. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.

t. Channels shall be welded to each other with a 1" x 4" x 1" continuously weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuously weld, typical.

u. Center legs 3" maximum from edge of tops, inside of rolls and backsplash surfaces.

O. Item 14 – Number not used

P. Item 15 – Number not used

Q. Item 16 - Number not used

R. Item 17 – Utility cart – Six required.
   1. Lakeside 521, each unit.

S. Item 18 – Ice maker – One required
   1. Manitowoc RNP0320.
   2. Provide the following:
      a. 120/1 with cord and plug.
      b. Nugget ice.
      c. Adaptor(s) if required for ice maker to mount on bin.
      d. D400 stainless steel bin.
      e. Stainless steel legs.
      f. Cuno ICE120-S water filter. DO NOT MOUNT BEHIND ICE MAKER.

T. Item 19 – Hand sink – Five required
   1. Provided and installed by plumbing contractor.
   2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

U. Item 20 – Number not used

V. Item 21 – Convection oven - Three required
   1. Vulcan VC44GD double stack.
   2. Provide the following:
      **a. ONE FUTURE**
      b. 120/1 with cord and plug, each unit.
      c. Gas manifold for double stack, each unit.
      d. Double stack, each unit.
      e. Stainless steel front, top, sides, and legs, each unit.

f. Stainless steel rear enclosure, when rear is exposed for both sections.

g. Non-marking grease resistant casters two with brakes, each unit.

h. Safe-T-Link HG-4D3/4”-48-SK gas appliance connector kit with double swivel ends. Secure restraining device to the building wall and equipment, one each unit**.**

i. Krowne 28-200 caster positioning system for rear casters, set in a bed of food grade 100% silicone sealant, secure to floor in four places with anchor kit, one each unit.

W. Item 22 – Range – One required

1. Vulcan 24S-4B-N.
2. Provide the following:
   a. Natural gas with pressure regulator.
   b. Stainless steel front, top, sides, cabinet, high shelf, and legs
   c. Four levelling swivel casters, two with brakes.
   d. Safe-T-Link HG-4D3/4”-48-SK gas appliance connector kit with double swivel ends. Secure restraining device to the building wall and equipment, each unit.
   e. Krowne 28-200 caster positioning system for rear casters, set in a bed of food grade 100% silicone sealant, secure to floor in four places with anchor kit, one each unit.

X. Item 23 – Braising pan – One required

1. Groen BPM40G.
2. Provide the following:
   a. Natural gas with pressure regulator, each unit.
   b. 120/1 with cord and plug, each unit.
   c. Manual tilt, each unit.
   d. Food strainer pouring spout, each unit.
   e. Flanged feet secure to floor with non corrosive anchors, each unit.
   f. T & S B-0300-102A-CR hot and cold water faucet with check valves MODIFIED with B-0107 spray valve. 14 gauge stainless steel fabricated faucet bracket mounted where shown. Dummy Hook mounted on front of bracket face.
   g. 14 gauge stainless steel faucet bracket where shown. Dummy hook mounted on front of face of bracket turn back.

Y. Item 24 – Floor Trough – One required

1. Provided and installed by the plumbing contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

Z. Item 25 – Steamer – Three required

1. Accutemp N61201E DBL, double stack.
2. Provide the following:
   a. **ONE FUTURE**
   b. Double stack, each unit.
   c. Natural gas with pressure regulator, each compartment.
   d. AT0A-4534-1 steam vent extension, each compartment.
   e. AT1A-7225-1 drain water tempering kit, each compartment.
   f. 120/1 with cord and plug, each unit.
   g. Stainless steel support stand with bullet feet, each unit.
   h. Two (EACH UNIT) Safe-T-Link HG-4D3/4”-48-SK gas appliance connector kit with double swivel ends. Secure restraining device to the building wall and equipment, two each unit (SIX total, TWO Future).

AA. Item 26 – Hose reel – One required.

1. T&S Brass B-7142-U05XS1E
2. Provide the following:
   a. 50ft heavy duty non-marking hose.
   b. Stainless steel trigger water gun with swivel.

BB. Item 27 – Food processor – Four required

1. Robot Coup R 301 Dice.
2. Provide the following:
   a. Two Future.
   b. 120/1, with cord and plug.
   c. Standard accessories.

BB. Item 28 – Work table – One required

1. Fabricated according to details, drawings and specifications, 36” high to top.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top.

b. Top turned down 1½" and back ½" on a slight angle on all free sides.

c. 8" high splash at all walls.

d. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.

e. Copper flashed weld studs capped with stainless steel acorn nuts.

f. ¾" tacky tape between all metal surfaces, installed to create a vermin proof seal.

g. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME

h. Stainless steel gussets fully welded 360 degrees to channels.

i. 1 5/8" 16 gauge stainless steel tubing legs.

j. 1 5/8" 16 gauge stainless steel tubing crossrails fully welded to legs.

k. Stainless steel adjustable bullet feet.

l. 16 gauge stainless steel removable overshelf mounted on 1 5/8" outside diameter tubing supports through splash to brackets welded to legs. Mount 60" above finished floor. Free sides turned down 1 ½" and back ½" on a slight angle and turn up 2" at walls.

m. Reduce over shelf length to allow space for equipment on top. Add third leg at rear of table for overshelf tubing support.

n. Channels shall be welded to each other with a 1"x1" x 4" x 1"x 1" continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

o. Center legs 3" maximum from edge of tops, inside of rolls and backsplash surfaces.

p. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

CC. Item 29 – Hot water dispenser – one required

1. Bunn H5X Element 43600.0002.

DD. Item 30 – Hood – One required

1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

EE. Item 31 – Fire control system – One required

1. Provided and installed by mechanical contractor.
   a. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

FF. Item 31 – Fire control system – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

GG. Item 32 – Hood fans – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

HH. Item 33 – Hood – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

II. Item 34 – Fire control system – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

JJ. Item 35 – Hood fans – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

KK. Item 36 – Hood – One required
1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

LL. Item 37 – Fire control system – One required
1. Provided and installed by mechanical contractor.

2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

MM. Item 38 – Hood fans – One required

1. Provided and installed by mechanical contractor.
2. Kitchen Equipment Contractor shall coordinate installation with kitchen equipment.

NN. Item 39 – Heated cabinet – Two required

1. Traulsen RHF132WP-HHG.
2. Provide the following:
   a. Item 39, 40, and 41 by same manufacture.
   b. 120/208/1.
   c. Cord and plug, each unit.
   d. Stainless steel interior and exterior, each unit.
   e. Half-height doors, each unit.
   f. Half height glass doors on kitchen side, each unit.
   g. Stainless steel half height doors on serving side, each unit.
   h. Hinge doors according to the kitchen plans.
   i. Eight pair of 16 gauge stainless steel universal tray slides with mounting hardware, each door.
   j. Non marking grease resistant casters two with brakes.

OO. Item 40 – Heated cabinet – Two required

1. Traulsen RHF232WP-HHG.
2. Provide the following:
   a. Item 39, 40, and 41 by same manufacture.
   b. 120/208/1.
   c. Cord and plug, each unit.
   d. Stainless steel interior and exterior, each unit.
   e. Half-height doors, each unit.
   f. Half height glass doors on kitchen side, each unit.
   g. Stainless steel half height doors on serving side, each unit.
   h. Hinge doors according to the kitchen plans.

i. Eight pair of 16 gauge stainless steel universal tray slides with mounting hardware, each door.

j. Non marking grease resistant casters two with brakes.

PP. Item 41 – Refrigerator – Two required

1. Traulsen RHT232WPUT-HHG.
2. Provide the following:
   a. Item 39, 40, and 41 by same manufacture.
   b. 120/1 with cord and plug, each unit.
   c. Stainless steel interior and exterior.
   d. Half-height doors, each unit.
   e. Half height Glass doors on kitchen line side, each unit.
   f. Stainless steel half height doors on serving side, each unit.
   g. Hinge doors according to the kitchen plans.
   h. Stainless steel half height doors on serving side.
   i. Eight pair of 16 gauge stainless steel universal tray slides with mounting hardware, each door.
   j. Non marking grease resistant casters two with brakes.

QQ. Item 42 – Salad bar – Two required

1. Duke TCM-60PG-N7.
2. Fabricated according to details, drawings and specifications.
3. Provide the following:
   a. Item 42, 44, 45, and 49 by same manufacture.
   b. 14 gauge stainless steel top, each unit.
   c. 34” high to top.
   d. 32” high to tray slide.
   e. Center cold pan in top. Equal spacing on both sides. Each unit.
   f. 120/1 with cord and plug, each unit.
   g. Sliding doors, each unit.
   h. Two Duke stainless steel solid tray side on fold down brackets, each unit.
   i. Duke TS580-60 food shield with LED lights and stainless steel shelves in lieu of glass shelf, each unit.

j. Food guard lights are to be pre-wired from the factory, single point connection, each unit.

k. Non standard laminate color on base front verify color and pattern with Architect, each unit.

l. 10'-0" cord and plug, each unit.

m. Four polyurethane casters two with brakes, each unit.

RR. Item 43 – Beverage refrigerator – Two required

1. True GDM-33CPT-54-HC-LD.
2. Provide the following:
   a. 120/1 with cord and plug, each unit.
   b. 4" diameter casters, each unit.

SS. Item 44 –Hot/Cold/Freeze counter – Five required

1. Duke THCF-92.
2. Fabricated according to details, drawings and specifications.
3. Provide the following:
   a. Item 42, 44, 45, and 49 by same manufacture.
   b. 14 gauge stainless steel top.
   c. 34" deep top.
   d. 34" high to top.
   e. 32" high to tray slide.
   f. Duke stainless steel solid tray side on fold down brackets, each unit..
   g. 120/1 with cord and plug, each unit.
   h. Duke TS540-88 food shield with LED lights, each unit.
   i. Food guard lights are to be pre-wired from the factory, single point connection, each unit.
   j. Expression drain handle, each unit.
   k. 7" stainless steel cutting board with fold down brackets, each unit.
   l. Non standard laminate color on base front verify color and pattern with Architect, each unit.
   m. Cord and plug, each unit.
   n. Four polyurethane casters two with brakes, each unit.

TT. Item 45 – Flat top counter – Two required

1. Duke TST-32.
2. Fabricated according to details, drawings and specifications.
3. Provide the following:
   a. Item 42, 44, 45, and 49 by same manufacture.
   b. 14 gauge stainless steel top.
   c. 34” deep top.
   d. 34” high to top.
   e. 32” high to tray slide.
   f. Duke stainless steel solid tray side on fold down brackets, each unit.
   g. Duke TS540-32 food shield with LED lights, each unit.
   h. Non standard laminate color on base front verify color and pattern with Architect, each unit.
   i. 120/1 with cord and plug, each unit.
   j. Four polyurethane casters two with brakes, each unit.

UU. Item 46 – Pizza oven – One required.
1. Existing, furnished and installed by owner.
2. Lincoln 1130-000-V-KF006.

VV. Item 47 – Work table – One required.
1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top. 36” high to top.
   b. Top turned down 1½” and back ½” on a slight angle on all free sides.
   c. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.
   d. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME.
   e. Copper flashed weld studs capped with stainless steel acorn nuts.
   f. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.
   g. Stainless steel gussets fully welded 360 degrees to channels.
   h. 1 5/8” 16 gauge stainless steel tubing legs.

i. Channels shall be welded to each other with a 1”x1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

j. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.

k. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

l. Four polyurethane casters two with brakes.

WW. Item 48 - Milk cooler – Two required

1. Traulsen RMC58D4.
2. Provide the Following:
   a. 120/1 with cord and plug set, each unit.
   b. Stainless steel interior and exterior, each unit.
   c. Wrap around bumpers and corner bumpers, each unit.

XX. Item 49 – Cashier stand – Two required

1. Duke TCS-30SS.
2. Fabricated according to details, drawings and specifications.
3. Provide the following:
   a. 34” high to top.
   b. 32” high to tray slide.
   c. Item 42, 44, 45, and 49 by same manufacture.
   d. Stainless steel drawer with cylinder lock and keys, each unit.
   e. Two Duke stainless steel solid tray side on fold down brackets, each unit.
   f. FH ferruled hole in top for cord and plug.
   g. Non standard laminate color on base front verify color and pattern with Architect, each unit.
   h. CO convenience outlet duplex outlet in counter base, each unit.
   i. Cord and plug, each unit.
   j. Four polyurethane casters two with brakes, each unit.

YY. Item 50 – Heater and proofer cabinet – One required

1. Metro C539-CLDC-U.

2. Provide the following:
   a. 120/1 with cord and plug.
   b. 1440 watts, 12 amps.
   c. Dutch doors.
   d. Door(s) hinged right.
   e. See thru lexan door panel(s).

ZZ. Item 51 – Refrigerated pizza prep – One required
1. Traulsen CLPT-2708-DW.
2. Provide the following:
   a. 120V/1 with cord and plug.

AAA. Item 52 – Work table – One required.
1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top. 36” high to top.
   b. Top turned down 1½” and back ½” on a slight angle on all free sides.
   c. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.
   d. Two 14 gauge stainless steel hat channels full length, fully welded to end channels. DO NOT OMIT OR NOTCH CHANNELS FOR DRAWER FRAME.
   e. Copper flashed weld studs capped with stainless steel acorn nuts.
   f. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.
   g. Stainless steel gussets fully welded 360 degrees to channels.
   h. 1 5/8” 16 gauge stainless steel tubing legs.
   i. Channels shall be welded to each other with a 1”x1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.
   j. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.
   k. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.
   l. Four polyurethane casters two with brakes.

BBB.Item 53 – Soiled dishtable – One required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top.
   b. 3” high with a 1½” diameter semi-roll at free sides.
   c. 18” high splash at walls.
   d. 14 gauge stainless steel fully welded channels, cap front.
   e. Copper flashed weld studs capped with stainless steel acorn nuts.
   f. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.
   g. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.
   h. 21” X 21” X 5” deep 14 gauge stainless steel coved corner pre-rinse sink with removable perforated 16 gauge stainless steel scrap basket and 1” round stainless steel tubing rack runners fully welded to basket.
   i. One (1) T & S B-1433-CR hose reel and riser support secured to wall with stainless steel screws
   j. One Fisher 30376 basket drain.
   k. Install one Item 54 below the sink
   l. Stainless steel gussets fully welded 360 degrees to channels.
   m. 1 5/8” 16 gauge stainless steel tubing legs.
   n. 1 5/8” 16 gauge stainless steel tubing crossrails fully welded 360 degrees to legs.
   o. Stainless steel adjustable bullet feet.
   p. Stainless steel adjustable flanged feet with two holes at all front legs secure to floor with two non corrosive anchors.
   q. Z clip splash to walls, unexposed.
   r. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.
   s. Channels shall be welded to each other with a 1” x 1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.
   t. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.

CCC.Item 51 – Drain strainer – Two required

1. The Drain Strainer plate top 1392, cost approximately $1,000.00.

DDD. Item 55 – Dish machine – one required

1. Hobart CL44E-EGR.
2. Provide the following:
   a. 480/3.
   b. Single point electrical connection for machine, tank heat, motors, and booster heater.
   c. Built in 70 degree rise booster heater.
   d. Electric tank heat.
   e. Higher than standard chamber with 24” opening.
   f. Table limit switch.
   g. Drain water tempering kit, factory installed.
   h. Fan interlock control.
   i. Two stainless steel vent hood with locking damper.
   j. Two Hobart wire racks with both sides cut out for bun pans.
   k. Two flat racks.
   l. Four peg racks.

EEE. Item 56 – Dish machine vent – one required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 18 gauge stainless steel fully welded liquid tight one piece duct extending up from dishwasher vents at each end over controls, angled all sides in to one point at middle over dishmachine, extend duct up to 6” above finished ceiling line.
   b. 14 gauge stainless steel welded angle trim at ceiling penetration.
   c. All fans, ductwork, electrical final connections, etc. by others.

FFF. Item 57 – Clean dishtable – one required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top.

b. 3” high with a 1½” diameter semi-roll at free sides.

c. 18” high splash at walls.

d. 14 gauge stainless steel fully welded channels, cap front.

e. Copper flashed weld studs capped with stainless steel acorn nuts.

f. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.

g. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.

h. Stainless steel gussets fully welded 360 degrees to channels.

i. 1 5/8” diameter 16 gauge stainless steel tubing legs.

j. 1 5/8” diameter 16 gauge stainless steel crossrails fully welded 360 degrees to legs.

k. Stainless steel adjustable bullet feet.

l. Stainless steel flanged feet with two holes at all front legs, secure to floor with two non corrosive anchors.

m. 16 gauge stainless steel removable overshelf mounted on 1 5/8” outside diameter tubing supports through splash to brackets welded to legs, 2” X 3/16” stainless steel band fully weld to brackets full length and stainless steel double sided pot hooks 8” on centers. Mount 60” above finished floor (66” at pot sink/dishtable), verify height with mini pre rinse faucet and owner. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.

n. Channels shall be welded to each other with a 1” x 1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

o. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.

p. Table limit switch for dishmachine.

q. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

r. Z clip splash to walls, unexposed.

GGG. Item 58 – Pot and pan sink – one required

1. Fabricated according to details, drawings and specifications.
2. Provide the following:
   a. 14 gauge stainless steel one piece coved corner top.
   b. 3” high with a 1½” diameter semi-roll at free sides.

c. 15” high splash at walls from top of semi roll (18” from drainboard) (to match 18” high dishtables splash height).

d. Weld in partition or NO SPLIT BOWLS allowed between bowls.

e. Three 24” X 26½” X 15” deep (12” deep from top) 14 gauge stainless steel coved corner sinks. 30” deep table overall.

f. Two 14 gauge stainless steel coved corner integral drainboards.

g. 18 gauge stainless steel undershelf where space allows notched and fully welded to legs. Free sides turned down 1 ½” and back ½” on a slight angle and at all walls turn up 2”.

h. 14 gauge stainless steel fully welded channels, cap front.

i. Copper flashed weld studs capped with stainless steel acorn nuts.

j. ¾” tacky tape between all metal surfaces, installed to create a vermin proof seal.

k. Stainless steel gussets fully welded 360 degrees to channels.

l. 1 5/8” 16 gauge stainless steel tubing legs.

m. 1 5/8” 16 gauge stainless steel tubing crossrails fully welded 360 degrees to legs.

n. Stainless steel adjustable bullet feet.

o. Stainless steel adjustable flanged feet with two holes at front corners secure to floor with two non corrosive anchors.

p. One T & S B-0231-CR faucet with ceramic cartridges.

q. One T & S B-0184 faucet with spray hose and ceramic cartridges.

r. Fisher 22411 lever handle drain(s) with overflow with 14 gauge stainless steel handle bracket secure to sink bottom with weld studs and stainless steel acorn nuts, hole in bracket 1/8” maximum larger (LARGE HOLE OR ELONGATED SLOT IS NOT ALLOWED) than handle diameter. MODIFIED drain handle length (reduce or extend) to make the drain handle flush with the face of the sink bowl.

s. 16 gauge stainless steel removable overshelf mounted on 1 5/8” outside diameter tubing supports through splash to brackets welded to legs, 2” X 3/16” stainless steel band fully weld to brackets full length and stainless steel double sided pot hooks 8” on centers. Mount 56” above finished floor (66” at pot sink/dishtable), verify height with mini pre rinse faucet and owner. Free sides turned down 1 ½” and back ½” on a slight angle and turn up 2” at walls.

t. Z clip splash to wall, unexposed.

u. Channels shall be welded to each other with a 1”x1” x 4” x 1”x 1” continuous weld, typical. Gussets shall be welded to channels or plate with a 360 degrees continuous weld, typical.

v. Center legs 3” maximum from edge of tops, inside of rolls and backsplash surfaces.

w. All welding and stainless steel surfaces grind smooth and polished to a number 4 finish.

HHH. Item 59 – Can opener – Four required

1. Edlund Model 270.
2. Provide the following:

d. Two future.

e. 120/1 with cord and plug.

III. Item 60 – Can opener – Two required

1. Hamilton beach HCO500, each unit.
2. Provide the following:

a. Secure to table top one each to item 9, with stainless steel screws, see plan.

## 2.5 ITEMIZED PRICES

1. Bidders that do not provide itemized prices for all specified Kitchen Equipment will be rejected.
3. List prices for alternates to specified items on a separate sheet with specifications.
4. Itemized prices may be submitted in Auto Quotes format or spread sheet.

Equipment Sub total (equipment only no labor)

_____

State Taxes (equipment only no labor)

_____

Local/County Taxes

_____

Bond (when required)

_____

Installation Labor

_____

**Total Bid Price**

**_____$_____**

## PART 3 – EXECUTION

3.1 Installation of Kitchen Equipment

A. Unload, uncrate, assemble, set-in place, hang, level and adjust Kitchen Equipment. Tag parts shipped loose. Furnish necessary installation instructions. Clean up all trash immediately upon completion of installation and remove from the project site.

B. Neatly seal gaps of ¼" or less between Kitchen Equipment and walls, other equipment and floors with a "50 year" food grade clear silicone sealant. Seal gaps of ¼" or more with 14 gauge stainless steel trim fully welded ground smooth and polished to No. 4 finish or neatly attach trim with concealed stainless steel blots and nuts silicon trim to wall.

C. Erect Kitchen Equipment at project site in full compliance with the codes and regulations of the state and local Health Department.

D. Remove all protective coatings and other markings from Kitchen Equipment before demonstration. Wash with soap and water, rinse clean and dry spotless.

E. Provide a competent foreman at the project site to supervise installation of all Kitchen Equipment, and to coordinate with other trades in reference to connections at time of installation. Tag and deliver plumbing and electrical parts, furnished loose and specified as part of the Kitchen Equipment to respective installing trades.

F. Provide all Zee clips and angles necessary for wall mounting of Kitchen Equipment.

G. Any sleeves, flanges of anchor bolts required to be built in to building structure to be provided to respective trades.

3.2 TESTING, CALIBRATION AND DEMONSTRATION

A. After completion of final connection by respective trades, test and calibrate Kitchen Equipment for proper operation. Make any necessary adjustments and re-test, repair or replace Kitchen Equipment producing objectionable noise.

B. Repair finishes marred during handling and installation or replace if required by the owner or consultant.

C. Schedule demonstration of Kitchen Equipment with manufacturer's representatives, and owner's personnel.

D. Provide pictures of completed punch list deficiencies to Contractor, Architect Owner and Consultant for review after all punch list work has been completed.

END OF SECTION

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 manual roller shades.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 SUBMITTALS

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

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator, and adjustable components.
5. Minimum Drawing Scale: 1/8 inch = 1 foot.

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
2. For the following products:

a. Shade Material: Not less than 6 inches square, with specified treatments applied. Mark face of material.

F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

G. Product Certificates: For each type of roller shade, signed by product manufacturer.

H. Qualification Data: For Installer.

I. Product Test Reports: For each type of roller shade.

J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

## 1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Product Standard: Provide roller shades complying with WCMA A 100.1.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

A. 5 year warranty for clutch operating mechanism of chain operated shade. All other models and parts are covered by a one year warranty which is standard with typical general conditions of the contract.

PART 2 - PRODUCTS

2.1 ROLLER SHADES (WC1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper Inc., Manual Flexshade (WC1) or a comparable product by one of the following:

1. Lutron Shading Solutions by VIMCO.
2. MechoShade Systems, Inc.

B. Sheer Shade Band Material (WC1): PVC-coated polyester.

1. Fabric Width: As appropriate for window size.
2. Pattern: Phifer, SheerWeave
3. Style: PW4800.
4. Colors: V10 Clay unless indicated otherwise on Specialties Schedule in Drawings.
5. Material Openness Factor: 1% Openness.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material.

D. Roller Idler Assembly
1. (Manual Shades): Fiberglass reinforced polyester thermopolymer (PBT), with spring-loaded pin to interlock with mounting bracket.

E. Actuator: Polyester based plastic such as GE Valox 420 or equal quality.

F. End Plug: Consists of an outside sleeve rotating freely on a center shaft, providing the bearing surfaces on which the roller rides. Outside sleeve and center shaft to be made of heat stabilized fiber reinforced plastic to ensure smooth, wear resistant operation.

G. Direction of Roll: Regular, from back of roller.

H. Mounting Brackets: 1018 plated steel stamping. Sizes 1-5/8” and 2-1/4”. Mount to face, ceiling, or jamb.

I. Fascia: L-shaped, formed-steel sheet or extruded aluminum, .060 wall with long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as required to fit window and mounting type indicated; removable design for access. Provide fascia and required components at all locations.

J. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside. Provide where fascias are used.

K. Endcaps: 1018 steel stamping. 2 sizes: 3-1/4” x 3-3/4” and 4-1/2” x 4-1/2”. Complete with adapter roller bracket. Installs to face, ceiling, or jamb. Accepts box covers and fabric guide.

L. Endcap Covers: Match fascia finish and install where fascias are used.

M. Bottom Hem/Slat Bar: Extruded aluminum, minimum 1/8” x 1”, encased in heat seamed hem of shade material.

N. Mounting:

1. Mounted to jamb head and overlapping window opening; permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

O. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

P. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.

1. Position of Clutch Operator: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
2. Clutch: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon with the capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
3. Loop Length: Full length of roller shade.
4. Bead Chain: Stainless steel.
5. Operating Function: Stop and hold shade at any position in ascending or descending travel. Designed never to need adjustment or lubrication. Provide preset limit stops to prevent shade from being raised or lowered too far.

## 2.2 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: 1018 plated steel stamping. Sizes 1-5/8” and 2-1/4” designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated. Brackets do not require additional adapters.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Field verify window dimensions prior to fabrication.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Install fascia and end caps to conceal roller and operating mechanism. Do not use exposed fastener.

### 3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

## 3.5 TESTING AND DEMONSTRATION

A. Test manual window shades to verify that all operating components are functional.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section Demonstration and Training."

## 3.6 PROTECTING

A. Clean shade assemblies and protect from damage from construction operations. If damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 122413

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fixed modular laminate clad casework and components.

B. Countertops.

1.2 RELATED SECTIONS

A. Section 06100 – Rough Carpentry.

B. Section 064023 – Interior Architectural Woodwork

C. Section 09653 – Resilient Wall Base and Accessories.

D. Section 15440 – Plumbing Fixtures

1.3 DEFINITIONS

A. Identification of casework components and related products by surface visibility.
1. Open Interiors: Any open storage unit without solid door or drawer fronts and units with full glass insert doors and/or acrylic doors.
2. Closed Interiors: Any closed storage unit behind solid door or drawer fronts, sliding solid doors.
3. Exposed Ends: Any storage unit exterior side surface that is visible after installation.
4. Other Exposed Surfaces: Faces of doors and drawers when closed, and tops of cabinets less than 72 inches above furnished floor.
5. Semi-Exposed Surfaces: Interior surfaces that are visible, bottoms of wall cabinets and tops of cabinets 72 inches or more above finished floor.
6. Concealed Surfaces: Any surface not visible after installation.

1.4 QUALITY ASSURANCE

A. Manufacturer: Minimum of 5 years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.

B. Source Limitations: Obtain institutional casework through one source from a single manufacturer.

C. Quality Standard: Provide products certified as meeting or exceeding ANSI-A 161.1-1998 testing standards and comply with AWI's "Architectural Wood work Quality Stands," Section 1600.

D. Product Designations: Drawings indicate sizes, configurations, and finish material of institutional casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."

1.5 SUBMITTALS

A. Comply with Section 01300, unless otherwise indicated.

B. Product Data: Manufacturer's catalog with specifications and construction details.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.
   1. Include section drawings of typical and special casework, work surfaces and accessories.
   2. Indicate locations of plumbing and electrical service field connection by others.

D. Casework Samples:
   1. Base cabinet: Cabinet conforming to specifications, with drawer and door.
   2. Wall cabinet: Cabinet conforming to specifications, with door.
   3. Cabinet samples shall be complete with specified hardware for doors, drawers and shelves.
   4. Component samples: Two sets of samples for each of the following:
      a. Decorative laminate color charts.
      b. PVC and ABS edgings.

1.6 PRODUCT HANDLING

A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed, store in ventilated place, protected from the weather, with relative humidity range of 20 percent to 50 percent.

B. Protect finished surfaces from soiling and damage during handling and installation with a polyethylene film or other protective covering.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least 1 week.
   1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
   2. After installation, control temperature and humidity to maintain relative humidity between 25 percent and 55 percent.

B. Conditions: Do not install casework until interior concrete work, masonry, plastering and other wet operations are complete.

C. Field Measurements: Where institutional casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating institutional casework with out field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of institutional casework.

1.9 WARRANTY

A. Lifetime Guarantee and Limited Warranty to the original owner against defective material and fabrication for as long as they own the product. This is a warranty of replacement and repair only, TMI will correct defects in material and/or fabrication without charge.

1.9 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and finish of institutional casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damages casework finish.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer:
1. Stevens Advantage Furnishings

a. Drawings and specifications are based on manufacturer's literature from Stevens Commercial Cabinetry and Millwork.

b. Subject to compliance with requirements, provide the named product above or a comparable product by one of the following:

1. Case Systems, Inc.
2. EGR Architectural Millwork
3. TMI Systems Design Corporation
4. Wood Systems Design Corporation.

2.2 MATERIALS

A. Core Materials:
1. Particleboard up to 7/8 inch thick: Industrial Grade average 47-pound density particleboard, ANSI A 208.1-1999, M-2.
2. Particleboard 1 inch thick and thicker: Industrial Grade average 45-pound density particle-board, ANSI A 208.1-1999, M-2.
3. Medium Density Fiberboard 1/4 inch thick: Average 54-pound density grade, ANSI A208.2.

B. Decorative Laminates:
1. High-pressure decorative laminate VGS (.028), NEMA Test LD 3-1995.
2. High-pressure decorative laminate HGS (.048), NEMA Test LD 3-1995.
3. High-pressure decorative laminate HGP (.039), NEMA Test LD 3-1995.
4. High-pressure cabinet liner CLS (.020), NEMA Test LD 3-1995.
5. High-pressure backer BKH (.048), (.039), (.028), NEMA Test LD3-1995.
6. Thermally fused melamine laminate, NEMA Test LD 3-1995.

C. Laminate Color Selection: Refer to Room Finish Schedule for laminate selections.
1. Maximum 1 color per unit face.

D. Edging Materials: Match Wilsonart® laminate as specified on Finish Schedule in Drawings. If laminate other that Wilsonart® is used, edge band color will be specified on Finish Schedule.
1. 1mm PVC banding.

2. 3mm PVC banding, machine profiled to 1/8 inch radius.

## 2.3 SPECIALTY ITEMS

A. Support Members: Furniture grade, epoxy powder coated steel.
1. Undercounter support brackets with integral wire management and leveling pad. Finish: Black

## 2.4 CABINET HARDWARE

A. Hinges:
1. Five knuckle, satin nickel plated, institutional grade, 2-3/4 inch overlay type with hospital tip. 0.095 inch thick. ANSI-BHMA standard A156.9, Grade 1.
a. Doors 48 inches and over in height have 3 hinges per door.
b. Hinge shall accommodate 13/16 inch thick laminated door and allow 270 degree swing.
c. Magnetic door catch with maximum 5 pound pull provided, attached with screws and slotted for adjustment.
d. Finish as selected from manufacturer's standard finishes.

B. Pulls:
1. Door and drawer front pulls, are anodized aluminum coated metal wire style, 96mm spacing on screws. Pull design shall comply with the Americans with Disability Act (ADA).
2. Provide two (2) pulls for drawers more than 24" wide.
3. Finish as selected from manufacturer's standard finishes.

C. Drawer Slides:
1. Regular & kneespace: 100-pound load rated epoxy coated steel, bottom corner mounted with smooth and quiet nylon rollers. Positive stop both directions with self-closing feature.
1. Drawers over 24" wide shall have a full extension, 150-pound load slides.
2. Paper storage, 150-pound load rated epoxy coated steel slides.
3. Box drawer, 75-pound rated epoxy coated steel slides.
4. File: Full extension, 150-pound load rated epoxy coated steel, bottom corner mounted with smooth and quiet nylon rollers. Positive stop both directions with self-closing feature.

a. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not allowed.

D. Catches: Catch shall provide opening resistance in compliance with American Disabilities Act.

E. Adjustable Shelf Supports:
1. Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers. Each shelf support has 2 integral support pins, 5mm diameter, to interface pre-drilled holes, and to prevent accidental rotation of support. The support automatically adapts to 3/4 inch or 1 inch thick shelving and provides non-tip feature for shelving. Supports may be field fixed if desired. Structural load to 1200 pounds (300 pounds per support) without failure.

F. Locks:

2. Automatic door bolt, Hafele #530-1604, used to secure inactive door on all locked cabinets.
3. Provide locks where indicated on Interior Elevations in Drawings.

F. Coat Rods: 1 inch diameter, 14-gauge chrome plated steel installed in captive mounting hardware.

G. File Suspension System: Extruded molding integral with top of drawer box sides to accept standard hanging file folders.

H. Provide door and drawer rubber clear silencers to all millwork.

I. Locks:

1. Automatic door bolt, Hafele #530-1604, used to secure inactive door on all locked cabinets.
2. Provide locks where indicated on Interior Elevations in Drawings.

2.5 FABRICATION:

A. Fabricate casework, countertops and related products to dimensions, profiles, and details shown.

B. Cabinet Body Construction:

1. Sub-Base: Cabinet sub-base shall be separate and continuous (no cabinet body side-to-floor), water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder-type jobsite construction of individual front, back, and intermediates, to form a secure and level platform to which cabinets attach.

a. Sub-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material by other trades.

2. Tops and bottoms are glued and doweled to cabinet sides and internal cabinet components such as fixed horizontals, rails and verticals. Minimum 6 dowels each joint for 24 inch deep cabinets and a minimum of 4 dowels each joint for 12 inch deep cabinets.

a. Tops, bottoms and sides of all cabinets are particleboard core.

2. Cabinet backs: 1/4 inch thick Grade 220 MDF.

a. Exposed back on fixed or movable cabinets: 3/4 inch thick particleboard with the exterior surface finished in VGS laminate as selected.
b. Flexible rail mounted cabinet backs: 3/4 inch thick particleboard structurally doweled into cabinet sides and top panels.

3. Fixed base and tall units have an individual factory-applied base, constructed of 3/4 inch thick exterior grade plywood. Base is 96mm (nominal 4 inch) high unless otherwise indicated on the drawings.

4. Base units, except sink base units: Full sub-top. Sink base units are provided with open top, a welded steel/epoxy painted sink rail full width at top front edge concealed behind face rail/doors, a split back removable access panel.

5. Side panels and vertical dividers shall receive adjustable shelf hardware at 32mm line boring centers. Mount door hinges, drawer slides and pull-out shelves in the line boring for consistent alignment.

6. Exposed and semi exposed edges.
   a. Edging: 1mm PVC.

7. Adjustable shelf core: 3/4 inch thick particleboard up to 36 inches wide, 1 inch thick particleboard over 36 inches wide.

   a. Front edge: 1mm PVC.

8. Interior finish, units with open Interiors:

   a. Top, bottom, sides, horizontal and vertical members, and adjustable shelving with VGS high-pressure decorative laminate.

9. Interior finish, units with closed Interiors:

   a. Top, bottom, sides, horizontal and vertical members, and adjustable shelving faces with thermally fused melamine laminate with matching prefinished back.

10. Exposed ends:

    a. Faced with VGS high-pressure decorative laminate.

11. Wall unit bottom:

    a. Faced with VGS high-pressure decorative laminate to match front of door.

12. Balanced construction of all laminated panels is mandatory. Unfinished core stock surfaces, even on concealed surfaces (excluding edges), are not permitted.

13. Cabinets over 5'-0" tall shall have at least one fixed shelf located approximately in the center as indicated in drawings.

C. Drawers:
   1. Sides, back and sub front: Minimum 1/2 inch thick particleboard, laminated with thermally fused melamine doweled and glued into sides. Top edge banded with 1mm PVC.
   2. Drawer bottom: Minimum 1/2 inch thick particleboard laminated with thermally fused melamine, screwed directly to the bottom edges of drawer box.
   3. Paper storage drawers: Minimum 3/4 inch thick particleboard sides, back, and sub front laminated with thermally fused melamine. Minimum 1/2 inch thick particleboard drawer bottoms screwed directly to the bottom edges of the drawer box. Provide PVC angle retaining bar at the rear of the drawer.

D. Door/Drawer Fronts:
   1. Core: 3/4 inch thick particleboard.
   2. Provide double doors in opening in excess of 24 inches wide.
   3. Faces:
      a. Exterior: VGS High-pressure decorative laminate.
      b. Interior: High-pressure cabinet liner CLS.

4. Door/drawer edges: 3mm PVC, external edges and outside corners machine profiled to 1/8 inch radius.

E. Open Shelving:
1. Core material: 3/4 inch or 1 inch thick particleboard.
2. Exterior: VGS High-pressure decorative laminate.
3. Edges: 3mm PVC, external edges and outside corners machine profiled to 1/8 inch radius.

2.6 DECORATIVE LAMINATE COUNTERTOPS:

A. General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets unless noted otherwise in Drawings.

B. Core: 1 inch thick ANSI A208.1-1993 M-2 particleboard
1. Use exterior plywood or phenolic-resin-bonded particleboard for countertops containing sinks.

C. Surface: HGS/HGP high-pressure decorative laminate with balanced backer sheeting. Refer to Finish Schedule per drawing for chemical resistance requirements..

D. Edges, including applied backsplash: 3mm PVC, exposed edges and corners machine profiled to 1/8 inch radius. Edges are machine applied with moisture curing polyurethane (PUR) hotmelt for fast setting, high strength adhesion.

E. Seams: No seams shall be placed within four feet of sink.

PART 3- EXECUTION

3.1 INSPECTION:

A. The casework contractor must examine the job site and the conditions under which the work under this section is to be performed, and notify the building owner in writing of unsatisfactory conditions. Do not proceed with work under this Section until satisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 PREPARATION:

A. Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.3 CASEWORK INSTALLATION:

A. Install plumb, level and true; shim as required, using concealed shims. Where institutional casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining door and drawers to a tolerance of 1/16 inch.

3. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Wall Cabinets: Hang cabinets straight, level and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contract points meet accurately. Allow for final adjustment after installation.

E. Adjust casework and hardware so door and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

F. Repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged cabinets or materials.

3.4 INSTALLATION OF TOPS

A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so project-site processing of top and edge surface is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at interval not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

B. Secure tops to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each front, end and back.

C. Abut top and edge surfaces in one true plane, with internal supports place to prevent deflection.

D. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and walls with adhesive.

E. Seal juncture of top, splash, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 CLEANING:

A. Leave cabinets broom clean inside and out. Wipe off fingerprints, pencil marks, and surface soil etc., in preparation for final cleaning by the building owner.

B. Remove and dispose of all packing materials and related construction debris.

COLOR SELECTION:

A. Laminate Color Selection: As indicated on Drawings.

B. Hinge & Pull Selection:
   1. Satin nickel plated hinges & Anodized aluminum wire pulls to be selected from manufacturer's full range.

C. Miscellaneous Hardware Color Selection:
   1. Support bracket for counter tops to be Black.

D. 1mm PVC Edge Banding Color Selection: As indicated on Drawings.

E. 3 mm PVC Edge Banding Color Selection: As indicated on Drawings.

END OF SECTION

## PART 1 GENERAL

### 1.1 SUMMARY

A. The following specifications for Wood Laboratory Casework and related equipment outline the minimum requirements expected by the Owner and Architect on this project.

B. Section Includes:

1. Furnishing, delivering to the building, uncrating, setting in place, leveling, and anchoring all casework, countertops, equipment, and technical products listed in the specifications, equipment schedule or shown on the drawings.
2. Furnishing and installing filler panels and scribes as required for finished installation.
3. Furnishing laboratory service fixtures and fittings, as described in the specifications, equipment list or shown on the drawings, that are directly attached to the casework or equipment, complete with tank nipples and lock nuts for mounting on tops or curbs. Installation and final connections will be by other respective trades as part of their work.
4. Furnishing laboratory sinks and cup sinks, complete with threaded sink outlets, and required overflows, plugs, and strainers as described in the specifications, equipment list or shown on the drawings. Installation and final connections will be by other respective trades as part of their work.
5. Furnishing electrical service fixtures, as described in the specifications, equipment list or shown on the drawings, that are directly attached to the casework or equipment. Installation and final connections will be by other trades as part of their work.
6. Removal of all debris, dirt, and rubbish accumulated as a result of installation of this equipment, to an onsite container provided by others.

### 1.2 RELATED DIVISIONS AND SECTIONS

A. Section 061000 – Rough Carpentry: Grounds/blocking provided within metal stud walls to adequately support wall mounted casework provided and installed in this section.

B. Section 096500 – Resilient Flooring: Base molding for laboratory casework provided and installed in this section.

C. Section 115300 – Laboratory Equipment: Specialized equipment described in this section and furnished in lab areas is provided and installed in this section of work.

1. Laboratory Fume Hoods provided and installed in section 123553.

D. Division 220000 – Plumbing: Material and final connections for rough-ins, drain lines, vents, traps, tailpieces, service piping, shut-off valves, adapters, supports, in-line vacuum breakers, thermostatic mixing valves, etc. are provided and installed in this division for laboratory sinks, faucets, service fixtures, emergency showers, and fume hoods that are part of laboratory casework.

E. Division 260000 – Electrical: Material and final connections for electrical rough-ins, junction boxes, conduit, wiring, etc. are provided in this division for laboratory casework electrical service fixtures.

F. Division 270000 – Communications: Voice, audio-video cabling, data and data outlets are provided in this division.

### 1.3 REFERENCES

A. ADAAG: 2004 Americans with Disabilities Act Accessibility Guidelines; Revised 2010 ADA Standards for Accessible Design.

B. ANSI/ISEA Z358.1-2014: Emergency Eyewash and Shower Equipment.

C. NFPA 30: Flammable and Combustible Liquids Code.

D. NFPA 45: Standard for Fire Protection for Laboratories Using Chemicals.

E. SEFA: Scientific Equipment and Furniture Association Recommended Practices. Desk Reference, 5th Edition, 2014. www.sefalabs.com

1. SEFA 2-2010: Recommended Practices for Installation.
2. SEFA 3-2010: Recommended Practices for Work Surfaces.
3. SEFA 7-2010: Recommended Practices for Laboratory Service Fixtures.
4. SEFA 8-W-2014: Recommended Practices for Wood Laboratory Grade Casework.

F. California Air Resources Board; CARB Phase 2 Compliant.

G. ANSI/HPVA HP-1 2009: Hardwood Veneer Core Plywood.

H. ANSI A208.1-2009: Particleboard (PBC); Composite Panel.

I. ANSI A208.2-2009: Medium Density Fiberboard (MDF); Composite Panel.

1.4 SUBMITTALS

A. Refer to Section 013300 for Submittal Procedures.

B. Shop Drawings: Submit shop drawings showing plans, service rough-Ins, elevations, sections, end views, service chases, countertop details, location and type of sinks and service fixtures, installation details, and location of grounds/blocking within walls for adequate wall cabinet reinforcement.

C. Manufacturer's Data:

1. Provide data indicating compliance with SEFA 8-W-2014, Laboratory Furniture Certificate of Performance Test from SEFA approved, Independent Test Facility.
2. Provide Test Report from SEFA approved, Independent Test Facility, certifying that wood casework finish complies with SEFA 8-W-2014, Chemical Resistance Testing requirements.

D. Selection Samples: Submit one (1) sample of custom stained wood casework.

1.5 QUALITY ASSURANCE

A. All laboratory casework, including cabinetry, work surfaces, sinks, and accessories, service fixtures and fittings, and technical products should be provided by the Laboratory Casework Manufacturer.

B. Provide certification that laboratory casework shall meet the performance requirements described in SEFA 8-W-2014.

C. Provide Casework manufactured and assembled in the USA.

1.6 PROJECT SITE CONDITIONS

A. Building: Should be enclosed and weather-tight. HVAC system should be operating and maintaining a temperature range of 65-80 deg F with relative humidity range of 30%-50% to maintain acceptable wood casework moisture content, and to prevent problems such as drawers swelling and doors warping.

B. Additional Conditions:

1. Required grounds/blocking in walls for reinforcement of wall-mounted cabinets must be in place.
2. If floor tile is required under casework, it must be in place.
3. Overhead ductwork, ceiling grid, tile, and light fixtures must be in place.
4. Wet operations should be complete.
5. Painting should be complete.
6. Service lines for water, gas, etc. must be flushed clean of dirt and chips, capped and tested for leaks prior to the Plumber's final connections.
7. Electrical service and lighting should be available in each room where casework will be installed.

C. Field Dimensions: Should be confirmed prior to product fabrication. General Contractor shall provide Guaranteed Dimensions if actual field dimensions are not available in time frame necessary to meet lead times for Laboratory Casework Manufacturer to produce and deliver to jobsite.

1.7 DELIVERY, STORAGE, HANDLING

A. Delivery: Products shall be delivered to the project site in undamaged condition, unloaded by casework installer, distributed to required rooms, unpackaged, and made ready for installation.

B. Storage: If rooms are not ready for installation, store product indoors, in ventilated areas with constant temperature range of 65-80 deg F, and range of relative humidity as noted in 1.06 A. Do not remove wrapping or packaging material. Laboratory Casework Manufacturer not responsible for off-site storage.

C. Handling: Use proper moving equipment to unload and distribute equipment and utilize personnel that are experienced in moving furniture and equipment.

D. Waste Disposal: Casework installers shall remove refuse resulting from their casework installation and place in trash container and leave installation site clean and free of debris. Trash container shall be provided by the General Contractor.

1.8 WARRANTY

A. Lifetime Warranty: Provide written warranty with close-out documents stating that this manufacturer shall guarantee that all Wood Casework provided on this contract to be free from defects in material and workmanship for the life of the product in the application and location installed, Purchaser shall notify Manufacturer's representative immediately of any defective product. Manufacturer shall have a reasonable opportunity to inspect the goods. No product shall be returned without purchaser's receipt of written shipping instructions from the manufacturer.

B. Warranty limitation: Casework must be installed by a factory certified installer or Lifetime Warranty shall be negated to a 2-Year Warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

1. Diversified Casework – Design Basis
2. Kewaunee
3. Architect Approved Equal.

B. Qualifications of other Manufacturers seeking prior approval to bid this project.

1. Provide list of five (5) installations of comparable size and scope completed within the past five (5) years, along with a contact name and phone number for each project.
2. Provide products AS SPECIFIED, unless deviations approved in writing.
3. Failure to submit product deviation list will result in Architect's assumption that proposed products DO NOT DEVIATE from specified products.
4. Provide certification that manufacturer's product complies with standards and test performance of SEFA 8-W-2014.

2.2 MATERIALS

A. General:

1. All casework shall be of modern design and shall be constructed in accordance with the recommended practices of the Scientific Equipment and Furniture Association. First class quality casework shall be established by use of modern machinery, tools, fixtures, and skilled workmanship.
2. The following definitions apply to wood laboratory casework units. Size and type of units is indicated on the drawings or equipment list.

a. EXPOSED SURFACES of casework include exterior surfaces visible after installation when all doors and drawer fronts are closed. Visible surfaces in open cases or behind clear glass doors shall be considered as exposed portions. Back of drawer fronts and panel doors shall be considered as exposed surfaces. Bottoms of wall hung cabinets shall be considered as exposed.

b. SEMI-EXPOSED SURFACES of casework shall include interior surfaces exposed to view only when opaque doors are open.

c. UNEXPOSED SURFACES not visible after installation include back rails, top side rails, stretchers, web frames, blocking, components concealed by drawers, underside of knee spaces and drawer aprons, and tops of 82" high tall and wall hung cabinets.

B. Casework Materials:

1. Materials used for construction of cabinets, cases and tables as specified herein shall meet or exceed the minimum standards as described.

a. All exterior surfaces exposed to view after installation, and all cabinet interior surfaces shall be Oak with the exception of back panels behind opaque doors which shall be Hardboard, and drawer boxes which shall be Birch.

b. All plywood panels with veneer core, particleboard core, or MDF core shall be CARB Phase 2 Compliant.

c. Exposed solid wood: Plain sawn Oak lumber, Grade FAS or better, clear and free of defects. Lumber shall be air dried, then kiln dried, and tempered to a moisture content of 6%-9% before use.

d. Unexposed solid wood: Other hardwoods may be used that are Grade FAS or better, clear and free of defects, and properly dried in same manner as exposed solid wood.

e. Plywood: Hardwood Veneer Core Plywood shall be minimum 3-ply (1/4"), 5-ply (1/2"), or 7-ply (3/4") with select Oak, Grade A-1, plain sliced, book match, veneer face and back, and shall be compliant with ANSI/HPVA HP-1 2009. All 9-ply (1") plywood shall be Grade A-1, whole piece, rotary cut, Oak veneer face and back. Use of other hardwood face veneer is acceptable in unexposed areas.

Combination core with composite cross bands is acceptable in lieu of veneer core.

f. Plywood: Composite Core Plywood for cabinet drawer fronts and doors shall be 3-ply, 3/4” thick select Oak, Grade A-1, plain sliced, book match veneer face and back, and shall be compliant with ANSI A208.1-2009 (PBC) or ANSI A208.2-2009 (MDF).

g. Banding: Plywood panels shall be edge banded where specified herein with 3mm solid Oak edge band.

h. Hardboard: Tempered hardboard shall be 1/4" thick. All hardboard shall be composed of wood fibers and resinous binder compressed under heat and pressure.

i. Glass: Wall Cabinet framed swinging and framed sliding doors shall have 1/8” float glass. Wall Cabinet and Tall Cabinet frameless sliding doors shall have 1/4” float glass with polished edges. Tall Cabinet framed swinging doors shall have 1/4" float glass.

j. Tempered Glass: Tempered safety glass will be provided ONLY WHEN SPECIFICALLY CALLED FOR on the drawings or equipment list.

## 2.3 FABRICATION

A. General:

1. The Wood Cabinetry selected for this project shall be as follows.

   a. Cabinet Front Style: MAJESTIC SERIES – Oak stained Clear, Northwoods (pending sample). Provide samples for verification.

   b. Cabinet drawer fronts and panel doors feature a square edge with slight radius, partial overlay style with vertical match grain fronts and Oak edge band.

   c. Drawer fronts and panel doors on each cabinet are cut from one (1) Oak composite core plywood panel as a MATCHING FRONT SET.

2. Cabinets, tables, and other units shall be of the size and configuration indicated on the drawings and/or equipment list. Wood cabinetry is bored, doweled, grooved, and rabbeted construction.

3. Base Cabinet Construction:

   a. Cabinet End Panels shall be 3/4", Oak veneer core plywood. End panels shall be doweled and glued to top frame members, intermediate rails, and bottoms.

   b. Vertical Partitions are 3/4", Oak veneer core plywood.

   c. Exposed or semi-exposed edges of end panels, partitions, bottom panels, and shelves shall be edged with 3mm solid Oak edge banding.

   d. Two-Piece Top Frame consists of nominal 1" X 3" solid Oak front rail, with back edge grooved to receive cross rails, and similar 1” X 3” solid Oak back rail, both set flush with cabinet ends, doweled and glued into place.

   e. Top Frame Cross Rails are nominal 1" X 2-1/4" solid hardwood fully housed into front and back rails with tongue and groove joints to form a full four-sided top frame. Provide cross rails at cabinets wider than 36”.

   f. Intermediate Rails are provided on all base cabinets between drawer/drawer configurations and drawer/door configurations. Rails are 1” X 3” solid Oak with back grooved to receive lock security panels (when panels are required). Rails shall be set flush with cabinet ends, doweled and glued into place.

g. Bottom Panel shall be 3/4”, Oak veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.

h. Back Panel shall be 1/4" thick Oak plywood when cabinet interior is exposed and 1/4" hardboard when cabinet interior is semi-exposed. Backs are recessed into grooved end panels and secured on all four (4) sides.

i. Recessed Front Toe Rail shall be 4”x 3/4" Oak veneer core plywood.

j. Cabinet Shelves shall be 1”, Oak veneer core plywood. Shelves are adjustable on 32mm centers, supported by four (4) nickel-plated steel pin and socket type shelf clips.

k. Security Panels are 1/4" thick hardboard. Panel is provided between drawer/drawer and drawer/door base cabinets only when called for, OR WHEN LOCKS ARE SPECIFIED TO BE KEYED DIFFERENT.

4. Wall Cabinet Construction:

a. Cabinet End Panels shall be 3/4", Oak veneer core plywood. End panels shall be doweled and glued to top and bottom panels.

b. Vertical Partitions shall be 3/4", Oak veneer core plywood.

c. Exposed or semi-exposed edges of end panels, top and bottom panels, partitions, and shelves shall be edged with 3mm solid Oak edge banding.

d. Top and Bottom Panels shall be 1”, Oak veneer core plywood. Panels shall be set flush with cabinet ends, doweled and glued into place.

e. Back Panel shall be 1/4” Oak plywood when cabinet interior is exposed and 1/4" hardboard when interior is semi-exposed. Back panels shall be rabbeted into ends and secured on all (4) sides.

f. Cabinet Shelves shall be 1”, Oak veneer core plywood. Shelves are adjustable on 32mm centers and supported by four (4) nickel-plated steel pin and socket type shelf clips.

g. Top and Bottom Back Rail shall be 4” x 3/4” hardwood veneer core plywood doweled and glued into end panels, and used for attaching the cabinet to wall.

5. Tall Cabinet Construction:

a. Cabinet End Panels shall be 3/4", Oak veneer core plywood. End panels shall be doweled and glued to top and bottom panels.

b. Vertical Partitions shall be 3/4", Oak veneer core plywood.

c. Exposed edges of end panels, top and bottom panels, partitions, and shelves shall be edged with 3mm solid Oak edge banding.

d. Cabinet Top Panel shall be 1”, Oak veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.

e. Cabinet Bottom Panel shall be 3/4”, Oak veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.

f. Top Back Rail and Center Back Rail shall be 3" x 1" solid hardwood doweled and glued into end panels.

g. Bottom Back Rail shall be 4” x 3/4” hardwood veneer core plywood doweled and glued into end panels.

h. Recessed Bottom Front Toe Rail shall be 4” x 3/4” Oak veneer core plywood doweled and glued into end panels.

i. Back Panel shall be 1/4” Oak plywood when cabinet interior is exposed and 1/4” hardboard when interior is semi-exposed. Back panels are recessed into grooved end panels and secured on four (4) sides.

j. Shelves shall be 1”, Oak veneer core plywood with one (1) center fixed shelf and four (4) adjustable shelves that are adjustable on 32mm centers, supported by four (4) nickel-plated steel pin and socket type shelf clips.

6. Drawers and Doors:

a. Drawer Fronts:

1) MAJESTIC SERIES - Square Edge Partial Overlay Style.

2) 3/4", Oak composite core plywood and 3mm solid Oak edge band with a slight radius.

3) Drawer fronts and panel doors on each cabinet have vertical match grain cut from one (1) plywood panel as a Matching Front Set.

b. Drawer Box Body:

1) Front, sides, and back are 1/2” thick 9-ply Birch plywood.

2) Dovetail joinery all four (4) corners.

3) 1/4” thick white finished hardboard bottom.

4) Bottom is set in grooves on four (4) sides and hot-melt glued on underside.

5) Drawer box has clear chemical resistant finish.

6) Top edge of box is provided with FINISHED TOP CAP to conceal edge of veneer core.

c. Panel Doors – Base Cabinets:

1) MAJESTIC SERIES: Square Edge Partial Overlay Style.

2) 3/4”, Oak composite core plywood and 3mm solid Oak edge band with a slight radius.

3) Panel doors and drawer fronts on each cabinet have vertical match grain cut from one (1) plywood panel as a Matching Front Set.

d. Panel Doors – Wall and Tall Cabinets:

1) MAJESTIC SERIES: Square Edge Partial Overlay Style.

2) 3/4", Oak composite core plywood and 3mm solid Oak edge band with a slight radius.

3) Panel doors on each cabinet have vertical match grain cut from one (1) plywood panel as a Matching Front Set.

e. Framed Glass Doors – Tall Cabinets:

4) MAJESTIC SERIES: Square Edge Partial Overlay Style.

5) 3/4" x 3” solid Oak top, bottom, and side rails, doweled and glued together, sanded for smooth fit, and edge detailed with a slight radius.

6) Tall cabinet door shall have a 3/4" x 6” wide solid Oak center rail.

## 2.4 LABORATORY GRADE WOOD FINISH

A. Prior to application of wood finish, component parts shall be carefully sanded and buffed in preparation for the finishing process.

1. Exposed wood surfaces shall receive a stain and sealer coat of synthetic resin. The product is then cured at elevated temperatures. After the sealer coat, the product shall be sanded, wiped clean, and then a double pass coat of chemical resistant synthetic resin shall be applied and cured at elevated temperatures.
2. Semi-exposed surfaces receive sealer coat and a double pass coat of chemically resistant synthetic resin.
3. Unexposed cabinet end panels receive a sealer coat.
4. Stain Color: Clear, Northwoods (pending sample). Provide samples of each to confirm best match to existing building.

B. Cabinet Wood Surface Finish Tests and Evaluation:

1. The final finished wood product shall meet the performance test requirements and evaluations described under Paragraph 8.0 Cabinet Surface Finish Tests found in Section 8-W-2014 of the SEFA Recommended Practices for Laboratory Grade Wood Casework.
2. Paragraph 8.1 Chemical Spot Test and 8.1.1 thru 8.1.3. This Test Procedure describes the testing of a OAK wood veneer panel without stain, using forty-nine (49) chemical reagents with each given a final rating system of Level 0, Level 1, Level 2, or Level 3. After testing, panel shall have no more than four (4) Level 3 conditions.
3. Paragraph 8.2 Hot Water Test and 8.2.1 thru 8.2.3. This Test Procedure describes the testing of a OAK wood veneer panel without stain, using hot water with no visible effect.
4. The above Test Procedures shall be performed for Wood Casework Manufacturer by an Independent third party, SEFA approved, testing facility.

## 2.5 CASEWORK HARDWARE AND ACCESSORIES

A. Hinges: Institutional type, ground tip, five-knuckle, with pins of not less than .177” in diameter and leaves of not less than .095" thick. Hinges shall be 2-3/4” long wrought steel with chemical resistant epoxy powder coating. Two (2) hinges shall be provided on doors under 36" in height and three (3) hinges for doors 36" and over. Standard color of epoxy powder coat is Black.

B. Pulls: Solid metal, wire type, 4" long mounted with two (2) screws fastened from back. Pulls shall have chemical resistant epoxy powder coating to match hinges. Provide two (2) pulls for drawers over 24" wide. Standard color of epoxy powder coat is Black.

C. Drawer Slides: Shall be easily removable with a 100 lb dynamic load rating, and have self-closing, 3/4 extension, epoxy powder coated steel, nylon rollers, bottom mount, positive stop features. File drawers shall have full extension, zinc plated anochrome finish, ball bearing, side mount slides with lever release.

D. Door Catches: Provide two (2), top and bottom, dual, self-aligning magnetic catches on base and wall cabinet doors, and two (2) heavy-duty magnetic catches on tall cabinet doors.

E. Elbow Catches: Brass with latch held by coiled compressing spring. Catch plates of 16-gauge plated steel. Provide on base and wall cabinets with double doors where locks are specified.

F. Spring Actuated Latch: Latch has 4-5/8" bevel slide bolt with 2-1/4 lbs./in. actuating spring. Provide on tall cabinets with double doors where locks are specified.

G. Leg Shoes: Molded vinyl or rubber, black, coved bottom type.

H. Glass: Type I, Class I, float glass.

I. Tote Trays: High impact molded plastic tray with high gloss.

J. Swinging Doors (Framed Glass Tall Cabinets): 1/8" thick float glass on wall cabinets and 1/4" thick float glass on tall cabinets. Locks, when indicated, shall be cam type.

K. Locks: Provided only if specifically shown on the Drawings or indicated on the equipment list.

1. Locks are laboratory grade, cylinder cam locks, with 5-disc tumbler mechanism, and a dull chrome-plated face. Tumblers and keys are brass, while plug and cylinder are die cast zinc alloy. Locks are equipped with RemovaCoreTM keying control. With the use of a control key, the key core of the lock assembly can be removed and a new key core inserted, changing the entire locking system.

a. Keying Option: Locks are keyed alike per room, but each room different and master keyed. Each lock in a room can be opened with one (1) key, but each room would have a different key, and all rooms can be opened with a single master key. Provide minimum of two (2) master keys per project.

## 2.6 WORK SURFACES, SINKS, AND ACCESSORIES

A. General:

1. Comply with physical and chemical resistance requirements for materials for tops, sinks, and accessories as specified herein and in accordance with SEFA 3-2010 Laboratory Work Surfaces.

2. Provide tops with smooth, clean, exposed surfaces and edges, in uniform plane, free of defects. Provide 4" high x 1" thick back splash and end splash where tops abut walls, or where shown on drawings.

a. Top sizes: Furnish tops in longest practical lengths, in configuration indicated on the drawings.

B. Work Surfaces:

1. Epoxy Resin Tops: Shall consist of sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments.

a. Wall counters shall be monolithic throughout without surface coating application, and shall be flat and 1" thick with 1/8" chamfered exposed edges. Provide drip grooves under all exposed edges. Exposed corners shall be eased slightly for safety. Bond joints of tops and splashes with highly chemical resistant cement with properties and color similar to base material. Standard color is Black.

b. Minimum Physical Properties and Test Results:

| TEST | ASTM | IMPERIAL |
|---|---|---|
| Rockwell Hardness | D785-08 | 109 (M scale) |
| Density | D792-00 | 133 (lb/ft3) |
| Compressive Strength | D695-02 | 33.5 (kpsi) |
| Flexural Strength | D790-07 | 14.9 (kpsi) |
| Fire Resistance | D635-06 | Self-Extinguishing |
| Water Absorption | D570-98 | 0.008 (% after 24 hrs) |
| Linear Thermal Expansion | D696-03 | 1.37x10-5 (in/in degree F) |
| Flame Spread Index | E84-06 | 0.29 (in) |
| Smoke Developed Index | E84-06 | 8.71 (in) |

c. Chemical Resistance Tests and Evaluation: Epoxy Resin Tops shall meet the performance test requirements and evaluations described under Paragraph 2.1.1 Chemical/Stain Resistance Test found in Section 3-2010 of the SEFA Recommended Practices for Laboratory Work Surfaces. Epoxy Resin Top

material shall be tested using forty-nine (49) Reagents and shall result in no more than four (4) Level-3 conditions.

C. Sinks:

1. Epoxy Resin Sinks: Shall be one-piece, molded construction. Sinks to be “drop-in” style with inside corners and bottoms coved for easy cleaning. Standard color of sink is Black.

D. Sink Outlets:

1. Epoxy Resin Sinks shall be provided with 1-1/2” dia. X 3” threaded polypropylene sink outlet with locknut, removable disc strainer, and sink stopper.

2.7 LABORATORY SERVICE FIXTURES, FITTINGS, AND ACCESSORIES

A. Water Faucets and Valves:

1. Provide units that comply with SEFA 7 – 2010, Laboratory Service Fittings Recommended Practices, and also complying with ANSI/ASME 112.18.1-2005 and certified by CSA International under CAN/CSA B.125.1-05.
2. Provide units fabricated from cast or forged red brass unless otherwise indicated.
3. Provide fittings complete with threaded mounting shanks, locknuts, and washers. Include necessary flanges, escutcheons, extension rods, etc.
4. Provide units complying with ADA accessible requirements where indicated on the drawings or equipment list. Provide one (1) faucet with 4” wrist blade handles at ADA sinks.
5. All water faucets shall be provided with aerators unless specifically noted to have serrated hose ends.
6. If serrated hose ends are designated on any water faucets, provide the unit with a vacuum breaker.
7. Water faucets shall have self-contained renewable compression valve units with stainless steel valve seats. Compression unit valve stem shall be sealed with molded TFE stem packing to prevent leakage. Provide color coded index discs.

B. Vandal Resistant Multiple Service Combination Faucets shall be provided with the following construction features.

1. Multiple Service Combination Faucets main body shall be constructed of heavy duty, cast brass that is sufficient to resist bending and breakage.
2. Provide Aerators of vandal-resistant design.
3. Index discs shall be tamperproof and cemented in place.
4. Fittings for laboratory gases shall be provided with ball valve (for ADA) and INTERNAL CHECK VALVE (except vacuum) to prevent back flow into gas system.
5. Nuts shall be provided with set screws.
6. Provide cemented threaded connections.
7. Combination water/gas faucets shall have inlet shanks machined from solid brass bar stock and heavy wall steel pipe.

C. Quality Assurance:

1. All water faucets and service fixtures shall be fully assembled and factory tested prior to shipment.

D. Faucet and Fixture Finish:

1. All water faucets and service fixtures shall have BLACK powder coat epoxy finish.

E. Vandal-Resistant Multiple Service Combination Faucets:

1. Sheldon Unimix Faucet No. 80032 or 80032-WB:

a. Combination cold water, hot water & aerator.
b. Black powder coat epoxy finish.
c. Color coded nylon handles for cold water.
d. Vandal-resistant features.
e. Wrist-blade handles at ADA sinks.

F. Electrical Fixtures:

1. Electrical Fixtures that are a part of, or installed in the lab casework shall be approved by the National Board of Underwriters and must conform to city and state building codes.
2. Knock-out boxes when indicated, shall be installed in the lab casework.
3. Receptacles shall be grounded type, 20-amp heavy-duty industrial grade.

2.8 TECHNICAL PRODUCTS LIST

A. The following specifications are provided to accurately describe the technical products shown on the drawings. Because of the specific educational function of these items, any deviation whatsoever must be submitted to the architect no less than 10 days prior to bid date for approval.

PART 3 EXECUTION

3.1 EXAMINATION

A. The casework contractor shall verify that building conditions have been completed as described in 1.06 A and B which outline building readiness required before casework installation begins.

3.2 INSTALLATION

A. Installer Qualifications: The Installer shall have a minimum of five (5) years of experience installing laboratory casework using professional and accepted trade practices and be familiar with SEFA's Recommended Practices as described in SEFA 2-2010, and be certified by the manufacturer as having the necessary skills and equipment to install the casework so as not to void the warranty.

B. Coordination: Coordinate the work of this section with regard to installing casework. Cooperate with other trades regarding mechanical and electrical connections to casework that are provided in their work, including final connections to sinks, plumbing fixtures, electrical fixtures, fume hoods, etc.

C. Performance:

1. Casework:

a. Set base cabinets in place, level, secure to walls or floors as necessary. Install fillers, trim and scribe to walls. Shim as required using concealed shims.
b. Screw continuous cabinets together with joints flush, tight and uniform.

c. Secure tall cabinets and wall cabinets to the walls. Secure these cabinets to solid supporting material, utilizing grounds/blocking that is provided in walls in another section of work.

2. Work Surfaces:

a. Work surfaces shall be installed with nominal 1” overhang on the front and end, unless otherwise indicated on the shop drawings.

b. Level and shim as necessary. Shims shall generally not exceed 1/8”.

c. Install work surfaces to achieve a uniform alignment of the front edge of the top.

d. Only factory-prepared field joints, located per the shop drawings, shall be permitted.

e. Secure work surfaces to the understructure with adhesive or mechanical fasteners per the manufacturer’s recommendations.

f. Provide flush joints not to exceed 1/8” between work surface sections.

g. Grout butt joints with material and method per the manufacturer’s recommendation.

h. Backsplashes and end returns shall be secured in place with joints sealed per manufacturer’s recommendation.

## 3.3 ADJUST AND CLEAN-UP

A. Adjust doors and drawers to operate smoothly.

B. Clean casework and touch-up as required.

C. Clean work surfaces.

D. Remove all debris, dirt, rubbish, and excess material as a result of the installation of this equipment and leave the site clean and orderly.

## 3.4 PROTECTION

A. Protect countertops with Kraft paper or cardboard after installation to help prevent damage from other trades.

B. The General Contractor is responsible for protection of casework, work surfaces, and fixtures from damage by work of other trades.

C. Equipment list: Refer to Specialty Science Schedule.

END OF SECTION

# SECTION 21 0500
# FIRE SUPPRESSION PIPING

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Furnish and install complete, tested and ready for use wet pipe or dry pipe automatic sprinkler system as described in these Specifications. Provide new fire service and risers inside building complete with all necessary flow switches, alarms, etc. to comply with NFPA 13 and all applicable local codes. The design of the system shall be performed by a NICET LEVEL 3 or 4 certified designer.

B. The Fire Protection Contractor shall ensure that all work conforms to local codes and regulations. The Fire Protection Contractor shall: 1) Verify existing water pressure at site prior to bidding. 2) Design pipe sizes based on existing water pressure or provide and install new fire pump as required to adequately provide proper coverage for building, and 3) Coordinate all electrical wiring and connections to pumps, valves, tamper switches, flow switches, etc. Wiring to be done under Division 26. Installation of the system shall be by a Fire Protection Contractor which is certified by the State in which the system will be installed.

### 1.02 SYSTEM DESCRIPTIONS

A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.

B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

C. Wet-Pipe Return Bend Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

### 1.03 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.
   1. Minimum Residual Pressure at Each Hose-Connection Outlet: 65 psig.
   2. Unless Otherwise Indicated, the Following Is Maximum Residual Pressure at Required Flow at Each Hose-Connection Outlet: 100 psig.

C. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications:
      a. Building Service Areas: Ordinary Hazard, Group 1.
      b. Churches: Light Hazard.
      c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      d. General Storage Areas: Ordinary Hazard, Group 1.
      e. Laundries: Ordinary Hazard, Group 1.
      f. Libraries, Except Stack Areas: Light Hazard.
      g. Library Stack Areas: Ordinary Hazard, Group 2.
      h. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
      i. Office and Public Areas: Light Hazard.
      j. Residential Living Areas: Light Hazard.
      k. Restaurant Service Areas: Ordinary Hazard, Group 1.
      l. Insert area: Insert hazard and group.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm/sq.ft. over 1500 sq. ft.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq.ft. over 1500 sq. ft.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft.
4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 120 sq. ft.
   b. Storage Areas: 130 sq. ft..
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

### 1.04 SUBMITTALS

A. Product Data: For each product indicated.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

C. Field test reports and certificates.

D. Field quality-control test reports.

E. Operation and maintenance data.

### 1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
   1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
   4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
   5. NFPA 230, "Fire Protection of Storage."

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

## 2.02 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern AWWA C153, ductile-iron compact pattern.
   2. Gaskets: AWWA C111, rubber.

C. Grooved-End, Ductile-Iron Pipe: AWWA C151, with factory- or field-formed, radius-cut-grooved ends according to AWWA C606.
   1. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Victaulic Co. of America.
      b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD.
      c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts.
      d. Grooved-End Transition Flange: UL 213, gasketed fitting with key for ductile-iron-pipe dimensions. Include flange-type, ductile-iron housing with rubber gasket listed for use with housing and steel bolts and nuts.

## 2.03 STEEL PIPE AND FITTINGS

A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
   1. Cast-Iron Threaded Flanges: ASME B16.1.
   2. Malleable-Iron Threaded Fittings: ASME B16.3.
   3. Gray-Iron Threaded Fittings: ASME B16.4.
   4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
   5. Steel Threaded Couplings: ASTM A 865.

B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
   1. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Anvil International, Inc.
         2) Central Sprinkler Corp.
         3) Ductilic, Inc.
         4) JDH Pacific, Inc.
         5) National Fittings, Inc.
         6) Shurjoint Piping Products, Inc.
         7) Southwestern Pipe, Inc.
         8) Star Pipe Products; Star Fittings Div.
         9) Victaulic Co. of America.
         10) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

C. Saddle taps are not allowed without written permission from AHJ.

**2.04 FLEXIBLE CONNECTORS**

A. Flexible connectors are not allowed without written permission of the AHJ. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
1. NPS 2 and Smaller: Threaded.
2. NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

B. Manufacturers:
1. Anamet Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Hyspan Precision Products, Inc.
7. Mercer Rubber Co.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. Unaflex Inc.

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

**2.05 SPRINKLER SPECIALTY FITTINGS**

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Outlet Specialty Fittings:
1. Manufacturers:
a. Anvil International, Inc.
b. Central Sprinkler Corp.
c. Ductilic, Inc.
d. JDH Pacific, Inc.
e. National Fittings, Inc.
f. Shurjoint Piping Products, Inc.
g. Southwestern Pipe, Inc.
h. Star Pipe Products; Star Fittings Div.
i. Victaulic Co. of America.
j. Ward Manufacturing.
2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
   1. Manufacturers:
      a. Central Sprinkler Corp.
      b. Fire-End and Croker Corp.
      c. Viking Corp.
      d. Victaulic Co. of America.

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
   1. Manufacturers:
      a. Elkhart Brass Mfg. Co., Inc.
      b. Fire-End and Croker Corp.
      c. Potter-Roemer; Fire-Protection Div.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
   1. Manufacturers:
      a. AGF Manufacturing Co.
      b. Central Sprinkler Corp.
      c. G/J Innovations, Inc.
      d. Triple R Specialty of Ajax, Inc.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
   1. Manufacturers:
      a. CECA, LLC.
      b. Merit.

## 2.06 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:
   1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
   2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench hand wheel, extension rod, locking device, and cast-iron barrel.
   3. Manufacturers:
      a. Grinnell Fire Protection.
      b. McWane, Inc.; Kennedy Valve Div.
      c. NIBCO.
      d. Stockham.

C. Butterfly Valves: UL 1091.
   1. NPS 2 and Smaller: Bronze body with threaded ends.
      a. Manufacturers:
         1) Global Safety Products, Inc.
         2) Milwaukee Valve Company.
   2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with grooved ends.
      a. Manufacturers:
         1) Central Sprinkler Corp.
         2) Global Safety Products, Inc.
         3) McWane, Inc.; Kennedy Valve Div.
         4) Mueller Company.

5) NIBCO.
6) Pratt, Henry Company.
7) Victaulic Co. of America.

D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
a. AFAC Inc.
b. American Cast Iron Pipe Co.; Waterous Co.
c. Central Sprinkler Corp.
d. Clow Valve Co.
e. Crane Co.; Crane Valve Group; Crane Valves.
f. Crane Co.; Crane Valve Group; Jenkins Valves.
g. Firematic Sprinkler Devices, Inc.
h. Globe Fire Sprinkler Corporation.
i. Grinnell Fire Protection.
j. Hammond Valve.
k. Matco-Norca, Inc.
l. McWane, Inc.; Kennedy Valve Div.
m. Mueller Company.
n. NIBCO.
o. Potter-Roemer; Fire Protection Div.
p. Reliable Automatic Sprinkler Co., Inc.
q. Star Sprinkler Inc.
r. Stockham.
s. United Brass Works, Inc.
t. Venus Fire Protection, Ltd.
u. Victaulic Co. of America.
v. Watts Industries, Inc.; Water Products Div.

E. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.
4) United Brass Works, Inc.
2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
a. Manufacturers:
1) Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.
5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.
8) Red-White Valve Corp.
9) United Brass Works, Inc.

F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch Visual.

2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
   a. Manufacturers:
      1) Milwaukee Valve Company.
      2) NIBCO.
      3) Victaulic Co. of America.
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
   a. Manufacturers:
      1) Central Sprinkler Corp.
      2) Grinnell Fire Protection.
      3) McWane, Inc.; Kennedy Valve Div.
      4) Milwaukee Valve Company.
      5) NIBCO.
      6) Victaulic Co. of America.

## 2.07 UNLISTED GENERAL-DUTY VALVES

A. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

B. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

C. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

## 2.08 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
   1. Manufacturers:
      a. AFAC Inc.
      b. Central Sprinkler Corp.
      c. Firematic Sprinkler Devices, Inc.
      d. Globe Fire Sprinkler Corporation.
      e. Grinnell Fire Protection.
      f. Reliable Automatic Sprinkler Co., Inc.
      g. Star Sprinkler Inc.
      h. Venus Fire Protection, Ltd.
      i. Victaulic Co. of America.
      j. Viking Corp.
   2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
      a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
      b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

B. Automatic Drain Valves: UL 1726, NPS 3/4 ball-check device with threaded ends.
   1. Manufacturers:
      a. AFAC Inc.
      b. Grinnell Fire Protection.

## 2.09 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Firematic Sprinkler Devices, Inc.
4. Globe Fire Sprinkler Corporation.
5. Grinnell Fire Protection.
6. Reliable Automatic Sprinkler Co., Inc.
7. Star Sprinkler Inc.
8. Venus Fire Protection, Ltd.
9. Victaulic Co. of America.
10. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:
1. UL 199, for nonresidential applications.
2. UL 1626, for residential applications.
3. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:
1. Concealed ceiling sprinklers, including cover plate.
2. Flush ceiling sprinklers, including escutcheon.
3. Pendent sprinklers.
4. Quick-response sprinklers.
5. Recessed sprinklers, including escutcheon.
6. Sidewall sprinklers.
7. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.10 HOSE CONNECTIONS

A. Manufacturers:
1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Grinnell Fire Protection.
8. Guardian Fire Equipment Incorporated.
9. McWane, Inc.; Kennedy Valve Div.
10. Mueller Company.
11. Potter-Roemer; Fire-Protection Div.
12. United Brass Works, Inc.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.
   1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
   2. Finish: Rough metal or chrome-plated.

## 2.11 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:
   1. AFAC Inc.
   2. Central Sprinkler Corp.
   3. Elkhart Brass Mfg. Co., Inc.
   4. Fire-End and Croker Corp.
   5. Fire Protection Products, Inc.
   6. GMR International Equipment Corporation.
   7. Guardian Fire Equipment Incorporated.
   8. Potter-Roemer; Fire-Protection Div.
   9. Reliable Automatic Sprinkler Co., Inc.
   10. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
   1. Type: Flush, with two inlets and square or rectangular escutcheon plate.
   2. Type: Exposed, projecting, with two inlets and round escutcheon plate.
   3. Finish: Polished chrome-plated.

## 2.12 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.
   1. Manufacturers:
      a. AFAC Inc.
      b. Central Sprinkler Corp.
      c. Firematic Sprinkler Devices, Inc.
      d. Globe Fire Sprinkler Corporation.
      e. Grinnell Fire Protection.
      f. Reliable Automatic Sprinkler Co., Inc.
      g. Star Sprinkler Inc.
      h. Viking Corp.

C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   1. Manufacturers:
      a. ADT Security Services, Inc.

b. Grinnell Fire Protection.
c. ITT McDonnell & Miller
d. Potter Electric Signal Company.
e. System Sensor.
f. Viking Corp.
g. Watts Industries, Inc.; Water Products Div.

D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
1. Manufacturers:
a. McWane, Inc.; Kennedy Valve Div.
b. Potter Electric Signal Company.
c. System Sensor.

**2.13 PRESSURE GAGES**

A. Manufacturers:
1. AGF Manufacturing Co.
2. AMETEK, Inc.; U.S. Gauge.
3. Brecco Corporation.
4. Dresser Equipment Group; Instrument Div.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2- to 4-1/2-inch diameter, dial pressure gage with range of 0 to 300 psig.
1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
2. Air System Piping: Include caption "AIR" or "AIR/WATER" on dial face.

**PART 3 - EXECUTION**

**3.01 PIPING APPLICATIONS, GENERAL**

A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

C. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints.

**3.02 STANDPIPE SYSTEM PIPING APPLICATIONS**

A. Grooved-end, black or galvanized, standard-weight steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

**3.03 SPRINKLER SYSTEM PIPING APPLICATIONS**

A. NPS 1-1/2 and Smaller: Plain-end, black, standard-weight steel pipe; locking-lug fittings; and twist-locked joints.

B. NPS 2 and Larger: Grooved-end, black, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

**3.04 VALVE APPLICATIONS**

A. Drawings shall indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
   a. Shutoff Duty: Use butterfly or gate valves.
2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
   a. Shutoff Duty: Use butterfly or gate valves.
   b. Throttling Duty: Use globe valves.

### 3.05 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.

D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
   2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
   3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

### 3.06 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 2 Section "Water Distribution" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 2 Section "Water Distribution" for backflow preventers.

### 3.07 WATER-SUPPLY CONNECTION

A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 15 Section "Plumbing Specialties" for backflow preventers.

### 3.08 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install drain valves on standpipes.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install standpipe system piping according to NFPA 14.
   2. Install sprinkler system piping according to NFPA 13.

M. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Fill wet-standpipe system piping with water.

P. Fill wet-pipe sprinkler system piping with water.

## 3.09 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

D. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

## 3.10 SPRINKLER APPLICATIONS

A. Where specific sprinkler types are not indicated, use the following sprinkler types:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Pendant sprinklers.
   3. Wall Mounting: Sidewall sprinklers.
   4. Sprinkler Finishes:
      a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
      b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
      c. Flush Sprinklers: Bright chrome, with painted white escutcheon.

d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
e. Residential Sprinklers: Dull chrome.

### 3.11 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

### 3.12 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install hose-connection valves with flow-restricting device, unless otherwise indicated.

D. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Refer to Division 10 Section "Fire-Protection Specialties" for cabinets.

### 3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.

B. Install freestanding-type, fire department connections in level surface.
1. Install protective pipe bollards on three sides of each fire department connection. Refer to Division 5 Section "Metal Fabrications" for pipe bollards.

C. Install ball drip valve at each check valve for fire department connection.

### 3.14 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Plumbing Specialties" for backflow preventers.

D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

F. Electrical Connections: Power wiring is specified in Division 26.

G. Connect alarm devices to fire alarm.

H. Ground equipment according to Division 26 Section "Grounding and Bonding."

I. Connect wiring according to Division 26 Section "Conductors and Cables."

### 3.15 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Mechanical Identification."

### 3.16 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Coordinate with fire alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

**END OF SECTION**

# SECTION 21 1100
# FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Water pipe.

B. Valves.

C. Fire department connections.

### 1.02 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

B. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.

C. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

E. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2014.

F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2020.

G. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

H. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

I. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

J. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).

K. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe; 2015.

L. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; 2017.

M. FM (AG) - FM Approval Guide; current edition.

N. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. UL (DIR) - Online Certifications Directory; Current Edition.

### 1.03 ADMINISTRATIVE REQUIREMENTS

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

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

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturer's catalog information.
   3. Indicate valve data and ratings.

D. Field Quality Control Submittals: Testing activities.

E. Project Record Documents:
   1. Record actual locations of piping mains, valves, connections, fire hydrants, free-standing fire department connections, underground manholes and vaults, valve boxes, thrust restraints, and invert elevations.

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

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Valve Repacking Kits: One for each type and size of valve.

**1.05 QUALITY ASSURANCE**

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

D. Welder Qualifications:
   1. Certify in accordance with ASME BPVC-IX.
   2. Provide certificate of compliance from local Authority Having Jurisdiction, indicating approval of welders.

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

F. Products:
   1. Listed, classified, and labeled as suitable for the purpose specified and indicated.
   2. Refer to FM (AG) - FM Approval Guide and UL (DIR).

G. Perform Work in accordance with local authorities having jurisdiction, municipality, and water utility requirements.

**1.06 DELIVERY, STORAGE, AND HANDLING**

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

**1.07 FIELD CONDITIONS**

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

**1.08 WARRANTY**

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

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

**2.02 WATER PIPE**

A. Steel Pipe: Standard weight, zinc-coated, listed, ASTM A53/A53M.
   1. Fittings: Comply with Cast-Iron Threaded Flanges: ASME B16.1 or ASME B16.4 Class 125, zinc-coated.
   2. Mechanically Factory Applied Protective Materials:
      a. Clean by wire brushing and solvent cleaning.
      b. Apply one coat of coal-tar primer and two coats of coal-tar enamel complying with AWWA C203.
      c. Protect threaded pipe ends and fittings prior to coating.
      d. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
      e. Steel Threaded Couplings: ASTM A 865.
   3. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
      a. Grooved-Joint Piping Systems:
         1) Manufacturers:
            (a) Anvil International, Inc.
            (b) Central Sprinkler Corp.
            (c) Ductilic, Inc.
            (d) JDH Pacific, Inc.
            (e) National Fittings, Inc.
            (f) Shurjoint Piping Products, Inc.
            (g) Southwestern Pipe, Inc.
            (h) Star Pipe Products; Star Fittings Div.
            (i) Victaulic Co. of America.
            (j) Ward Manufacturing.
         2) Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
         3) Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

B. Ductile Iron Pipe: Listed, AWWA C151/A21.51.
   1. Fittings: AWWA C110/A21.10, ductile iron, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR rubber gasket with 3/4 inch diameter rods.
   3. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
      a. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern AWWA C153, ductile-iron compact pattern.
      b. Gaskets: AWWA C111, rubber.
   4. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Victaulic Co. of America.

b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD.
c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts.
d. Grooved-End Transition Flange: UL 213, gasketed fitting with key for ductile-iron-pipe dimensions. Include flange-type, ductile-iron housing with rubber gasket listed for use with housing and steel bolts and nuts.

C. **Saddle taps are not allowed without written permission from AHJ.**

## 2.03 VALVES

A. General:
1. Manufacturer's name and pressure rating marked on valve body.
2. Minimum Compliance: UL (DIR) listed and labeled.
3. Maximum Inlet Pressure: 400 psi.
4. Maximum Service Temperature: 180 degrees F.
5. Valve Coatings:
a. Internally: 4 mils, 0.004 inch epoxy, minimum.
b. Externally: Epoxy base then fire red enamel paint or heat-fused red epoxy paint.

## 2.04 FIRE DEPARTMENT CONNECTIONS:

A. Manufacturers:
1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Guardian Fire Equipment Incorporated.
8. Potter-Roemer; Fire-Protection Div.
9. Reliable Automatic Sprinkler Co., Inc.
10. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
1. Type: Flush, with two inlets and square or rectangular escutcheon plate.
2. Type: Exposed, projecting, with two inlets and round escutcheon plate.
3. Finish: Polished chrome-plated.

C. Free-Standing Inlet:
1. Construction:
a. Type: Free standing type, ASTM B584 poured brass alloy.
b. Inlets: Two-way, 2-1/2 inch NPS female inlets, thread size compatible with fire department hardware.
c. Rated Working Pressure: 175 psi.
d. Double clapper-valves, rocker-lug caps and chain, and cast-in function-identifying lettering.
e. Finish: Polished brass.

f. Label: Sprinkler - Fire Department Connection.

## PART 3 EXECUTION

### 3.01 EXAMINATION

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

### 3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

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

### 3.03 INSTALLATION

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

a. Ensure minimal interruption of service on the existing line.
b. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

5. Penetrations:
a. Provide ductile-iron or Schedule 40 steel for pipes passing through walls of valve pits and structures.
b. Fill annular space between sleeves and walls with rich cement mortar.
c. Fill annular space between pipe and sleeves with mastic.

B. Special Requirements:
1. Ductile Iron Piping:
a. Unless otherwise specified, install pipe and fittings in accordance with paragraph "General Requirements".
b. Allowable Deflection:
1) Maximum Allowable Deflection: As stated in AWWA C600.
2) If the alignment requires deflection in excess of the above limitations, furnish special blends or a sufficient number of shorter pipe lengths to provide angular deflections within the limit set forth.
c. Pipe Anchorage:
1) Provide concrete thrust blocks (reaction backing), for pipe anchorage except where metal harness is indicated.
2) Thrust blocks to comply with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks to be as indicated.
3) Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
4) Provide metal harness in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as indicated in NFPA 13, except as otherwise indicated.
d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

C. Valves:
1. Set valves on solid bearing.
2. Center and plumb valve box over valve.
3. Set box cover flush with finished grade.

## 3.04 SERVICE CONNECTIONS

A. Provide fire water service to Local Authority Having Jurisdiction requirements with reduced pressure backflow preventer and water meter with by-pass valves and sand strainer.

B. Provide sleeve in retaining wall for service main. Support with reinforced concrete bridge. Caulk enlarged sleeve watertight.

C. Anchor fire service main to interior surface of foundation wall.

D. Provide 18 gauge, 0.0478 inch galvanized sheet metal sleeve surrounding service main to 6 inches above floor and 6 feet minimum below grade. Size for 2 inches minimum of glass fiber insulation stuffing.

## 3.05 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Coordinate with fire alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

**3.06 CLEANING**

A. Upon completion of the installation of water lines and appurtenances, remove and haul away all surplus material, including debris resulting from the work.

**3.07 CLOSEOUT ACTIVITIES**

A. See Section {3326} - {3326} for additional requirements.

B. Demonstrate proper operation of equipment to Owner's designated representative.

C. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Conduct walking tour of project.
3. Briefly describe function, operation, and maintenance of each component.

D. Training: Train Owner's personnel on operation and maintenance of system.

**END OF SECTION**

This page intentionally left blank

# SECTION 21 1200
# FIRE-SUPPRESSION STANDPIPES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Fire hose cabinets.

B. Valves.

C. Fire department connections.

### 1.02 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.

B. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2019.

C. NFPA 1963 - Standard for Fire Hose Connections; 2019.

D. UL 405 - Fire Department Connection Devices; Current Edition; Including All Revisions.

### 1.03 ADMINISTRATIVE REQUIREMENTS

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

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.

C. Shop Drawings: Indicate supports, components, accessories, and sizes.
   1. Submit shop drawings and product data to Owner's insurance underwriter for approval.
   2. Submit proof of approval to Architect or Engineer/Engineer.

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

E. Operation Data: Include appropriate manufacturer's data.

F. Maintenance Data: Include servicing requirements and test schedule.

G. Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

### 1.05 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 14. Maintain one copy on site.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

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

### 1.07 WARRANTY

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

## PART 2 PRODUCTS

### 2.01 FIRE HOSE CABINETS

A. Cabinet:
   1. Style: Recessed mounted.
   2. Tub: 16 gauge, 0.0598 inch thick steel, prepared for pipe and accessory rough-in.

3. Door: 12 gauge, 0.1046 inch thick steel, flush, glazed with 1/4 inch (6.35 mm) thick wired glass full panel; hinged, positive latch device.
4. Finish: Prime coated.

B. Hose Rack: Steel with polished chrome finish; swivel type with pins and water stop.

C. Hose: 1-1/2 inch diameter, 100 feet long, of polyurethane lined synthetic hose; mildew and rot-resistant.

D. Nozzle: Chrome plated plastic; combination fog, straight stream, and adjustable shut-off.

**2.02 VALVES**

A. Hose Connection Valve Cabinets:
1. Style: Recessed, Semi-recessed, or surface mounted.
2. Tub: 16 gauge, 0.0598 inch thick steel, prepared for pipe and accessory rough-in.
3. Door: 12 gage, 0.1046 inch thick steel, hinged, positive latch device.
4. Finish: Enameled, color red.

**2.03 FIRE DEPARTMENT CONNECTIONS**

A. Type: Flush, wall mount made of corrosion resistant metal complying with UL 405.
1. Inlets: Two-way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
2. Configuration: Horizontal.
3. Signage: Raised or engraved lettering 1 inch minimum indicating system type.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 14.

C. Locate and secure cabinets plumb and level.

D. Locate hose station valve in cabinet at 60 inches above finished floor.

E. Connect standpipe system to water source ahead of domestic water connection.

F. Where static pressure exceeds 100 psi but is less than 100 psi at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.

G. Where static pressure exceeds 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 90 psi.

H. Flush entire system of foreign matter.

**3.02 FIELD QUALITY CONTROL**

A. Division 1 - Field inspection, testing, and adjusting.

B. Test entire system in accordance with NFPA 14.

C. Test shall be witnessed by Fire Marshal.

**END OF SECTION**

# SECTION 21 1300
# FIRE-SUPPRESSION SPRINKLER SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

C. Fire department connections.

### 1.02 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.

B. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 1963 - Standard for Fire Hose Connections; 2019.

D. UL (DIR) - Online Certifications Directory; Current Edition.

E. UL 405 - Fire Department Connection Devices; Current Edition; Including All Revisions.

### 1.03 ADMINISTRATIVE REQUIREMENTS

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

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:
   1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
   2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
   3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect or Engineer/Engineer.

D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

E. Designer's qualification statement.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
   2. Sprinkler Wrenches: For each sprinkler type.

J. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

### 1.05 QUALITY ASSURANCE

A. Comply with FM (AG) requirements.

B. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience and approved by manufacturer.

E. Equipment and Components: Provide products that bear FM (AG) label or marking.

F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:
   1. Tyco Fire Protection Products; _____: www.tyco-fire.com/#sle.
   2. Viking Corporation; _____: www.vikinggroupinc.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.

B. Occupancy: Light hazard; comply with NFPA 13.

C. Water Supply: Determine volume and pressure from water flow test data.

D. Interface system with building control system.

E. Provide fire department connections where indicated.

F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

### 2.03 SPRINKLERS

A. Suspended Ceiling Type: Semi-recessed or Recessed, pendant type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Chrome plated.
   4. Escutcheon Plate Finish: Chrome plated.
   5. Fusible Link: Fusible solder link type or Glass bulb type, temperature rated for specific area hazard.

B. Exposed Area Type: Upright type with guard.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Fusible Link: Fusible solder link type or glass bulb type, temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed or Recessed, horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Chrome plated.
   4. Escutcheon Plate Finish: Chrome plated.
   5. Fusible Link: Fusible solder link type or Glass bulb type, temperature rated for specific area hazard.

D. Guards: Finish to match sprinkler finish.

**2.04 PIPING SPECIALTIES**

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
   1. Activate electric alarm.
   2. Test and drain valve.
   3. Replaceable internal components without removing valve from installed position.

B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

C. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

E. Fire Department Connections:
   1. Type: Flush, wall mount made of corrosion resistant metal complying with UL 405.
      a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
      b. Configuration: Horizontal.
      c. Rated Working Pressure: 175 psi.
      d. Sleeve: Brass, 18 inches height.
      e. Signage: Raised or engraved lettering 1 inch minimum indicating system type.

F. Supervisory Switches: As required.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Install buried shut-off valves in valve box. Provide post indicator.

D. Provide approved double check valve assembly at sprinkler system water source connection.

E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

F. Locate outside alarm gong on building wall as indicated.

G. Place pipe runs to minimize obstruction to other work.

H. Place piping in concealed spaces above finished ceilings.

I. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.

J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

K. Flush entire piping system of foreign matter.

L. Install guards on sprinklers where indicated.

M. Hydrostatically test entire system.

N. Require test be witnessed by Authority Having Jurisdiction.

**3.02 INTERFACE WITH OTHER PRODUCTS**

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

**END OF SECTION**

# SECTION 22 0500
# BASIC PLUMBING REQUIREMENTS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to other Mechanical Sections, in addition to Division 01 - General Requirements.

B. If conflicts occur between Basic Mechanical Requirements and Division 01, the provisions of Division 01 shall normally dictate; however, the more stringent of the two shall be followed and the Contractor shall indicate the differences in written form and submit to the Engineer for clarification.

### 1.02 REGULATORY REQUIREMENTS

A. Obtain and pay for permits and inspection fees for work included in this phase of the Contract. Comply in every respect with requirements of local inspection departments, National Fire Protection Association, and Local and State Ordinances and Codes. However, this requirement does not relieve the Contractor of the responsibility of complying with these specifications and drawings where specific conditions are of a higher quality and quantity than the requirements for complying with the most stringent of the codes, rules, ordinances or the specifications. Reference to standards is intended to be the latest revision of the standard.

B. The applicable portions of the following listed codes and standards are hereby made a part of this specification, except where requirements are exceeded in these specifications and drawings.
   1. National Fire Protection Association (NFPA).
   2. Codes and Ordinances of the Local Authority Having Jurisdiction (AHJ).
   3. International Mechanical Code, with City Amendments, if applicable.
   4. International Plumbing Code, with City Amendments, if applicable.
   5. International Fuel Gas Code, with City Amendments, if applicable.
   6. International Building Code, with City Amendments, if applicable.

### 1.03 APPLICABLE STANDARDS

A. The following organizations are hereinafter referenced as those whose standards are the basis for the designs, and manufactured items purchased shall conform to these standards where applicable.
   1. ANSI - American National Standards Institute.
   2. AGA - American Gas Association.
   3. ASME - American Society of Mechanical Engineers.
   4. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
   5. ASTM - American Society for Testing Materials.
   6. ARI - Air Conditioning and Refrigeration Institute.
   7. ADA - Americans with Disabilities Act.
   8. AMCA - Air Moving and Conditioning Association.
   9. NEBB - National Environmental Balancing Bureau
   10. AABC - Associated Air Balance Council
   11. UL - Underwriters' Laboratories, inc.
   12. AWWA - American Water Works Association.

B. The following construction standards are required for the installations of this project:
   1. SMACNA - Sheet Metal and Air Contractors National Association.
   2. Fire Damper and Heat Stop Guide for Air Handling Systems.
   3. HVAC Duct Contruction Standards.

4. HVAC Air Duct Leakage Test Manual.
5. High Pressure Duct Construction Standards.
6. Ducted Electric Heat Guide for Air Handling Systems.
7. Flexible Duct Performance & Installation Standards.
8. OSHA - Department of Labor: Occupational Safety and Health Standards, Latest Revisions.

**1.04 DRAWINGS AND SPECIFICATIONS**

A. Drawings and specifications shall be considered complementary to each other and work referenced in one and not included in the other shall be furnished complete as though included in both. In case of conflicts between the drawings and specifications, the specifications shall take precedence.

B. If floor plans, detail drawings, schedules, or specifications are not sufficiently detailed or explained, or if there are any discrepancies between architectural floor plans, specifications, schedules, or detail drawings, the Contractor shall notify the Engineer of same in writing, prior to bid opening. The Engineer will then inform the Contractor, in writing, which document takes precedence and/or furnish such information, drawings, etc., as required; after which the Contractor shall comply with same as part of this contract.

C. If the Contractor deems it necessary to make departures from the drawings, details of such departures and reasons for same shall be submitted for acceptance. No departures shall be made without prior written acceptance by the Engineer.

D. The Contractor shall be responsible for properly using the information on the Architectural, Structural, Civil, Mechanical and Electrical Drawings. All dimensional information shall be obtained from the appropriate drawings for new construction, and by taking actual measurements at the site for work to existing facilities. In no case shall drawings be scaled for dimensions. Should there be a discrepancy in figures, drawings, and/or specifications, the Engineer shall be notified immediately and shall determine the necessary adjustments.

E. Contractors shall visit the site, verify all existing items indicated on plans and/or in specifications and familiarize themselves with existing conditions and local requirements. The Contractor shall accept conditions as they exist and each proposal shall reflect all costs occasioned by these conditions. The lack of specific information on drawings shall not relieve the Contractor of this responsibility, nor be reason for any extra charges. The submission of bids shall be considered an acknowledgment on the part of the bidder of his site visitation.

F. Unless otherwise expressly agreed to in writing, all rights to the specifications and drawings prepared by CEC Corporation shall belong to CEC Corporation. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been met, including the payment of fees. Each page of the drawings, if prepared in whole or in part by CEC Corporation, and all pages of Mechanical, Plumbing and Fire Protection Sections of the Specifications are covered by copyright and may not be reproduced, published or used in any way without the permission of CEC Corporation.

G. References made herein to materials, equipment, piping, or methods and procedures such as sterilization or cleaning, shall refer to the new items which are a part of this Contract, and shall not pertain to existing systems or material, etc., which are not being changed or rerouted under this Contract.

**1.05 ADEQUACY OF WORK**

A. Drawings are diagrammatic and cannot show every connection in detail or every line of piping in its exact location. Details are subject to the requirements of ordinances and also structural and architectural conditions. Carefully investigate structural and finish conditions affecting the

work, and arrange the work accordingly; furnish all such fittings and accessories as may be required to meet the conditions to give satisfactory operation.

B. By submitting a bid on this work, the Contractor sets forth that his personnel has the necessary technical training and ability and that they will install this work in a satisfactory and workmanlike manner, up to the best standard of the trade, complete and in good working order.

C. Should any discrepancy or apparent difference occur between Drawings and Specifications, or should an error occur in the work of others affecting the mechanical-electrical work, the Contractor shall notify the Engineer at once. If the Contractor proceeds with the work affected without instructions from the Engineer, he shall make good any resultant damage or defect. All misunderstandings of the Drawings and Specifications shall be clarified by the Engineer.

**1.06 WORKMANSHIP AND MATERIALS**

A. Workmanship shall be the best quality and performed by mechanics skilled in their trades. The Contractor shall furnish the services of an experienced superintendent who will be constantly in charge of the erection of the work until completed and accepted. Included in the work shall be proper unloading, installing, connecting, adjusting, starting, and testing of work involved, including equipment and materials furnished by others and the Owner.

B. Unless otherwise hereinafter specified, all materials and equipment under this Division of the Specifications shall be new, of best grade, and as listed in the printed catalogs of the manufacturer. Each article of its kind shall be the standard product of a single manufacturer.

C. Whenever the words “or equal”, “or equal approved”, “equivalent equipment”, “acceptable”, or other words of similar intent or meaning are used, implying that judgment is to be exercised, it is understood that it refers to the judgment of the Engineer.

D. The Engineer shall have the right to accept or reject material, equipment and/or workmanship, and determine when the Contractor has complied with the requirements herein specified.

E. The Contractor shall coordinate with all trades in determining that various phases of work will not interfere with the final efficient operation or use of materials or equipment installed under this Contract. Interference shall be called to the attention of the Engineer before installation is made. The Engineer shall then instruct the Contractor to make such changes and corrections as deemed necessary.

**1.07 EQUIPMENT: GENERAL**

A. Manufacturers’ published instructions shall be followed in making all installations, erecting, cleaning, and operating of all materials and equipment. Rotating equipment shall be statically and dynamically balanced for minimum vibration and low operating noise level.

B. Equipment capacities shall not be less than specified or scheduled.

C. All equipment and major components thereof shall be equipped with a permanently attached nameplate bearing manufacturer’s name, address, catalog number and serial number. For equipment installed where exposed to the weather, the nameplate shall be corrosion-resistant metal with information engraved or stamped.

D. All moving parts, belts, pulleys, and other rotating parts shall be provided with suitable guards or enclosures in accordance with Federal, State, and local regulations.

E. All equipment to be installed shall be the standard catalog products of the manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall be products which have been in satisfactory use at least three years, unless otherwise accepted by the Engineer.

F. The installation of any materials and equipment not meeting the specified standards shall be removed and all new materials or equipment meeting the approval of the Engineer shall then be installed at no cost to the Owner.

G. Design is based on equipment as described in these specifications and equipment schedules. Any change in foundation bases, electrical wiring, conduit, circuit breakers, disconnects, connections, piping, controls, and openings that are required by alternate equipment submitted and accepted shall be the responsibility of the Contractor.

H. The Contractor shall be responsible for placing equipment or apparatus too large to pass through doors or stair wells, etc. within the building prior to completion of the enclosing structures. Properly protect the equipment from damage from normal construction processes and/or the elements after installation within the structure.

**1.08 DELIVERY, STORAGE AND HANDLING**

A. Materials and equipment shall not be stored at the site until ready for installation or until there is suitable space provided to properly protect equipment from the elements. Equipment shall be delivered and stored in original containers and shall be continuously protected from damage. Any damaged materials or equipment shall be replaced with new equipment or repaired to the satisfaction of the Engineer. Repainting of equipment will be required where damaged in shipment or by improper protection at the site. Rotating equipment stored on the site shall be turned through two full rotations a minimum of once a month.

**1.09 SUBSTITUTION OF MATERIALS, FIXTURES & EQUIPMENT**

A. Where equipment is specified by a manufacturer's name and catalog number only, or where a specified manufacturer or manufacturers are named as being acceptable, provided all design and space requirements are met, and subject to acceptance by the Engineer, no substitution or other equipment will be allowed.

B. Where materials, fixtures, or equipment are specified by manufacturer's name and catalog number, and the words "or equal approved" or similar working is used, such specification shall be deemed to establish style, type, and quality of the equipment required and may include certain desirable technical features. The Contractor may offer, for acceptance, any material, item, or equipment or process which he believes is equal to or better in every respect to that indicated or specified as a substitution, provided it also meets space and capacity requirements.

C. Any alternate proposal for substitute equipment, or use of equipment not specified by catalog number, shall include all necessary changes and additions to other work occasioned by this substitute equipment. Additionally, each alternate proposal shall stipulate that the substitute product will fit the space allotted to the specified items and will provide equal or greater clearances for services, maintenance and/or removal. The Contractor shall be allowed only one substitution proposal; if the substitute items are not acceptable to the Engineer, the specified items or products shall be installed without change in cost.

D. Acceptance of a proposed substitution shall not be held to have relieved the Contractor of responsibility for the proper execution of the work, nor from guarantee and maintenance requirements imposed by the Contract Documents. Where no substitutions are proposed or accepted in conformity with the provisions of this article, then no deviation from the material or equipment specified will be allowed.

E. Unless specifically requested hereinafter, prior approval of substitute items will not be considered by the Engineer during the bidding phase.

**1.10 SUBMITTAL DATA AND SHOP DRAWINGS**

A. GENERAL: Three copies each of brochures, shop drawings, and material lists as required by the specifications, shall be prepared and submitted to the Engineer for review within thirty days after award of the Contract. No work indicated on any one shop drawing shall be started until such drawings have been reviewed and accepted by the Engineer.

B. Space is critical; therefore, equipment of larger sizes than shown, even though of an acceptable manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

C. Where equipment manufacturers named as equivalent or accepted as equal are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected. Contractor shall submit, for acceptance, 1/4 inch scale shop drawings for equipment rooms, plan and section, roof plan, etc.

**1.11 PRODUCT DATA**

A. Contractors shall submit complete brochures of all equipment to be installed.

B. Contractors shall submit a list of all material as specified not covered by brochures or shop drawings.

C. Submittal brochures shall be indexed by specification section with table of contents, bound in a three ring binder, and identical. Data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification sections and paragraphs. No consideration will be given to partial submittals. No submittal shall be accepted directly from supply house or manufacturer's representatives nor will substitutions be discussed with anyone other than the successful Contractor after the contract is awarded.

D. All materials and equipment shall be submitted by manufacturer, trade name, and model number. The submittal shall include data requested in the individual sections. The Contractor shall not assume that applicable catalogs are available to the Architect's or Engineer's office. Maintenance and operating manuals and coded order forms are not suitable submittal material. Each sheet of printed material shall be clearly marked (using arrows, underlining, or circling) to show the particular sizes, types, model numbers, ratings, capacities, and options actually being proposed. Non-applicable material shall be crossed out. All specified features must be specifically noted on the submittal.

E. Where the item is a substitution, the submittal must be complete with adequate proof of its quality equal to the item specified. Substitutions made because of installation problems, non-availability, later delivery, etc., shall be explained in the transmittal letter accompanying the submittal. Substitute items shall be accepted only under the following conditions: "Should the material or equipment fail or perform unsatisfactorily during the warranty period, this material and/or equipment shall be replaced with material or equipment specified by name in these specifications, at no additional cost to the Owner. Contractor shall PERSONALLY bring a sample of the substitute item to the Engineer office for his inspection at time submittals are made if Engineer requests same."

F. When items are omitted from the submittal or if submittal is not received by the Engineer within thirty days of Contract date, it shall be construed to mean that only items specified by name and number shall be installed and no substitutions shall be accepted.

G. In the event that submitted materials, appliances, etc., are not, in the opinion of the Engineer, in conformity with the specifications, the Engineer reserves the right to reject this equipment.

H. If items other than those specified or approved as submitted are found installed on the project, they shall be removed and the specified items shall be installed at no cost to the Owner.

I. Submittals shall be reviewed by the Engineer for conformance with design concept only. Review will not include deviations from detail requirements unless these deviations are specifically listed by the Contractor in writing and attached to the data. The Contractor's responsibility includes, but is not limited to, obtaining and aptly applying all field measurements; construction criteria including all means and methods, materials, catalog numbers, and similar data for checking and coordinating with the requirements of the work. Quantities of materials and equipment will not be checked by the Engineer.

## 1.12 SHOP DRAWINGS

A. Contract drawings are diagrammatic design drawings and are not intended as installation drawings. Each Contractor shall, within thirty days after award of contract, and prior to beginning any installations, prepare NEW AND ORIGINAL detailed shop drawings for the following:
   1. Ductwork
   2. Control Wiring Diagrams
   3. Interlock Wiring Diagrams
   4. Kitchen Plumbing Rough-Ins,
   5. and other critical spaces as directed by the Engineer, showing the exact location and dimensions, spacing and location of each piece of equipment and piping. Reproduction of Engineer's design drawings shall not be considered as shop drawings.

B. The Contractor shall coordinate to ascertain that there are no conflicts. The Contractor is responsible for rearrangement and revision required to dimensions, connection sizes, special installment requirements, horsepower, voltage, and phase of all equipment.

C. Each trade, in cooperation with all other trades, shall determine, prior to commencing work, the sequence of the installation of all trades.

D. In no case will wire to wire or terminal type of wiring diagrams for control system be included or checked as submittal; they shall be included as information only. Temperature control function diagram and written description only shall be accepted by the Engineer.

E. The Contractor's responsibility includes, but is not limited to, obtaining and aptly applying all field measurements, construction criteria including means and methods, and materials and necessary coordination data for making all installations complete and operating to the full intent of the Contract Drawings and Specifications.

F. Shop drawings shall be submitted to and approved by the Engineer prior to beginning of any installations. The Engineer will assist in resolving installation problems and conflicts only when furnished with complete shop drawings prepared by the Contractor for all phases of the work and only when the Contractor cannot solve a problem. When installations are made without submitting shop drawings, the Contractor is responsible for immediate correction at his own cost for conflicts and to installations contrary to the intent of design drawings.

## 1.13 CONSTRUCTION RECORD DRAWINGS

A. Each Contractor shall purchase or obtain from the Architect/Engineer one complete set of final design documents of the Contract Drawings and shall record on these drawings all locations, dimensions, and depths of all buried and concealed piping and conduits, plugged outlets, and equipment. The master copy shall be maintained at the job site at all times and shall be marked daily as construction progresses. These drawings shall not be used for reference or construction but shall be available for the Engineer's review. No backfilling of trenches will be permitted until Record Drawings are approved as up-to-date.

B. Depth of sewers and other underground piping prints shall be from a permanent bench mark which shall be shown on drawings.

C. At completion of the work, the data on these prints shall be given to the Engineer of record and transferred electronically to CAD drawing format. The electronic files shall then be copied to a CD for reproducible prints by the Contractor or building Owner, dated, marked "Record Drawings".

## 1.14 MANUFACTURER'S INSPECTION

A. At the completion of work and before acceptance, an authorized representative of the manufacturers of mechanical and electrical equipment shall personally inspect the installation and operation of his equipment to determine that it is properly installed and in good operating

order. If equipment is to be concealed, the representative shall make his checks during the course of installation. The Contractor shall submit to the Engineer a statement signed by each manufacturer's accordance with the manufacturer's recommendations and is operating properly.

B. Inspection shall include new air conditioning equipment, special systems, and such items as are specifically designated by the Engineer.

**1.15 TESTING LABORATORY CERTIFICATION**

A. All equipment and materials where applicable shall be listed by Underwriters' Laboratories and shall bear the Underwriters' Laboratories label.

B. All material, equipment, products furnished and installed on this project shall bear the label, symbol and other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled and/or listed equipment or material and whose listing of labeling states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner, when such label, symbol, or listing is available.

**1.16 FIRE AND SMOKE DEVELOPMENT RATINGS OF MATERIALS**

A. All materials and products installed on this project shall have published fire and smoke developed ratings that conform with U.L. classifications and NFPA 90A and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less and a fuel contribution rating of 50 or less.

**1.17 ASBESTOS**

A. No product which contains asbestos shall be incorporated into any component of this Project.

B. If asbestos is encountered in any existing installations, Contractor shall stop work immediately and notify the Owner. No work shall be commenced in the area containing asbestos until complete removal or abatement has been accomplished by Owner.

**1.18 EXISTING UTILITY PIPING**

A. The drawings indicate all known utility and drainage piping existing on the site of the work. Location of said piping is in accordance with information furnished to the Engineer by the Owner. Responsibility for locating, uncovering, disposing, or maintaining all existing utility piping shall rest solely with the Contractor, who shall plan and conduct his operations in such a manner to insure safe conditions for the entire construction period.

B. Existing underground piping shall be maintained in service unless otherwise noted. Contractor shall promptly repair all utility piping to be maintained in service, at no expense to the Owner, in the event that they are damaged as a result of his work of this project. All valve boxes, manholes, or other appurtenances of utilities which are to remain in service shall be raised or lowered to meet new finished grades as indicated on appropriate drawings.

C. Make arrangements for connections to utilities required for the work as shown on drawings and pay all charges and fees in connection with any service connections, making installations complete in all aspects.

D. Each Contractor shall furnish and install all materials, equipment, and labor required for finished, complete, and operating service connections. Contractors shall be responsible for making personal contact with proper officials of utility companies prior to bid opening and obtaining all details of service requirements and for including ALL costs for ALL requirements for complete services.

E. Any detail requirements for utility metering and/or connections is specified hereinafter in the appropriate section.

F. Existing utility piping which is to be abandoned shall be completely removed where it occurs in the area of excavation. Abandoned piping shall be plugged or capped in a manner acceptable to the Engineer. Existing manholes shown to be abandoned shall be filled with sand.

G. Any minor adjustment in location or alignment of new work to avoid or to connect to existing utilities shall be performed as directed by the Engineer without additional cost to the Owner.

**1.19 INTERRUPTION OF SERVICES**

A. While work is in progress, except for designated short intervals when connections are to be made, continuity of service shall be maintained to all existing systems. Time and duration of interruptions shall be coordinated with the Owner. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing system caused by his operations.

B. Existing air conditioning, plumbing, and special systems serve vital operations. These vital operations include providing for the general health and welfare of the building. To satisfy these requirements, all interruptions of service must be held to an outage time of four hours, unless otherwise approved by the Owner.

C. Coordination of such outages shall result from a written request to the Superintendent of Construction who will indicate the permissible times for outages. Request shall be submitted at least 72 hours prior to outage time requested.

**1.20 EXCAVATION AND BACKFILL**

A. Provide all excavation and backfill required for work of this section, in accordance with applicable requirements of Division 31 - Earthwork Section. Coordinate disposition of building materials to avoid interference with all other work.

B. Provide barricade protection and shoring as required for safety.

C. Do not backfill until after testing and inspection of installed pipe work.

D. All plants, turf, and surfacing that occur in the areas of the excavation shall be carefully removed and placed where they will not be damaged. After the excavations are filled, the plants, turf, and surfacing shall be replaced as directed. All sidewalks, driveways, or other cement or asphalt surfaces which are damaged during excavating shall be repaired to match the adjacent work in material and finish and in accordance with requirements established by authorities having jurisdiction over subject walks, lawns, or streets.

E. Provide clearance (12 inches minimum) under suspended piping and ductwork under the building. The Contractor shall be responsible for necessary excavation to obtain such clearance and if such clearance is not found to exist at the completion of the project, the Contractor shall excavate as required to meet this specification.

F. Piping trenches not under the building shall be parallel to building lines unless otherwise noted on drawings.

G. Trenches shall be cut a minimum of six inches (6") below required depth to allow for bedding material. The bottoms of sewer trenches shall be accurately graded to best secure all available fall. Sewer and water pipes shall be laid in separate trenches. All piping shall have a minimum cover of 24 inches unless otherwise noted or accepted. Trenches shall be a minimum of SIX inches (6") wide and not less than FOUR inches (4") wider than outside diameter of a single pipe or conduit being installed. When more than one pipe is installed in a trench, the trench shall be widened appropriately to allow the pipe to be laid side-by-side with a minimum of FOUR inches (4") of sand between each pipe. In no case shall different services be installed one above the other. Piping and/or conduit of various trades shall NOT be installed in same trench unless permission in granted by the Engineer. Where required by depth and/or type of soil, trenches shall be properly and adequately shored to prevent cave-ins and slides.

H. Properly backfill, flood, and tamp all excavations to the finished grade AFTER the piping has been observed and accepted. The backfill for all pipe may be excavation material, except that at least six inches (6") of clean pit run sand shall be placed over the pipe and six inches (6") of sand below the pipe. A minimum of 12 inches of sand is required for all piping including sewer. Backfill shall be placed in six inch (6") layers, wetted and compacted to the density of adjacent soil. Continue this process until trenches are completely backfilled. Surplus materials shall be hauled from the project. Where trench backfill settles below finished grade during the one year guarantee period, the Contractor shall take necessary steps to correct same as accepted by the Engineer.

I. Trenches backfilled prior to observation of piping or conduit by the AHJ shall be reopened as directed by the AHJ.

**1.21 OPENINGS: CUTTING, REPAIRING**

A. Holes in Concrete: Sleeves shall be furnished, accurately located, and installed in forms before pouring of concrete. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the acceptance of the Structural Engineer prior to cutting or drilling. No cutting or boring of structural members shall be done without WRITTEN permission of the Structural Engineer.

B. Verify that all chases and openings are properly located.

C. Damage to existing facilities shall be repaired as required to restore these facilities to their original condition. All openings through floor, ceilings, walls, etc., shall be sealed rat and insect-proof, whether exposed to view or within walls, with a fire resistant sealant.

**1.22 CONCRETE WORK**

A. Provide concrete equipment bases for pumps, air handling units, chillers, boilers, etc. Provide anchors, thrust blocks, and all piping supports in trenches.

B. Furnish all required templates for anchor bolts and dimension drawings for housekeeping pads. All concrete shall be in accordance with that specified under Division 03 - Concrete of the Specifications.

**1.23 MANNER OF RUNNING PIPE AND CONDUIT**

A. All pipe and ducts (except gas), shall be concealed in chases, walls, furred spaces, or above the ceilings unless otherwise noted.

B. In mechanical/electrical rooms, janitor’s closets, or other storage spaces, where necessary, piping may be run exposed. Exposed piping shall be run in the neatest, most inconspicuous manner and parallel to building lines. Piping shall be run high as possible when exposed in rooms.

C. No piping or duct shall be installed in structural concrete slabs, beams, walls, or concrete structure without prior approval unless specifically noted on the drawings.

**1.24 EQUIPMENT AND CONNECTIONS**

A. All apparatus, equipment, devices, and appliances which are indicated to have pipe connections shall be so equipped. Each such mechanical connection shall be valved and/or trapped.

**1.25 MOTORS AND CONTROLS**

A. Unless noted to the contrary, motors of one horsepower and larger shall be three phase with voltage compatible with the building electrical system. Motor sizes shown on drawings are minimum acceptable sizes.

B. Motors less than one horsepower shall be 115 volts or 200/230 volts, single phase, with built-in thermal protection and shall be furnished with manual or magnetic starters as required, unless otherwise noted on drawings.

C. The Contractor shall furnish a suitable motor starter with the necessary number of auxiliary contacts required for the use with the proper type of switch controls in the cover. Motor starters shall be equal to Furnas, Siemens, General Electric, Cutler-Hammer, or Square D, with three leg overload protection; except special requirements for motor starters shall be specified under the particular piece of equipment requiring starter. Mounting of motor starters and wiring shall be installed under Electrical Division.

**1.26 ELECTRICAL WIRING OF TEMPERATURE CONTROL EQUIPMENT**

A. The Contractor shall be responsible for complete installation of all the automatic temperature control wiring. All power wiring, interlock wiring as required, starter connections, and disconnect switches shall be installed under Electrical Division. Control wiring shall be a minimum of No. 18 AWG and shall be copper with THW or THWN-THHN insulation. Control wiring shall be installed in EMT conduit when above grade, PVC when below. See applicable section for conduit specifications.

B. Contractor shall provide necessary wiring diagrams showing power wiring, interlock wiring, and temperature control wiring which shall be used for making the control wiring and interlock wiring installations.

C. At the completion of all construction work, there shall be a meeting at the job site of all parties involved, who shall inspect, test, and check each control circuit, interlock circuit, and power circuit for all equipment and shall determine by mutual agreement that all equipment is properly wired for the operations intended. A letter to this effect, signed by all three parties, shall be furnished to the Engineer at the time of final inspection. This letter shall read as follows:

1. “We, the undersigned authorized representatives of the Contractor, hereby certify that we have met together at the site and have by test and check found that entire temperature control system and interlock wiring systems are properly installed and wired and all items are functioning in accordance with design requirements and Contract Drawings and Specifications.”

**1.27 CLEAN-UP**

A. All unused material and debris resulting from the performance of work shall be removed from the premises as it accumulates.

**1.28 HOISTING, SCAFFOLDING, AND TRANSPORTATION**

A. Furnish hoisting facilities to set materials and equipment in place and provide scaffolding, ladders, and facilities for equipment installations and for adjustment and balancing, installation of grilles, and cleaning of fixtures and devices. Provide transportation to deliver materials, equipment, tools and labor to perform the work.

**1.29 SLEEVES FOR ALL PIPES AND CONDUITS**

A. For pipes through outside walls above grade, install Schedule 40 GALVANIZED steel pipe sleeves having an inside diameter of 1-1/2 inches greater than the outside diameter of piping being installed. Sleeves shall be flush with each wall surface.

B. Where pipes pass through floors not on fill, 22 gage GALVANIZED sheet metal sleeves shall be used. In concrete floors they shall extend one inch above the floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least one inch (1") greater than outside diameter of insulation. Sleeves shall be set before concrete is poured.

C. Sleeves in footings, grade beams, under sidewalks, drives, and elsewhere noted on drawings shall be Schedule 40 PVC plastic pipe with chemical weld joints. Use long sweep ells where pipe turns are made.

D. Where pipe passes through a concrete wall, beam, or floor below grade or below ground water level, a through-wall or floor seal shall be installed. Sealing fitting shall be installed in concrete forms before concrete is poured. Fitting shall be O.Z. Gedney Type FSK where sealing is

required on one side of wall only and Type WSK where sealing on both sides of wall is required. Installation shall be in accordance with manufacturers' instructions.

E. The annular space around piping and sleeves shall be filled with a fire resistant sealant as specified hereinafter. Both sides of wall, floor, ceiling, or roof shall be sealed to the satisfaction of the Engineer whether exposed to view or within walls. ALL openings around pipe shall be insect, vermin, and rodent proof.

**1.30 ROOF PENETRATIONS AND FLASHINGS**

A. Refer to Specification Division 07 - Thermal and Moisture Protection.

**1.31 SEALING OF PENETRATIONS (FIRE STOPPING)**

A. Seal all small openings in floors, walls, ceilings, etc. around pipe, etc. with Dow Corning Fire Stop Sealant System, 3M Fire Barrier 2000+ Silicone Sealant Systems, or approved equal, in conformance with U.L. testing procedures.

B. Seal all openings larger than 1/4" around pipe, duct, etc., through roof, walls and floors above grade with a two-part foam, or one-part sealant material approved by the Engineer, at least 1-1/2" thick, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 deg. F. for two hours. Fire and smoke barrier will be required in all floors above grade of multi-story buildings and in all walls of fireproof construction. All empty holes and all large openings around pipe, etc., shall also be filled with two-part fire stopping materials. One-part may be used for single penetrations at plumbing fixtures, sleeves, and fire rated expansion joints.

C. The firestopping system shall be materials that expand to fill cavities or provide adhesion to substrates, and that will maintain seal under normal expected movement of substrates. MATERIAL SHALL NOT REQUIRE A RISE IN TEMPERATURE TO INSTALL OR ACTUATE THE SEAL. Fire Stop Systems shall utilize materials that are UL Classified as "Fill, Void, or Cavity Materials" and "Through Penetration Firestop Systems." Materials shall have been tested in accordance with ASTM E814 "Methods for Fires Tests of Through-Penetration Firestops" and UL 1479 "Fire Tests of Through-Penetration Firestops."

D. Mineral fiber board, mineral fiber matting and mineral fiber putty may be used as forming and damming for the foam and may be left in place as an integral part of the seal if of a fire rated material. Plywood, particle board, or other combustible foaming and damming materials shall be removed after foaming is completed.

E. Foam exposed in finished areas shall be neatly trimmed flush with the finish surface. In traffic areas, foam sealed areas shall be covered with a traffic surface approved by the Architect.

F. Application of foam in penetrations shall be made in accordance with the manufacturer's recommended procedure. Upon completion of the installation, the openings around all penetrations shall be airtight to prevent passage of water, smoke, fire or vermin. Proper installation shall be verified by proper color change and cell structure of cured foam.

G. Damming materials shall be removed after foam has cured for 24 hours if of other than fire sensitive materials. Seal all voids that have developed in foam with Dow Corning RTV sealant as required to provide full coverage.

H. Inspect penetration seals after 24 hours and inject additional foam where required for a tight seal. Reinspect after added foam has cured 24 hours. Cut and trim cured foam with sharp knife as required for finished appearance.

I. Nelson Flameseal Putty, Flamemaster (Flamastic 77), and Thomas & Betts Flamesafe Fire Stop System may be acceptable products for sealing of penetrations provided they are installed according to manufacturer's recommendations and are approved by the Engineer prior to installation.

**1.32 FLOOR AND CEILING PLATES**

A. Furnish and install chromium plated escutcheon plates around pipes passing exposed through walls, floors, or ceilings. Plates shall be sized to fit outside of pipe or sleeves and/or insulation and shall fit snugly. Plates shall fit around sleeves where they extend through the floor. Solid chromium plated plates with set screws shall be installed on any piping where split ring or compression type plates will not stay in position.

B. Where ducts pass through walls, floors, or ceilings, install sheet metal collars to cover the void around the duct where fire barrier is not required.

C. Escutcheons of galvanized steel shall be installed on all steel or aluminum flue vent pipes.

**1.33 TESTS AND ADJUSTMENTS**

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer, who shall be notified a minimum of 48 hours in advance. All work shall be completely installed, tested as required by this section and the City and State Ordinances, and shall be repeated upon request to the satisfaction of the Engineer's representative.

B. All domestic water piping shall be flushed out, tested at 150 psi and shall be left under pressure of the supply main or a minimum of 40 PSI for the balance of the construction period.

C. Piping tests shall be made with the medium and under pressures listed below:

**1.34 TEST**

A.

| TYPE OF SYSTEM | GAGE PRESSSURE (Lb/sq.in. or vaccum in inches) | TEST MEDIUM |
|---|---|---|
| Soil, Waste, and Vent piping with Bldg.ncluding Rain Water leaders and Storm Drains | Minimum of 10 feet head inexcess of ultimate pressure for 4 hrs. min, with no loss in head. | Water |
| Domestic Hot and Cold Water | 150 PSI: 24 hours | Water |
| Gas: Low Pressure (Less than12" HG) | 15" HG: 2 hours | Air |
| Gas: High Pressure | 125 PSI: 8 hours | Air |

1. NOTE: Additional tests may be required as specified in each Section of these Specifications.

B. Test gages shall have been calibrated for accuracy within three (3) months of date tests are made. Evidence of calibration shall be available to Engineer upon request.

C. Test gages shall have a range such that the test pressure will fall at mid-range of dial.

D. For remodel projects, test medium shall be the same substance as that being used in the system.

E. Test Procedures shall be applied for minimum periods noted and until tests are complete.

F. Final pressures at end of test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

G. Check of systems during application of test pressures shall include visual check for water medium leakage, soap bubble, or similar for air and nitrogen medium.

H. During heating and cooling cycles, linear expansion shall be checked at all elbows, U bends, expansion joints, etc., for proper clearance.

I. The Engineer shall be notified 48 hours prior to each test and other specification requirements requiring action by the Engineer. All tests shall be made in presence of the City Inspector and Engineer's representative.

J. Maintain written logs of all tests specified above.

**1.35 OPERATION TEST**

A. At completion of installations, Contractor shall operate all mechanical and plumbing systems for a period of at least two days of eight hours each to demonstrate fulfillment of the requirements of the Contract. During this time, all adjustments shall be made to the equipment until the entire system is in satisfactory operating condition acceptable to the Engineer.

**1.36 FINAL OPERATION AND INSTRUCTION**

A. Upon completion of the installation of the equipment and after final acceptance, and on Engineer's request, the Contractor shall place a competent person at the building who shall operate the plant for a period of one eight hour day, instructing the Owner in all details of operation and maintenance. This requirement is in addition to "Operation Test" specified above.

B. Any required instructions from manufacturer's representatives shall be given during this period. The time specified under "Operation Test" will not substitute for the one day of final operation and instruction.

**1.37 OPERATION**

A. The Owner may require operation of parts of all of the installation for beneficial occupancy prior to final acceptance.

B. Cost of utilities for such operation shall be paid by the Owner. Said operation shall not be construed as acceptance of the work; however, Contractor shall obtain written agreement with Owner regarding beginning date for warranty and guarantee purposes. Unless such agreement is obtained, warranties and guarantees shall go into effect upon completion.

**1.38 DAMAGE BY LEAKS**

A. The Contractor shall be responsible for damages to the grounds, walks, roads, buildings, piping systems, electrical systems and their equipment and contents, caused by leaks in the piping system installed by this Contractor as a part of this Contract. He shall repair, at his expense, all damage so caused. All repair work shall be done as directed by the Engineer.

**1.39 EMERGENCY REPAIRS**

A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities during the Contract period.

**1.40 REQUIREMENTS FOR FINAL ACCEPTANCE OF PROJECT**

A. All of the following items must be completed prior to final acceptance of project. No exceptions will be made and no final acceptance of payment will be made until all items are completed.

1. CLEANING EQUIPMENT AND PREMISES:
   a. Thoroughly clean all parts of the piping, valves, and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster and other materials and all oil and grease; adhesive labels, and foreign materials shall be removed. Surfaces shall be carefully wiped.
   b. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
   c. All piping shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves, and similar items shall be thoroughly cleaned.
   d. Gas, air, and oil piping shall be blown out with clean compressed air or inert gas.
   e. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of the work.
2. DEFICIENCY LISTS: Correct all deficiencies listed at time of Substantial Completion.
3. OWNER'S OPERATING AND SERVICE MANUAL: Submit, at least ten days prior to Final Acceptance, one copy of the Owner's Manual to the Engineer for his acceptance. Following the Engineer's acceptance, prepare three copies of bound, indexed, Owner's Manual to be delivered at time of Final Acceptance, which shall include but not be limited to the following:
   a. System operating instructions.
   b. System piping and valving diagram.
   c. System control drawings.
   d. System interlock drawings.
   e. System maintenance instructions.
   f. Material and equipment lists.
   g. Serial numbers of all principal pieces of equipment.
   h. Manufacturer's, suppliers', and subcontractors' names, addresses, and telephone numbers; both local representatives and manufacturers' service headquarters.
   i. Equipment operating and maintenance instructions and parts lists.
   j. Certified performance curves.
   k. Manufacturer's certification.
   l. Balancing and performance test report.
   m. Oiling, lubrication, and greasing data.
   n. Complete electrical load data from operation test.
   o. Belt sizes, types and lengths.
   p. Valve chart.
4. INSTRUCTIONS:
   a. All verbal instructions as herein specified shall have been performed.
   b. Provide the following:
      1) System operating instructions.
      2) System piping and valving diagram.
      3) System control drawings.
      4) System interlock drawings.
5. CERTIFICATIONS: Provide three bound copies containing the following:
   a. Balancing and Performance Test Report.
   b. Manufacturer's certifications.
   c. Contractor's guarantees.
   d. Owner's acknowledgment of receipt of instruction, enumerating items in Owner's Manual. List of manufacturers' guarantees executed by the Contractor (those extending beyond one year.)

6. RECORD DRAWINGS: Deliver the specified record drawings to the Engineer.
7. Furnish the services of an Engineer or Technician acceptable to the Engineer to instruct the Owner's authorized representative in the complete and detailed operation of each and every system and piece of equipment. Instructions shall be conducted for the period of time necessary to thoroughly familiarize Owner's personnel and to accomplish the desired results. Upon completion of these instructions to the Owner, provide a letter to the Owner signed by him stating dates and names of personnel giving instruction and those receiving instruction. NOTE: One copy of these letters shall be included in data to be furnished for final acceptance and shall be sent directly to the Engineer.

**1.41 GUARANTEES AND WARRANTIES**

A. The Contractor shall guarantee to the Owner that all labor, materials furnished, and work performed are in accordance with the contract, contract drawings, specifications, authorized alterations, and additions. Should any defect develop during the contract guarantee period due to improper materials, workmanship, or arrangement, the same together with any other work affected in correcting such defect shall be made good by the Contractor without expense to the Owner.

B. The materials and equipment shall be warranted to be free from defects by the manufacturer. Any defect that develops or failure that occurs during the contract guarantee period together with any other work affected in correcting such defect or failure shall be made good by the Contractor without expense to the Owner. Manufacturer and Contractor shall include cost of labor in the warranty of all equipment.

C. The contract guarantees and warranty periods shall be from the date the complete facility is accepted by the Owner, unless other dates are mutually agreed upon between Owner and Contractor.

D. The Contractor's work shall be guaranteed for a minimum of one year unless noted otherwise in specific sections of these specifications.

E. The materials and equipment shall be warranted for a minimum of one year. Some components may be specified with or normally have longer standard warranty periods. In this case, the longer warranty period shall be provided by the Contractor.

**1.42 DEMOLITION AND RELOCATION (WHERE APPLICABLE)**

A. The Contractor shall remove and/or relocate, modify, or reinstall all items as indicated on drawings or required by the installation of new materials, equipment, and outlets. All removal and/or salvage and all materials and equipment shall remain the property of the Owner and shall be stored at such locations on site as designated by the Owner.

B. All waste, trash, debris and other such unusable items shall be promptly removed from the site and disposed by the Contractor.

C. All items of equipment to be relocated shall be thoroughly cleaned, inspected, and reinstalled in a proper manner by workmen skilled in the trade and in conformance with standard practice of trade involved. Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore item to good operation. Should equipment designated for relocation be found to be damaged and/or unsuitable for relocation, it shall be called to the attention of the Engineer prior to dismantling for further instructions before removal. Items damaged during removal and/or storage are the responsibility of the Contractor and shall be replaced or repaired by him in a manner acceptable to the Owner. After reinstallation, items shall be "fire-tested" and/or given operational tests and put back into proper working order. Service piping and/or wiring to items to be removed or relocated shall be removed to points at which reuse is to be continued or service is to remain. Services not reused shall be capped, sealed, or otherwise cut-off or disconnected in a safe manner acceptable to the Owner and shall be done in such a manner to

result in a minimum of interruption to services of adjacent occupied areas. Services to existing occupied areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specified acceptance of the Owner and a time schedule accepted by him for the cut-off period.

D. The Contractor shall be responsible for the loss or damage of existing facilities caused by him or his workmen and shall be responsible for repairing all damage and the replacement of such losses. The Contractor shall erect such temporary barricades, with necessary safety devices as required, to protect working personnel and/or others from injury and shall remove such temporary protection upon completion of the project. Where existing construction is removed to provide working access to existing utilities and where partitions, walls, floors, and ceilings are removed, the Contractor shall remove and reinstall in locations accepted, all devices required for the complete final system in each and every respect. Contractor shall provide temporary service facilities to all equipment which must remain in operation during the construction period and shall make such necessary arrangements, send proper notices, and perform all such services as required to maintain in service operation all plumbing, air conditioning and ventilation systems in all new and existing areas as required for the continuing operation of the facility being remodeled.

E. The Contractor shall be responsible for proper operation of existing facilities in the existing buildings after water or gas services have been cut off and/or systems have been drained for necessary changes or additions to systems. The Contractor shall check all flush valves and other water consuming devices and shall clean and service any items which are malfunctioning due to dirt or trash entering pipe. Any stuck flush valves shall be serviced. The Contractor shall survey entire area where gas is cut off and shall relight all pilots on all equipment upon restoration of gas and shall restore all gas fired equipment to normal operation.

**PART 4COORDINATION**

**2.01 EMBEDS AND BLOCKOUTS**

A. All trade Contractors requiring any embedded items to be cast into the precast concrete wall panels shall review the wall panel shop drawings and indicate the exact location and piece mark of the embedded item on the panel elevations. These items include, but are not limited to: hollow metal door frames, channel frames, steel plates, sleeves, blockouts, conduit, junction boxes, and any other equipment required by other trades. The wall panel shop drawings shall be reviewed and returned to the precast panel manufacturer with cut sheets and any special instructions pertinent to the placement of the embedded items.

B. All openings and embeds required for proper installation of Contractor’s equipment not shown on shop drawings marked up by Contractor shall be provided by responsible Contractor at no additional cost to the project.

**2.02 DELIVERY AND INSTALLATION**

A. All trade Contractors shall furnish and deliver any embedded items required for their trade to the precast plant manufacturer. These Contractors shall have a technician present at the precast manufacturing plant to supervise this work at no charge to the precast manufacturer.

**2.03 SCHEDULE**

A. The review and return of the embed placement submittal drawings and the delivery of embedded items shall be done in a timely manner that will not delay the production schedule of the precast manufacturer. Any item not delivered in time for casting into the wall panels shall be rectified by the trade requiring that item at their expense. In a case where embedded items are not delivered in time for casting into a wall panel, the precast manufacturer shall provide a blockout based on sizes furnished by the trades requiring them.

**END OF SECTION**

# SECTION 22 0516
# EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Pipe loops, offsets, and swing joints.

### 1.02 REFERENCE STANDARDS

A. EJMA (STDS) - EJMA Standards; Tenth Edition.

B. UL (DIR) - Online Certifications Directory; Current Edition.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

E. Maintenance Data: Include adjustment instructions.

## PART 2 PRODUCTS

### 2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Inner Hose: Stainless steel.

B. Exterior Sleeve: Double braided, stainless steel.

C. Pressure Rating: 125 psi up to 12 inch.

D. Joint: Flanged or Threaded with union.

E. Size: Use pipe sized units.

F. Maximum offset: 3/4 inch on each side of installed center line.

### 2.02 ACCESSORIES

A. Pipe Alignment Guides:
   1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

**END OF SECTION**

# SECTION 22 0517
# SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe sleeve-seals.

### 1.02 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

C. UL (DIR) - Online Certifications Directory; Current Edition.

## PART 2 PRODUCTS

### 2.01 PIPE SLEEVES

A. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

E. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

### 2.02 PIPE-SLEEVE SEALS

A. Modular Mechanical Sleeve-Seal:
   1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
   2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
   3. Size and select seal component materials in accordance with service requirements.
   4. Service Requirements:
      a. Corrosion resistant.

b. Underground, buried, and wet conditions.
c. Fire Resistant: 1 hour, UL (DIR) approved.

5. Glass-reinforced plastic pressure end plates.

B. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

C. Pipe Sleeve Material:
1. Bearing Walls: Steel or cast iron
2. Masonry Structures: Sheet metal or fiber.

D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

E. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.

F. Pipeline-Casing Seals:
1. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

## PART 3 EXECUTION

### 3.01 PREPARATION

### 3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

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

D. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
a. Pack solid using mineral fiber complying with ASTM C592.
b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.

E. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**

©the.**stacy**.group

This page intentionally left blank

# SECTION 22 0523
# GENERAL-DUTY VALVES FOR PLUMBING PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Angle valves.
B. Ball valves.
C. Butterfly valves.
D. Check valves.
E. Gate valves.
F. Globe valves.
G. Lubricated plug valves.

### 1.02 RELATED REQUIREMENTS

A. Section 22 0553 - Identification for Plumbing Piping and Equipment.
B. Section 22 0719 - Plumbing Piping Insulation.
C. Section 22 1005 - Plumbing Piping.

### 1.03 ABBREVIATIONS AND ACRONYMS

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

### 1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.
B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).
C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
H. ASME B31.9 - Building Services Piping; 2017.
I. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).

K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).

L. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

M. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

N. AWWA C606 - Grooved and Shouldered Joints; 2015.

O. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).

P. MSS SP-67 - Butterfly Valves; 2017.

Q. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

R. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

S. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.

T. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

U. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

V. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

W. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

X. NSF 61 - Drinking Water System Components - Health Effects; 2019.

Y. NSF 372 - Drinking Water System Components - Lead Content; 2016.

## 1.05 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

## 1.06 QUALITY ASSURANCE

A. Manufacturer:
   1. Company must specialize in manufacturing products specified in this section, with not less than three years of experience.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
   4. Secure check valves in either the closed position or open position.
   5. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
   2. Store valves in shipping containers and maintain in place until installation.

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

A. Handle large valves with sling, modified to avoid damage to exposed parts.

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

**PART 2 PRODUCTS**

**2.01 APPLICATIONS**

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Dead-End: Single-flange butterfly (lug) type.
   3. Throttling: Provide globe, angle, ball, or butterfly.

C. Domestic, Hot and Cold Water Valves:
   1. 2 inch and Smaller:
      a. Bronze and Brass: Provide with solder-joint ends.
      b. Bronze Angle: Class 125, bronze disc.
      c. Ball: One piece, full port, brass with brass trim.
      d. Bronze Swing Check: Class 125, bronze disc.
      e. Bronze Gate: Class 125, NRS.
      f. Bronze Globe: Class 125, bronze disc.
   2. 2-1/2 inch and Larger:
      a. Iron, 2-1/2 inch to 4 inch: Provide with threaded ends.
      b. Iron Ball: Class 150.
      c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
      d. Iron Grooved-End Butterfly: 175 CWP.
      e. Iron Swing Check: Class 125, metal seats.
      f. Iron Swing Check with Closure Control: Class 125, lever and spring.
      g. Iron Grooved-End Swing Check: 300 CWP.
      h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
      i. Iron Plate-Type Check: Class 125; single plate; metal seat.
      j. Iron Gate: Class 125, NRS.
      k. Iron Globe: Class 125.

**2.02 GENERAL REQUIREMENTS**

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 inch and larger.
   2. Handwheel: Valves other than quarter-turn types.
   3. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.

D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.

E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Source Limitations: Obtain each valve type from a single manufacturer.

**2.03 BRONZE, ANGLE VALVES**

A. Class 125; CWP Rating: 200 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. End Connections: Pipe thread.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

**2.04 BRASS, BALL VALVES**

A. One Piece, Full Port with Brass Trim and Push-to-fit or Threaded Connections:
1. Comply with MSS SP-110.
2. CWP Rating: 200 psi.
3. Body: Forged brass.
4. Seats: PTFE.
5. Stem: Brass.
6. Ball: Chrome-plated brass.
7. Operator: Handle.

B. Two Piece, Full Port with Brass Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. Body: Forged brass.
4. Seats: PTFE.
5. Stem: Brass.
6. Ball: Chrome-plated brass.

**2.05 IRON, BALL VALVES**

A. Class 125, Full Port, Stainless Steel Trim:
1. Comply with MSS SP-72.
2. CWP Rating: 200 psi.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. End Connections: Flanged.

5. Seats: PTFE.
6. Operator: Lever with locking handle.

**2.06 IRON, SINGLE FLANGE BUTTERFLY VALVES**

A. Lug Style; Bi-directional dead-end service without use of downstream flange:
   1. Class 125 or Class 150 flanges.
   2. Comply with MSS SP-67, Type I.
   3. Lug Style, Service Pressure Ratings:
      a. 100 psi for sizes 14 to 24 inch.
      b. 150 psi for sizes 2 to 12 inch.
      c. Vacuum down to 29.9 in-Hg.
   4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
   5. Stem: One or two-piece stainless steel.
   6. Seat: EPDM.
   7. Disc: Stainless steel.
   8. Finish: Epoxy coated.
   9. Operator: Gear operator with handwheel over direct-mount actuator base.

**2.07 IRON, GROOVED-END BUTTERFLY VALVES**

A. CWP Rating: 175 psi.
   1. Comply with MSS SP-67, Type I.
   2. Body: Coated ductile iron.
   3. Stem: Two-piece stainless steel.
   4. Disc: Coated ductile iron.
   5. Disc Seal: EPDM.

**2.08 BRONZE, SWING CHECK VALVES**

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Pressure and Temperature Rating: MSS SP-80, Type 3.
   2. Design: Y-pattern, horizontal or vertical flow.
   3. Body: Bronze, ASTM B62.
   4. Ends: Threaded or soldered as indicated.
   5. Disc: Bronze.

**2.09 IRON, HORIZONTAL SWING CHECK VALVES**

**2.10 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL**

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

### 2.11 IRON, GROOVED-END SWING CHECK VALVES

A. Class 300:
   1. CWP Rating: 300 psi.
   2. Body: ASTM A536, Grade 65-45-12 ductile iron.
   3. Seal: EPDM.
   4. Disc: Ductile iron.
   5. Coating: Black, non-lead paint.

### 2.12 IRON, CENTER-GUIDED CHECK VALVES

### 2.13 IRON, PLATE TYPE CHECK VALVES

A. Class 125 Single-Plate:
   1. Comply with API STD 594.
   2. CWP Rating: 200 psi.
   3. Design: Wafer, spring-loaded plate.
   4. Body: ASTM A126, gray iron.
   5. Resilient Seat: EPDM.

### 2.14 BRONZE GATE VALVES - UP TO 3"

### 2.15 IRON GATE VALVES - 2" AND LARGER

A. OS & Y:
   1. Pressure and Temperature Rating: MSS SP-70, Type I.
   2. Body: ASTM A126, gray iron with bolted bonnet.
   3. End Connections: Flanged.
   4. Trim: Bronze.
   5. Disc: Solid wedge.
   6. Packing and Gasket: Asbestos free.

### 2.16 BRONZE, GLOBE VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

### 2.17 IRON, GLOBE VALVES

A. Class 125 and Class 250:
   1. Class 125, WOG Rating: 200 psi.
   2. Class 250, WOG Rating: 500 psi.
   3. Comply with MSS SP-85, Type I.
   4. Body: Gray iron; ASTM A126, with bolted bonnet.
   5. Connection Ends: Flanged.
   6. Trim: Bronze.
   7. Packing and Gasket: Asbestos free, adjustable.
   8. Operator: Handwheel or chainwheel.
   9. Pressure and Temperature Rating: ASME B16.1.

### 2.18 LUBRICATED PLUG VALVES

A. Regular Gland with Flanged Ends:
   1. Comply with MSS SP-78, Type II.
   2. Class 125: CWP Rating: 200 psi.
   3. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
   4. Pattern: Regular or short.

5. Plug: Cast iron or bronze with sealant groove.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

### 3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.

**END OF SECTION**

This page intentionally left blank

# SECTION 22 0529
# HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Prefabricated trapeze-framed systems.

B. Strut systems for pipe or equipment support.

C. Beam clamps.

D. Pipe hangers.

E. Pipe rollers and roller supports.

F. Pipe supports, guides, shields, and saddles.

G. Nonpenetrating rooftop supports for low-slope roofs.

H. Anchors and fasteners.

### 1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

L. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

M. FM (AG) - FM Approval Guide; current edition.

N. MFMA-4 - Metal Framing Standards Publication; 2004.

O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

P. UL (DIR) - Online Certifications Directory; Current Edition.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

## 1.03 ADMINISTRATIVE REQUIREMENTS

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

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

## 1.04 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

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

## 1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

# PART 2 PRODUCTS

## 2.01 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.

D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

E. Materials for Metal Fabricated Supports: Comply with Section 05 5000.
   1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
   2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

F. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
   1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

## 2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

A. Prefabricated Trapeze-Framed Metal Strut Systems:
   1. Strut Channel or Bracket Material:
      a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
   2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   3. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
   4. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

## 2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:
   1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
   2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:
   1. Threaded zinc-plated steel unless otherwise indicated.
   2. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch: 1/4 inch diameter.
      c. Piping larger than 1 inch: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C. Channel Nuts:
   1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

## 2.04 BEAM CLAMPS

A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

B. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).

D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.

E. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

F. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.

G. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

H. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

## 2.05 PIPE HANGERS

A. Band Hangers, Adjustable:
   1. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

B. Swivel Ring Hangers, Adjustable:
   1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
   2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.

C. Clevis Hangers, Adjustable:

## 2.06 PIPE CLAMPS

A. Riser Clamps:
   1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
   2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
   3. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B. Strut Clamps:
   1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.

C. Insulation Coupling:
   1. Two bolt-type clamps designed for installation under insulation.
   2. Material: Carbon steel with epoxy copper or zinc finish.

## 2.07 PIPE ROLLERS AND ROLLER SUPPORTS

A. Manufacturers:
   1. ASC Engineered Solutions; _____: www.asc-es.com/#sle.
   2. FNW; 7902: www.fnw.com/#sle.
   3. nVent Caddy, a brand of nVent; _____: www.erico.com/#sle.
   4. _____.
   5. Substitutions: See Section 01 6000 - Product Requirements.
   6. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

## 2.08 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Intermediate Anchors and Pipe Alignment Guides:
   1. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
   2. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
   3. Pipe Size 10 inch: 0.75 inch U-bolt.
   4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
   5. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
   6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

C. Pipe Shields for Insulated Piping:
   1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
   2. General Construction and Requirements:
      a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
      b. Shields Material: UV-resistant polypropylene with glass fill.
      c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
      d. Service Temperature: Minus 40 to 178 degrees F.
      e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

D. Pipe Supports:
   1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   2. Liquid Temperatures Up to 122 degrees F:
      a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
      b. Support From Below: MSS SP-58 types 35 through 38.

E. Pipe Supports, Thermal Insulated:
   1. General Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
      c. Provide pipe supports for 1/2 to 30 inch iron pipes.
      d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
   2. PVC Jacket:
      a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
      b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
      c. Minimum Thickness: 60 mil, 0.06 inch.

## 2.09 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

A. Manufacturers:
   1. Anvil International; H-Block: www.anvilintl.com/#sle.
   2. B-Line, a brand of Eaton Corporation; _____: www.eaton.com/#sle.
   3. Green Link, Inc; _____: www.greenlinkengineering.com/#sle.
   4. nVent Erico, a brand of nVent; _____: www.erico.com/#sle.
   5. PHP Systems/Design; _____: www.phpsd.com/#sle.
   6. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com/#sle.
   7. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

C. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

D. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

E. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

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

### 3.02 INSTALLATION

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

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect or Engineer, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect or Engineer, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

**END OF SECTION**

# SECTION 22 0553
# IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

### 1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Schedules:
   1. Submit plumbing component identification schedule listing equipment, piping, and valves.
   2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
   3. Valve Data Format: Include id-number, location, function, and model number.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

E. Project Record Documents: Record actual locations of tagged valves.

## PART 2 PRODUCTS

### 2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch diameter and higher.

### 2.02 NAMEPLATES

A. Description: Laminated piece with up to three lines of text.
   1. Letter Color: Black.
   2. Letter Height: 1/4 inch.
   3. Background Color: Light Contrasting Color.
   4. Nameplate Height: 3/4 inch.
   5. Nameplate Material:
      a. Flexible: Vinyl with adhesive backing per ASTM D709.
      b. Metal: Brass with center-side holes for screw fastening.

### 2.03 TAGS

A. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.

B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

### 2.04 PIPE MARKERS

A. Comply with ASME A13.1.

B. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.

C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

E. Identification Scheme, ASME A13.1:
   1. Primary: External Pipe Diameter, Uninsulated or Insulated.
      a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
      b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
      c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
      d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
      e. Over 10 inches: Use 32 inch field-length with 3-1/2 inch text height.
   2. Secondary: Color scheme per fluid service.
      a. Fire Quenching Fluids: White text on red background.
      b. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

## 2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. Plumbing Equipment: Yellow.
   2. Plumbing Valves: Green.
   3. Heating/Cooling Valves: Blue.

# PART 3 EXECUTION

## 3.01 PREPARATION

A. Degrease and clean surfaces to receive identification products.

## 3.02 INSTALLATION

A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags in clear view and align with axis of piping

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

# SECTION 22 0719
# PLUMBING PIPING INSULATION

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.

B. Glass fiber insulation.

C. Jacketing and accessories.

### 1.02 RELATED REQUIREMENTS

A. Firestopping per Division 7.

B. Painting insulation jacket per Division 9.

C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

### 1.03 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

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

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

### 1.05 QUALITY ASSURANCE

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

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

### 1.06 DELIVERY, STORAGE, AND HANDLING

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

### 1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## PART 2 PRODUCTS

### 2.01 REGULATORY REQUIREMENTS

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

### 2.02 GLASS FIBER INSULATION

A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

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

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Blanket: 1.0 pcf density.
   3. Weave: 10 by 20.

H. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement: ASTM C449.

### 2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

### 2.04 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.

2. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.

C. Aluminum Jacket:
1. Thickness: 0.025 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

**3.03 SCHEDULES**

A. Plumbing Systems:
   1. Domestic Hot Water Supply:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: Up to 1-1/2 inch.
         2) Thickness: 1-1/2 inch.
      b. Glass Fiber Insulation:
         1) Pipe Size Range: Above 1-1/2 inch.
         2) Thickness: 2 inch.
   2. Domestic Hot Water Recirculation:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: All sizes.
         2) Thickness: 1-1/2 inch.
   3. Domestic Cold Water:
      a. Glass Fiber Insulation:
         1) Thickness: 1 inch.
      b. Glass Fiber Insulation:
         1) Pipe Size Range: Above 1-1/2 inch.
         2) Thickness: 1-1/2 inch.
         3) Roof Drain Bodies:
         4) Roof Drainage Above Grade:

B. Cooling Systems:
   1. Condensate Drains:
      a. Glass Fiber Insulation:
         1) Thickness: 1/2 inch.
   2. Refrigerant Piping:
      a. Glass Fiber Insulation:
         1) Thickness: 1/2 inch.

**END OF SECTION**

# SECTION 22 1005
# PLUMBING PIPING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.
B. Sanitary waste piping, above grade.
C. Chemical-resistant sanitary waste piping.
D. Domestic water piping, buried within 5 feet of building.
E. Domestic water piping, above grade.
F. Storm drainage piping, buried within 5 feet of building.
G. Storm drainage piping, above grade.
H. Natural gas piping, buried within 5 feet of building.
    1. Natural gas piping, above grade.
I. Pipe flanges, unions, and couplings.
J. Pipe hangers and supports.
K. Ball valves.
    1. Butterfly valves.
    2. Pressure reducing valves.
L. Pressure relief valves.
M. Strainers.

### 1.02 RELATED REQUIREMENTS

A. Section 22 0553 - Identification for Plumbing Piping and Equipment.
B. Section 22 0719 - Plumbing Piping Insulation.

### 1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
E. ASME B31.1 - Power Piping; 2018.
F. ASME B31.9 - Building Services Piping; 2017.
G. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2019.
H. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
I. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.
J. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

L. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2020.

M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

N. ASTM A888 - ASTM A888; 2024.

O. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

P. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

S. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

T. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

U. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

V. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

W. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015, with Editorial Revision (2018).

X. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

Y. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

Z. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

AA. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

BB. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

CC. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

DD. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

EE. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2019a.

FF. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2020.

GG. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2019a.

HH. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

II. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

JJ. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

KK. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).

LL. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.

MM. AWWA C606 - Grooved and Shouldered Joints; 2015.

NN. AWWA C651 - Disinfecting Water Mains; 2014.

OO. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

PP. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).

QQ. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

RR. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

SS. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

TT. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

UU. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

VV. MSS SP-67 - Butterfly Valves; 2017.

WW. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

XX. NSF 61 - Drinking Water System Components - Health Effects; 2019.

YY. NSF 372 - Drinking Water System Components - Lead Content; 2016.

ZZ. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2017.

AAA. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

## 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

E. Project Record Documents: Record actual locations of valves.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

## 1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### 1.07 FIELD CONDITIONS

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

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

### 2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301 / ASTM A888 , hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

### 2.03 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301 / ASTM A888, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

### 2.04 CHEMICAL-RESISTANT SANITARY WASTE PIPING

A. Orion acid waste piping (waste and vents).

B. Blueline flame retardant polypropylene with an IAPMO certified operating temperature of 220°F.

C. ASTM F1412-2016 and NSF/ ANSI 14-2015 compliant.

D. Schedule 40 fittings / joints per ASTM F1412, D4101, and D2657

### 2.05 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
   1. Fittings: No joints below slabs or underground.

## 2.06 DOMESTIC WATER PIPING, ABOVE GRADE

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

## 2.07 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

## 2.08 STORM DRAINAGE PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

## 2.09 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASTM A234/A234M, forged steel welding type.
   2. Joints: ASME B31.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

## 2.10 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.
   3. Paint / coating: Rust resistant epoxy coating (color as selected by Architect).

## 2.11 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.
   2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Sizes Over 1 inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.
   3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. No-Hub Couplings:
   1. Testing: In accordance with ASTM C1277 and CISPI 310.

2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.12 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

B. Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or Carbon steel, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or Carbon steel, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
5. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes 6 inch and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 6 inch and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.

## 2.13 BALANCING VALVES

A. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

B. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch:
   1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi, minus 4 to 250 deg F WOG service.

C. Automatic Flow Limiting Cartridge, Size 3/4 inch:
   1. Class 125, brass or bronze body, stainless steel cartridge, threaded connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.5 gpm WOG service.

D. Automatic Flow Limiting Cartridge with Ball Valve, Size 1/2 to 1 inch:
   1. Class 125, brass or bronze body, stainless steel cartridge, leak-proof stem, threaded or soldered connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.25 to 1.5 gpm WOG service.

E. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

## 2.14 PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Watts Regulator Company: www.wattsregulator.com/#sle.

B. 2 inch and Smaller:
   1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, pressure gauges, and isolation valves.

C. 2 inch and Larger:
   1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.

## 2.15 PRESSURE RELIEF VALVES

A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

## 2.16 STRAINERS

A. Size 2 inch and Smaller:
   1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
   2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 1-1/2 inch to 4 inch:
   1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

## PART 3 EXECUTION

### 3.01 EXAMINATION

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

### 3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

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

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

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

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 0516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
   1. See Section 22 0719.

H. Provide access where valves and fittings are not exposed.
   1. Coordinate size and location of access doors with Section 08 3100.

I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.

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

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

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

M. Excavate in accordance with Section 31 2316.

N. Backfill in accordance with Section 31 2323.

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

P. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.

Q. Install water piping to ASME B31.9.

R. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

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

U. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

V. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
9. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 22 0548.
10. Support cast iron drainage piping at every joint.

## 3.04 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install globe valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring-loaded check valves on discharge of water pumps.

H. Provide flow controls in water recirculating systems where indicated.

## 3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

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

## 3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

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

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

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

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

E. Maintain disinfectant in system for 24 hours.

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

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

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

## 3.07 SERVICE CONNECTIONS

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

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

**END OF SECTION**

# SECTION 22 1006
# PLUMBING PIPING SPECIALTIES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Refrigerator valve and recessed box.
F. Backflow preventers.
G. Double check valve assemblies.
H. Water hammer arrestors.
I. Mixing valves.
J. Floor drain trap seals.

### 1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.
B. Section 22 3000 - Plumbing Equipment.
C. Section 22 4000 - Plumbing Fixtures.

### 1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ASME A112.6.3 - Floor and Trench Drains; 2019.
C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
H. NSF 61 - Drinking Water System Components - Health Effects; 2019.
I. NSF 372 - Drinking Water System Components - Lead Content; 2016.
J. PDI-WH 201 - Water Hammer Arresters; 2017.

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.
B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
E. Operation Data: Indicate frequency of treatment required for interceptors.
F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

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

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Loose Keys for Outside Hose Bibbs: One.
   2. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

**1.05 QUALITY ASSURANCE**

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

**1.06 DELIVERY, STORAGE, AND HANDLING**

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

**PART 2 PRODUCTS - SEE PLUMBING FIXTURE SCHEDULE ON DRAWINGS**

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or fast closing valves.

H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

**END OF SECTION**

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 private water-distribution piping and related components outside the building for water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

C. Public water distribution piping and related components shall conform to City of Owasso Construction Guidelines and Specifications for Water Lines.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene-monomer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
   3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:
1. Comply with NSF 14 for plastic potable-water-service piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.2 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.
1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.
1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

C. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.
1. Comply with UL 1285 for fire-service mains if indicated.
2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
1. Manufacturers: Subject to compliance with requirements of City of Owasso.
2. Nonrising-Stem, Resilient-Seated Gate Valves:
a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:
1. Manufacturers: Subject to compliance with requirements of City of Owasso.
2. Description: Sleeve and valve compatible with drilling machine.
a. Standard: MSS SP-60.
b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.

c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 CHECK VALVES

A. AWWA Check Valves:
1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
a. Standard: AWWA C508.
b. Pressure Rating: 175 psig.

2.7 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:
1. Manufacturers: Subject to compliance with requirements of City of Owasso.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.

2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.8 WATER METERS
1. Water meters will be subject to compliance with requirements of City of Owasso.

2.9 WATER METER BOXES
1. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Subject to compliance with requirements of City of Owasso.

2.10 PROTECTIVE ENCLOSURES

A. Freeze-Protection Enclosures:

1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
   a. Standard: ASSE 1060.
   b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
   c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
      1) Housing: Reinforced-aluminum or-fiberglass construction.
         a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
         b) Drain opening for units with drain connection.
         c) Access doors with locking devices.
         d) Insulation inside housing.
         e) Anchoring devices for attaching housing to concrete base.
      2) Electric heating cable or heater with self-limiting temperature control.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
   2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
   3. Use the following for valves in vaults and aboveground:
      a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
      b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
      c. Check Valves: AWWA C508, swing type.`
   4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
   5. Relief Valves: Use for water-service piping in vaults and aboveground.
      a. Air-Release Valves: To release accumulated air.
      b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.

c. Combination Air Valves: To release or admit air.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of City of Owasso water department and of size and in location indicated.

B. Make connections larger than NPS 2 with tapping machine according to the following:
1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Make connections NPS 2 and smaller with drilling machine according to the following:
1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

D. Comply with NFPA 24 for fire-service-main piping materials and installation.

E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

F. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

G. Install piping by tunneling by boring, under streets and other obstructions that cannot be disturbed.

H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping.

J. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.

K. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Locking mechanical joints.
   2. Set-screw mechanical retainer glands.
   3. Bolted flanged joints.
   4. Heat-fused joints.
   5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
   2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
   3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
   4. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.8 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according requirements of City of Owasso.

3.9 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.10 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

3.11 PROTECTIVE ENCLOSURE INSTALLATION

A. Install concrete base level and with top approximately 2 inches above grade.

B. Install protective enclosure over valves and equipment.

C. Anchor protective enclosure to concrete base.

3.12 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

3.13 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.

D. Connect water-distribution piping to interior domestic water piping.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.14 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
   1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.15 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.16 CLEANING

A. Clean and disinfect water-distribution piping as follows:
   1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

D. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

# 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 gravity-flow, nonpressure, sanitary sewerage outside the building, with the following components:
   1. Pipe and fittings.
   2. Nonpressure and pressure couplings.
   3. Cleanouts.
   4. Manholes

## 1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene-monomer rubber.

B. LLDPE: Linear low-density, polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

## 1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

## 1.5 SUBMITTALS

A. Product Data: For the following:
   1. Pipe materials.
   2. Special pipe fittings.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

## 2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

## 2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

## 2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

## 2.4 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
   1. NPS 3 to NPS 6: SDR 35.
   2. Gaskets: ASTM F 477, elastomeric seals.

## 2.5 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   1. Top-Loading Classification: Heavy and Extra-heavy duty.
   2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

## 2.6 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch (100-mm) minimum thickness, and of length to provide depth indicated.
   5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   6. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

7. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
    a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

B. Cast-in-Place-Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete as required to prevent flotation.
2. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
3. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
    a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

## 2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

PART 3 - EXECUTION

## 3.1 EARTHWORK

A. E**x**cavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

## 3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
   1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
      a. Shielded flexiblecouplings for same or minor difference OD pipes.
      b. Shielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
   2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

## 3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install cleanouts for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure, drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
   2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
   3. Install piping with 36-inch minimum cover.
   4. Install piping below frost line.
   5. Install ductile-iron special fittings according to AWWA C600.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

## 3.4 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
   2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
   3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
   4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

## 3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

## 3.6 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Form continuous concrete channels and benches between inlets and outlet.

F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

G. Install manhole cover inserts in frame and immediately below cover.

## 3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
   4. Use extra-heavy-duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

## 3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

## 3.9 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

## 3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate report for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
      a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
      b. Close openings in system and fill with water.
      c. Purge air and refill with water.
      d. Disconnect water supply.
      e. Test and inspect joints for leaks.

f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

## 3.11 CLEANING

A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION 22 13 13

# SECTION 22 3000
# PLUMBING EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Commercial gas-fired water heaters.

B. Diaphragm-type compression tanks.

C. In-line circulator pumps.

### 1.02 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2019.

C. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

### 1.03 ADMINISTRATIVE REQUIREMENTS

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

### 1.04 SUBMITTALS

A. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.

B. Shop Drawings:
   1. Indicate heat exchanger dimensions, size of tappings, and performance data.
   2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

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

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

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Water Softener Salt: 50 pounds.

### 1.05 QUALITY ASSURANCE

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

B. Certifications:
   1. Water Heaters: NSF approved.
   2. Electric Water Heaters: UL listed and labeled to UL 174.

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

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

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

### 1.06 DELIVERY, STORAGE, AND HANDLING

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

### 1.07 WARRANTY

A. Provide five year manufacturer warranty for domestic water heaters.

## PART 2 PRODUCTS

### 2.01 WATER HEATERS

A. Manufacturers:
1. A.O. Smith Water Products Co
2. Slate Water Heaters

B. Commercial Gas-Fired Water Heaters:
1. Type: Automatic, natural gas-fired, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
4. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
5. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

### 2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

### 2.03 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

E. Drive: Flexible coupling.

### 2.04 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

**END OF SECTION**

This page intentionally left blank

# SECTION 22 4000
# PLUMBING FIXTURES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Mop sinks.

F. Electric water coolers.

### 1.02 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.; 2013.

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

E. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.

F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018.

G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.

H. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.

I. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

J. ASME A112.19.14 - Six Liter Water Closets Equipped with Dual Flushing Device; 2013 (Reaffirmed 2018).

K. ASME A112.19.15 - Bathtub/Whirlpool Bathtubs with Pressure Sealed Doors; 2012.

L. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2005.

M. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2015.

N. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).

O. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.

P. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between - 30 C and 30 C with a Vitreous Silica Dilatometer; 2016.

Q. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials; 2008 (Reapproved 2015).

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

S. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

T. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

U. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

V. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

W. NSF 61 - Drinking Water System Components - Health Effects; 2019.

X. NSF 372 - Drinking Water System Components - Lead Content; 2016.

**1.03 SUBMITTALS**

A. Division 1 - Submittals: Procedures for submittals.

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

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.

E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

**1.04 QUALITY ASSURANCE**

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

**1.05 DELIVERY, STORAGE, AND HANDLING**

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

**1.06 WARRANTY**

A. Provide five year manufacturer warranty for electric water cooler.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

A. Refer to schedules on the plans for fixture selections

B. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

C. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

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

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

**3.02 PREPARATION**

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

**3.03 INSTALLATION**

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

B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports/wall carriers and bolts.

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

**3.04 INTERFACE WITH WORK OF OTHER SECTIONS**

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

**3.05 ADJUSTING**

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

**3.06 CLEANING**

A. Clean plumbing fixtures and equipment.

**3.07 PROTECTION**

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

**3.08 SCHEDULES**

**END OF SECTION**

This page intentionally left blank

# SECTION 23 0500
# BASIC MECHANICAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to other Mechanical Sections, in addition to Division 01 - General Requirements.

B. If conflicts occur between Basic Mechanical Requirements and Division 01, the provisions of Division 01 shall normally dictate; however, the more stringent of the two shall be followed and the Contractor shall indicate the differences in written form and submit to the Engineer for clarification.

### 1.02 REGULATORY REQUIREMENTS

A. Obtain and pay for permits and inspection fees for work included in this phase of the Contract. Comply in every respect with requirements of local inspection departments, National Fire Protection Association, and Local and State Ordinances and Codes. However, this requirement does not relieve the Contractor of the responsibility of complying with these specifications and drawings where specific conditions are of a higher quality and quantity than the requirements for complying with the most stringent of the codes, rules, ordinances or the specifications. Reference to standards is intended to be the latest revision of the standard.

B. The applicable portions of the following listed codes and standards are hereby made a part of this specification, except where requirements are exceeded in these specifications and drawings.
   1. National Fire Protection Association (NFPA).
   2. Codes and Ordinances of the Local Authority Having Jurisdiction (AHJ).
   3. International Mechanical Code, with City Amendments, if applicable.
   4. International Plumbing Code, with City Amendments, if applicable.
   5. International Fuel Gas Code, with City Amendments, if applicable.
   6. International Building Code, with City Amendments, if applicable.

### 1.03 APPLICABLE STANDARDS

A. The following organizations are hereinafter referenced as those whose standards are the basis for the designs, and manufactured items purchased shall conform to these standards where applicable.
   1. ANSI - American National Standards Institute.
   2. AGA - American Gas Association.
   3. ASME - American Society of Mechanical Engineers.
   4. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
   5. ASTM - American Society for Testing Materials.
   6. ARI - Air Conditioning and Refrigeration Institute.
   7. ADA - Americans with Disabilities Act.
   8. AMCA - Air Moving and Conditioning Association.
   9. NEBB - National Environmental Balancing Bureau
   10. AABC - Associated Air Balance Council
   11. UL - Underwriters' Laboratories, inc.
   12. AWWA - American Water Works Association.

B. The following construction standards are required for the installations of this project:
   1. SMACNA - Sheet Metal and Air Contractors National Association.
   2. Fire Damper and Heat Stop Guide for Air Handling Systems.
   3. HVAC Duct Contruction Standards.

4. HVAC Air Duct Leakage Test Manual.
5. High Pressure Duct Construction Standards.
6. Ducted Electric Heat Guide for Air Handling Systems.
7. Flexible Duct Performance & Installation Standards.
8. OSHA - Department of Labor: Occupational Safety and Health Standards, Latest Revisions.

**1.04 DRAWINGS AND SPECIFICATIONS**

A. Drawings and specifications shall be considered complementary to each other and work referenced in one and not included in the other shall be furnished complete as though included in both. In case of conflicts between the drawings and specifications, the specifications shall take precedence.

B. If floor plans, detail drawings, schedules, or specifications are not sufficiently detailed or explained, or if there are any discrepancies between architectural floor plans, specifications, schedules, or detail drawings, the Contractor shall notify the Engineer of same in writing, prior to bid opening. The Engineer will then inform the Contractor, in writing, which document takes precedence and/or furnish such information, drawings, etc., as required; after which the Contractor shall comply with same as part of this contract.

C. If the Contractor deems it necessary to make departures from the drawings, details of such departures and reasons for same shall be submitted for acceptance. No departures shall be made without prior written acceptance by the Engineer.

D. The Contractor shall be responsible for properly using the information on the Architectural, Structural, Civil, Mechanical and Electrical Drawings. All dimensional information shall be obtained from the appropriate drawings for new construction, and by taking actual measurements at the site for work to existing facilities. In no case shall drawings be scaled for dimensions. Should there be a discrepancy in figures, drawings, and/or specifications, the Engineer shall be notified immediately and shall determine the necessary adjustments.

E. Contractors shall visit the site, verify all existing items indicated on plans and/or in specifications and familiarize themselves with existing conditions and local requirements. The Contractor shall accept conditions as they exist and each proposal shall reflect all costs occasioned by these conditions. The lack of specific information on drawings shall not relieve the Contractor of this responsibility, nor be reason for any extra charges. The submission of bids shall be considered an acknowledgment on the part of the bidder of his site visitation.

F. Unless otherwise expressly agreed to in writing, all rights to the specifications and drawings prepared by CEC Corporation shall belong to CEC Corporation. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been met, including the payment of fees. Each page of the drawings, if prepared in whole or in part by CEC Corporation, and all pages of Mechanical, Plumbing and Fire Protection Sections of the Specifications are covered by copyright and may not be reproduced, published or used in any way without the permission of CEC Corporation.

G. References made herein to materials, equipment, piping, or methods and procedures such as sterilization or cleaning, shall refer to the new items which are a part of this Contract, and shall not pertain to existing systems or material, etc., which are not being changed or rerouted under this Contract.

**1.05 ADEQUACY OF WORK**

A. Drawings are diagrammatic and cannot show every connection in detail or every line of piping in its exact location. Details are subject to the requirements of ordinances and also structural and architectural conditions. Carefully investigate structural and finish conditions affecting the

work, and arrange the work accordingly; furnish all such fittings and accessories as may be required to meet the conditions to give satisfactory operation.

B. By submitting a bid on this work, the Contractor sets forth that his personnel has the necessary technical training and ability and that they will install this work in a satisfactory and workmanlike manner, up to the best standard of the trade, complete and in good working order.

C. Should any discrepancy or apparent difference occur between Drawings and Specifications, or should an error occur in the work of others affecting the mechanical-electrical work, the Contractor shall notify the Engineer at once. If the Contractor proceeds with the work affected without instructions from the Engineer, he shall make good any resultant damage or defect. All misunderstandings of the Drawings and Specifications shall be clarified by the Engineer.

**1.06 WORKMANSHIP AND MATERIALS**

A. Workmanship shall be the best quality and performed by mechanics skilled in their trades. The Contractor shall furnish the services of an experienced superintendent who will be constantly in charge of the erection of the work until completed and accepted. Included in the work shall be proper unloading, installing, connecting, adjusting, starting, and testing of work involved, including equipment and materials furnished by others and the Owner.

B. Unless otherwise hereinafter specified, all materials and equipment under this Division of the Specifications shall be new, of best grade, and as listed in the printed catalogs of the manufacturer. Each article of its kind shall be the standard product of a single manufacturer.

C. Whenever the words “or equal”, “or equal approved”, “equivalent equipment”, “acceptable”, or other words of similar intent or meaning are used, implying that judgment is to be exercised, it is understood that it refers to the judgment of the Engineer.

D. The Engineer shall have the right to accept or reject material, equipment and/or workmanship, and determine when the Contractor has complied with the requirements herein specified.

E. The Contractor shall coordinate with all trades in determining that various phases of work will not interfere with the final efficient operation or use of materials or equipment installed under this Contract. Interference shall be called to the attention of the Engineer before installation is made. The Engineer shall then instruct the Contractor to make such changes and corrections as deemed necessary.

**1.07 EQUIPMENT: GENERAL**

A. Manufacturers’ published instructions shall be followed in making all installations, erecting, cleaning, and operating of all materials and equipment. Rotating equipment shall be statically and dynamically balanced for minimum vibration and low operating noise level.

B. Equipment capacities shall not be less than specified or scheduled.

C. All equipment and major components thereof shall be equipped with a permanently attached nameplate bearing manufacturer’s name, address, catalog number and serial number. For equipment installed where exposed to the weather, the nameplate shall be corrosion-resistant metal with information engraved or stamped.

D. All moving parts, belts, pulleys, and other rotating parts shall be provided with suitable guards or enclosures in accordance with Federal, State, and local regulations.

E. All equipment to be installed shall be the standard catalog products of the manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall be products which have been in satisfactory use at least three years, unless otherwise accepted by the Engineer.

F. The installation of any materials and equipment not meeting the specified standards shall be removed and all new materials or equipment meeting the approval of the Engineer shall then be installed at no cost to the Owner.

G. Design is based on equipment as described in these specifications and equipment schedules. Any change in foundation bases, electrical wiring, conduit, circuit breakers, disconnects, connections, piping, controls, and openings that are required by alternate equipment submitted and accepted shall be the responsibility of the Contractor.

H. The Contractor shall be responsible for placing equipment or apparatus too large to pass through doors or stair wells, etc. within the building prior to completion of the enclosing structures. Properly protect the equipment from damage from normal construction processes and/or the elements after installation within the structure.

**1.08 DELIVERY, STORAGE AND HANDLING**

A. Materials and equipment shall not be stored at the site until ready for installation or until there is suitable space provided to properly protect equipment from the elements. Equipment shall be delivered and stored in original containers and shall be continuously protected from damage. Any damaged materials or equipment shall be replaced with new equipment or repaired to the satisfaction of the Engineer. Repainting of equipment will be required where damaged in shipment or by improper protection at the site. Rotating equipment stored on the site shall be turned through two full rotations a minimum of once a month.

**1.09 SUBSTITUTION OF MATERIALS, FIXTURES & EQUIPMENT**

A. Where equipment is specified by a manufacturer's name and catalog number only, or where a specified manufacturer or manufacturers are named as being acceptable, provided all design and space requirements are met, and subject to acceptance by the Engineer, no substitution or other equipment will be allowed.

B. Where materials, fixtures, or equipment are specified by manufacturer's name and catalog number, and the words "or equal approved" or similar working is used, such specification shall be deemed to establish style, type, and quality of the equipment required and may include certain desirable technical features. The Contractor may offer, for acceptance, any material, item, or equipment or process which he believes is equal to or better in every respect to that indicated or specified as a substitution, provided it also meets space and capacity requirements.

C. Any alternate proposal for substitute equipment, or use of equipment not specified by catalog number, shall include all necessary changes and additions to other work occasioned by this substitute equipment. Additionally, each alternate proposal shall stipulate that the substitute product will fit the space allotted to the specified items and will provide equal or greater clearances for services, maintenance and/or removal. The Contractor shall be allowed only one substitution proposal; if the substitute items are not acceptable to the Engineer, the specified items or products shall be installed without change in cost.

D. Acceptance of a proposed substitution shall not be held to have relieved the Contractor of responsibility for the proper execution of the work, nor from guarantee and maintenance requirements imposed by the Contract Documents. Where no substitutions are proposed or accepted in conformity with the provisions of this article, then no deviation from the material or equipment specified will be allowed.

E. Unless specifically requested hereinafter, prior approval of substitute items will not be considered by the Engineer during the bidding phase.

**1.10 SUBMITTAL DATA AND SHOP DRAWINGS**

A. GENERAL: Three copies each of brochures, shop drawings, and material lists as required by the specifications, shall be prepared and submitted to the Engineer for review within thirty days after award of the Contract. No work indicated on any one shop drawing shall be started until such drawings have been reviewed and accepted by the Engineer.

B. Space is critical; therefore, equipment of larger sizes than shown, even though of an acceptable manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

C. Where equipment manufacturers named as equivalent or accepted as equal are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected. Contractor shall submit, for acceptance, 1/4 inch scale shop drawings for equipment rooms, plan and section, roof plan, etc.

**1.11 PRODUCT DATA**

A. Contractors shall submit complete brochures of all equipment to be installed.

B. Contractors shall submit a list of all material as specified not covered by brochures or shop drawings.

C. Submittal brochures shall be indexed by specification section with table of contents, bound in a three ring binder, and identical. Data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification sections and paragraphs. No consideration will be given to partial submittals. No submittal shall be accepted directly from supply house or manufacturer's representatives nor will substitutions be discussed with anyone other than the successful Contractor after the contract is awarded.

D. All materials and equipment shall be submitted by manufacturer, trade name, and model number. The submittal shall include data requested in the individual sections. The Contractor shall not assume that applicable catalogs are available to the Architect's or Engineer's office. Maintenance and operating manuals and coded order forms are not suitable submittal material. Each sheet of printed material shall be clearly marked (using arrows, underlining, or circling) to show the particular sizes, types, model numbers, ratings, capacities, and options actually being proposed. Non-applicable material shall be crossed out. All specified features must be specifically noted on the submittal.

E. Where the item is a substitution, the submittal must be complete with adequate proof of its quality equal to the item specified. Substitutions made because of installation problems, non-availability, later delivery, etc., shall be explained in the transmittal letter accompanying the submittal. Substitute items shall be accepted only under the following conditions: "Should the material or equipment fail or perform unsatisfactorily during the warranty period, this material and/or equipment shall be replaced with material or equipment specified by name in these specifications, at no additional cost to the Owner. Contractor shall PERSONALLY bring a sample of the substitute item to the Engineer office for his inspection at time submittals are made if Engineer requests same."

F. When items are omitted from the submittal or if submittal is not received by the Engineer within thirty days of Contract date, it shall be construed to mean that only items specified by name and number shall be installed and no substitutions shall be accepted.

G. In the event that submitted materials, appliances, etc., are not, in the opinion of the Engineer, in conformity with the specifications, the Engineer reserves the right to reject this equipment.

H. If items other than those specified or approved as submitted are found installed on the project, they shall be removed and the specified items shall be installed at no cost to the Owner.

I. Submittals shall be reviewed by the Engineer for conformance with design concept only. Review will not include deviations from detail requirements unless these deviations are specifically listed by the Contractor in writing and attached to the data. The Contractor's responsibility includes, but is not limited to, obtaining and aptly applying all field measurements; construction criteria including all means and methods, materials, catalog numbers, and similar data for checking and coordinating with the requirements of the work. Quantities of materials and equipment will not be checked by the Engineer.

## 1.12 SHOP DRAWINGS

A. Contract drawings are diagrammatic design drawings and are not intended as installation drawings. Each Contractor shall, within thirty days after award of contract, and prior to beginning any installations, prepare new and original detailed shop drawings for the following:
   1. Ductwork
   2. Control Wiring Diagrams
   3. Interlock Wiring Diagrams
   4. Kitchen Plumbing Rough-Ins,
   5. and other critical spaces as directed by the Engineer, showing the exact location and dimensions, spacing and location of each piece of equipment and piping. Reproduction of Engineer's design drawings shall not be considered as shop drawings.

B. The Contractor shall coordinate to ascertain that there are no conflicts. The Contractor is responsible for rearrangement and revision required to dimensions, connection sizes, special installment requirements, horsepower, voltage, and phase of all equipment.

C. Each trade, in cooperation with all other trades, shall determine, prior to commencing work, the sequence of the installation of all trades.

D. In no case will wire to wire or terminal type of wiring diagrams for control system be included or checked as submittal; they shall be included as information only. Temperature control function diagram and written description only shall be accepted by the Engineer.

E. The Contractor's responsibility includes, but is not limited to, obtaining and aptly applying all field measurements, construction criteria including means and methods, and materials and necessary coordination data for making all installations complete and operating to the full intent of the Contract Drawings and Specifications.

F. Shop drawings shall be submitted to and approved by the Engineer prior to beginning of any installations. The Engineer will assist in resolving installation problems and conflicts only when furnished with complete shop drawings prepared by the Contractor for all phases of the work and only when the Contractor cannot solve a problem. When installations are made without submitting shop drawings, the Contractor is responsible for immediate correction at his own cost for conflicts and to installations contrary to the intent of design drawings.

## 1.13 CONSTRUCTION RECORD DRAWINGS

A. Each Contractor shall purchase or obtain from the Architect/Engineer one complete set of final design documents of the Contract Drawings and shall record on these drawings all locations, dimensions, and depths of all buried and concealed piping and conduits, plugged outlets, and equipment. The master copy shall be maintained at the job site at all times and shall be marked daily as construction progresses. These drawings shall not be used for reference or construction but shall be available for the Engineer's review. No backfilling of trenches will be permitted until Record Drawings are approved as up-to-date.

B. Depth of sewers and other underground piping prints shall be from a permanent bench mark which shall be shown on drawings.

C. At completion of the work, the data on these prints shall be given to the Engineer of record and transferred electronically to CAD drawing format. The electronic files shall then be copied to a CD for reproducible prints by the Contractor or building Owner, dated, marked "Record Drawings".

## 1.14 MANUFACTURER'S INSPECTION

A. At the completion of work and before acceptance, an authorized representative of the manufacturers of mechanical and electrical equipment shall personally inspect the installation and operation of his equipment to determine that it is properly installed and in good operating order. If equipment is to be concealed, the representative shall make his checks during the

course of installation. The Contractor shall submit to the Engineer a statement signed by each manufacturer's accordance with the manufacturer's recommendations and is operating properly.

B. Inspection shall include new air conditioning equipment, special systems, and such items as are specifically designated by the Engineer.

**1.15 TESTING LABORATORY CERTIFICATION**

A. All equipment and materials where applicable shall be listed by Underwriters' Laboratories and shall bear the Underwriters' Laboratories label.

B. All material, equipment, products furnished and installed on this project shall bear the label, symbol and other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled and/or listed equipment or material and whose listing of labeling states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner, when such label, symbol, or listing is available.

**1.16 FIRE AND SMOKE DEVELOPMENT RATINGS OF MATERIALS**

A. All materials and products installed on this project shall have published fire and smoke developed ratings that conform with U.L. classifications and NFPA 90A and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less and a fuel contribution rating of 50 or less.

**1.17 ASBESTOS**

A. No product which contains asbestos shall be incorporated into any component of this Project.

B. If asbestos is encountered in any existing installations, Contractor shall stop work immediately and notify the Owner. No work shall be commenced in the area containing asbestos until complete removal or abatement has been accomplished by Owner.

**1.18 EXISTING UTILITY PIPING**

A. The drawings indicate all known utility and drainage piping existing on the site of the work. Location of said piping is in accordance with information furnished to the Engineer by the Owner. Responsibility for locating, uncovering, disposing, or maintaining all existing utility piping shall rest solely with the Contractor, who shall plan and conduct his operations in such a manner to insure safe conditions for the entire construction period.

B. Existing underground piping shall be maintained in service unless otherwise noted. Contractor shall promptly repair all utility piping to be maintained in service, at no expense to the Owner, in the event that they are damaged as a result of his work of this project. All valve boxes, manholes, or other appurtenances of utilities which are to remain in service shall be raised or lowered to meet new finished grades as indicated on appropriate drawings.

C. Make arrangements for connections to utilities required for the work as shown on drawings and pay all charges and fees in connection with any service connections, making installations complete in all aspects.

D. Each Contractor shall furnish and install all materials, equipment, and labor required for finished, complete, and operating service connections. Contractors shall be responsible for making personal contact with proper officials of utility companies prior to bid opening and obtaining all details of service requirements and for including ALL costs for ALL requirements for complete services.

E. Any detail requirements for utility metering and/or connections is specified hereinafter in the appropriate section.

F. Existing utility piping which is to be abandoned shall be completely removed where it occurs in the area of excavation. Abandoned piping shall be plugged or capped in a manner acceptable to the Engineer. Existing manholes shown to be abandoned shall be filled with sand.

G. Any minor adjustment in location or alignment of new work to avoid or to connect to existing utilities shall be performed as directed by the Engineer without additional cost to the Owner.

**1.19 INTERRUPTION OF SERVICES**

A. While work is in progress, except for designated short intervals when connections are to be made, continuity of service shall be maintained to all existing systems. Time and duration of interruptions shall be coordinated with the Owner. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing system caused by his operations.

B. Existing air conditioning, plumbing, and special systems serve vital operations. These vital operations include providing for the general health and welfare of the building. To satisfy these requirements, all interruptions of service must be held to an outage time of four hours, unless otherwise approved by the Owner.

C. Coordination of such outages shall result from a written request to the Superintendent of Construction who will indicate the permissible times for outages. Request shall be submitted at least 72 hours prior to outage time requested.

**1.20 EXCAVATION AND BACKFILL**

A. Provide all excavation and backfill required for work of this section, in accordance with applicable requirements of Division 31 - Earthwork Section. Coordinate disposition of building materials to avoid interference with all other work.

B. Provide barricade protection and shoring as required for safety.

C. Do not backfill until after testing and inspection of installed pipe work.

D. All plants, turf, and surfacing that occur in the areas of the excavation shall be carefully removed and placed where they will not be damaged. After the excavations are filled, the plants, turf, and surfacing shall be replaced as directed. All sidewalks, driveways, or other cement or asphalt surfaces which are damaged during excavating shall be repaired to match the adjacent work in material and finish and in accordance with requirements established by authorities having jurisdiction over subject walks, lawns, or streets.

E. Provide clearance (12 inches minimum) under suspended piping and ductwork under the building. The Contractor shall be responsible for necessary excavation to obtain such clearance and if such clearance is not found to exist at the completion of the project, the Contractor shall excavate as required to meet this specification.

F. Piping trenches not under the building shall be parallel to building lines unless otherwise noted on drawings.

G. Trenches shall be cut a minimum of six inches (6") below required depth to allow for bedding material. The bottoms of sewer trenches shall be accurately graded to best secure all available fall. Sewer and water pipes shall be laid in separate trenches. All piping shall have a minimum cover of 24 inches unless otherwise noted or accepted. Trenches shall be a minimum of SIX inches (6") wide and not less than FOUR inches (4") wider than outside diameter of a single pipe or conduit being installed. When more than one pipe is installed in a trench, the trench shall be widened appropriately to allow the pipe to be laid side-by-side with a minimum of FOUR inches (4") of sand between each pipe. In no case shall different services be installed one above the other. Piping and/or conduit of various trades shall NOT be installed in same trench unless permission in granted by the Engineer. Where required by depth and/or type of soil, trenches shall be properly and adequately shored to prevent cave-ins and slides.

H. Properly backfill, flood, and tamp all excavations to the finished grade AFTER the piping has been observed and accepted. The backfill for all pipe may be excavation material, except that at least six inches (6") of clean pit run sand shall be placed over the pipe and six inches (6") of sand below the pipe. A minimum of 12 inches of sand is required for all piping including sewer. Backfill shall be placed in six inch (6") layers, wetted and compacted to the density of adjacent soil. Continue this process until trenches are completely backfilled. Surplus materials shall be hauled from the project. Where trench backfill settles below finished grade during the one year guarantee period, the Contractor shall take necessary steps to correct same as accepted by the Engineer.

I. Trenches backfilled prior to observation of piping or conduit by the AHJ shall be reopened as directed by the AHJ.

**1.21 OPENINGS: CUTTING, REPAIRING**

A. Holes in Concrete: Sleeves shall be furnished, accurately located, and installed in forms before pouring of concrete. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the acceptance of the Structural Engineer prior to cutting or drilling. No cutting or boring of structural members shall be done without WRITTEN permission of the Structural Engineer.

B. Verify that all chases and openings are properly located.

C. Damage to existing facilities shall be repaired as required to restore these facilities to their original condition. All openings through floor, ceilings, walls, etc., shall be sealed rat and insect-proof, whether exposed to view or within walls, with a fire resistant sealant.

**1.22 CONCRETE WORK**

A. Provide concrete equipment bases for pumps, air handling units, chillers, boilers, etc. Provide anchors, thrust blocks, and all piping supports in trenches.

B. Furnish all required templates for anchor bolts and dimension drawings for housekeeping pads. All concrete shall be in accordance with that specified under Division 03 - Concrete of the Specifications.

**1.23 MANNER OF RUNNING PIPE AND CONDUIT**

A. All pipe and ducts (except gas), shall be concealed in chases, walls, furred spaces, or above the ceilings unless otherwise noted.

B. In mechanical/electrical rooms, janitor’s closets, or other storage spaces, where necessary, piping may be run exposed. Exposed piping shall be run in the neatest, most inconspicuous manner and parallel to building lines. Piping shall be run high as possible when exposed in rooms.

C. No piping or duct shall be installed in structural concrete slabs, beams, walls, or concrete structure without prior approval unless specifically noted on the drawings.

**1.24 EQUIPMENT AND CONNECTIONS**

A. All apparatus, equipment, devices, and appliances which are indicated to have pipe connections shall be so equipped. Each such mechanical connection shall be valved and/or trapped.

**1.25 MOTORS AND CONTROLS**

A. Unless noted to the contrary, motors of one horsepower and larger shall be three phase with voltage compatible with the building electrical system. Motor sizes shown on drawings are minimum acceptable sizes.

B. Motors less than one horsepower shall be 115 volts or 200/230 volts, single phase, with built-in thermal protection and shall be furnished with manual or magnetic starters as required, unless otherwise noted on drawings.

C. The Contractor shall furnish a suitable motor starter with the necessary number of auxiliary contacts required for the use with the proper type of switch controls in the cover. Motor starters shall be equal to Furnas, Siemens, General Electric, Cutler-Hammer, or Square D, with three leg overload protection; except special requirements for motor starters shall be specified under the particular piece of equipment requiring starter. Mounting of motor starters and wiring shall be installed under Electrical Division.

## 1.26 ELECTRICAL WIRING OF TEMPERATURE CONTROL EQUIPMENT

A. The Contractor shall be responsible for complete installation of all the automatic temperature control wiring. All power wiring, interlock wiring as required, starter connections, and disconnect switches shall be installed under Electrical Division. Control wiring shall be a minimum of No. 18 AWG and shall be copper with THW or THWN-THHN insulation. Control wiring shall be installed in EMT conduit when above grade, PVC when below. See applicable section for conduit specifications.

B. Contractor shall provide necessary wiring diagrams showing power wiring, interlock wiring, and temperature control wiring which shall be used for making the control wiring and interlock wiring installations.

C. At the completion of all construction work, there shall be a meeting at the job site of all parties involved, who shall inspect, test, and check each control circuit, interlock circuit, and power circuit for all equipment and shall determine by mutual agreement that all equipment is properly wired for the operations intended. A letter to this effect, signed by all three parties, shall be furnished to the Engineer at the time of final inspection. This letter shall read as follows:

1. “We, the undersigned authorized representatives of the Contractor, hereby certify that we have met together at the site and have by test and check found that entire temperature control system and interlock wiring systems are properly installed and wired and all items are functioning in accordance with design requirements and Contract Drawings and Specifications.”

## 1.27 CLEAN-UP

A. All unused material and debris resulting from the performance of work shall be removed from the premises as it accumulates.

## 1.28 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. Furnish hoisting facilities to set materials and equipment in place and provide scaffolding, ladders, and facilities for equipment installations and for adjustment and balancing, installation of grilles, and cleaning of fixtures and devices. Provide transportation to deliver materials, equipment, tools and labor to perform the work.

## 1.29 SLEEVES FOR ALL PIPES AND CONDUITS

A. For pipes through outside walls above grade, install Schedule 40 galvanized steel pipe sleeves having an inside diameter of 1-1/2 inches greater than the outside diameter of piping being installed. Sleeves shall be flush with each wall surface.

B. Where pipes pass through floors not on fill, 22 gage galvanized sheet metal sleeves shall be used. In concrete floors they shall extend one inch above the floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least one inch (1") greater than outside diameter of insulation. Sleeves shall be set before concrete is poured.

C. Sleeves in footings, grade beams, under sidewalks, drives, and elsewhere noted on drawings shall be Schedule 40 PVC plastic pipe with chemical weld joints. Use long sweep ells where pipe turns are made.

D. Where pipe passes through a concrete wall, beam, or floor below grade or below ground water level, a through-wall or floor seal shall be installed. Sealing fitting shall be installed in concrete forms before concrete is poured. Fitting shall be O.Z. Gedney Type FSK where sealing is

required on one side of wall only and Type WSK where sealing on both sides of wall is required. Installation shall be in accordance with manufacturers' instructions.

E. The annular space around piping and sleeves shall be filled with a fire resistant sealant as specified hereinafter. Both sides of wall, floor, ceiling, or roof shall be sealed to the satisfaction of the Engineer whether exposed to view or within walls. ALL openings around pipe shall be insect, vermin, and rodent proof.

**1.30 ROOF PENETRATIONS AND FLASHINGS**

A. Refer to Specification Division 07 - Thermal and Moisture Protection.

**1.31 SEALING OF PENETRATIONS (FIRE STOPPING)**

A. Seal all small openings in floors, walls, ceilings, etc. around pipe, etc. with Dow Corning Fire Stop Sealant System, 3M Fire Barrier 2000+ Silicone Sealant Systems, or approved equal, in conformance with U.L. testing procedures.

B. Seal all openings larger than 1/4" around pipe, duct, etc., through roof, walls and floors above grade with a two-part foam, or one-part sealant material approved by the Engineer, at least 1-1/2" thick, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 deg. F. for two hours. Fire and smoke barrier will be required in all floors above grade of multi-story buildings and in all walls of fireproof construction. All empty holes and all large openings around pipe, etc., shall also be filled with two-part fire stopping materials. One-part may be used for single penetrations at plumbing fixtures, sleeves, and fire rated expansion joints.

C. The firestopping system shall be materials that expand to fill cavities or provide adhesion to substrates, and that will maintain seal under normal expected movement of substrates. MATERIAL SHALL NOT REQUIRE A RISE IN TEMPERATURE TO INSTALL OR ACTUATE THE SEAL. Fire Stop Systems shall utilize materials that are UL Classified as "Fill, Void, or Cavity Materials" and "Through Penetration Firestop Systems." Materials shall have been tested in accordance with ASTM E814 "Methods for Fires Tests of Through-Penetration Firestops" and UL 1479 "Fire Tests of Through-Penetration Firestops."

D. Mineral fiber board, mineral fiber matting and mineral fiber putty may be used as forming and damming for the foam and may be left in place as an integral part of the seal if of a fire rated material. Plywood, particle board, or other combustible foaming and damming materials shall be removed after foaming is completed.

E. Foam exposed in finished areas shall be neatly trimmed flush with the finish surface. In traffic areas, foam sealed areas shall be covered with a traffic surface approved by the Architect.

F. Application of foam in penetrations shall be made in accordance with the manufacturer's recommended procedure. Upon completion of the installation, the openings around all penetrations shall be airtight to prevent passage of water, smoke, fire or vermin. Proper installation shall be verified by proper color change and cell structure of cured foam.

G. Damming materials shall be removed after foam has cured for 24 hours if of other than fire sensitive materials. Seal all voids that have developed in foam with Dow Corning RTV sealant as required to provide full coverage.

H. Inspect penetration seals after 24 hours and inject additional foam where required for a tight seal. Reinspect after added foam has cured 24 hours. Cut and trim cured foam with sharp knife as required for finished appearance.

I. Nelson Flameseal Putty, Flamemaster (Flamastic 77), and Thomas & Betts Flamesafe Fire Stop System may be acceptable products for sealing of penetrations provided they are installed according to manufacturer's recommendations and are approved by the Engineer prior to installation.

### 1.32 FLOOR AND CEILING PLATES

A. Furnish and install chromium plated escutcheon plates around pipes passing exposed through walls, floors, or ceilings. Plates shall be sized to fit outside of pipe or sleeves and/or insulation and shall fit snugly. Plates shall fit around sleeves where they extend through the floor. Solid chromium plated plates with set screws shall be installed on any piping where split ring or compression type plates will not stay in position.

B. Where ducts pass through walls, floors, or ceilings, install sheet metal collars to cover the void around the duct where fire barrier is not required.

C. Escutcheons of galvanized steel shall be installed on all steel or aluminum flue vent pipes.

### 1.33 TESTS AND ADJUSTMENTS

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer, who shall be notified a minimum of 48 hours in advance. All work shall be completely installed, tested as required by this section and the City and State Ordinances, and shall be repeated upon request to the satisfaction of the Engineer's representative.

B. All domestic water piping shall be flushed out, tested at 150 psi and shall be left under pressure of the supply main or a minimum of 40 PSI for the balance of the construction period.

C. Piping tests shall be made with the medium and under pressures listed below:

### 1.34 OPERATION TEST

A. At completion of installations, Contractor shall operate all mechanical and plumbing systems for a period of at least two days of eight hours each to demonstrate fulfillment of the requirements of the Contract. During this time, all adjustments shall be made to the equipment until the entire system is in satisfactory operating condition acceptable to the Engineer.

### 1.35 FINAL OPERATION AND INSTRUCTION

A. Upon completion of the installation of the equipment and after final acceptance, and on Engineer's request, the Contractor shall place a competent person at the building who shall operate the plant for a period of one eight hour day, instructing the Owner in all details of operation and maintenance. This requirement is in addition to "Operation Test" specified above.

B. Any required instructions from manufacturer's representatives shall be given during this period. The time specified under "Operation Test" will not substitute for the one day of final operation and instruction.

### 1.36 OPERATION

A. The Owner may require operation of parts of all of the installation for beneficial occupancy prior to final acceptance.

B. Cost of utilities for such operation shall be paid by the Owner. Said operation shall not be construed as acceptance of the work; however, Contractor shall obtain written agreement with Owner regarding beginning date for warranty and guarantee purposes. Unless such agreement is obtained, warranties and guarantees shall go into effect upon completion.

### 1.37 DAMAGE BY LEAKS

A. The Contractor shall be responsible for damages to the grounds, walks, roads, buildings, piping systems, electrical systems and their equipment and contents, caused by leaks in the piping system installed by this Contractor as a part of this Contract. He shall repair, at his expense, all damage so caused. All repair work shall be done as directed by the Engineer.

## 1.38 EMERGENCY REPAIRS

A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities during the Contract period.

## 1.39 REQUIREMENTS FOR FINAL ACCEPTANCE OF PROJECT

A. All of the following items must be completed prior to final acceptance of project. No exceptions will be made and no final acceptance of payment will be made until all items are completed.
   1. CLEANING EQUIPMENT AND PREMISES:
      a. Thoroughly clean all parts of the piping, valves, and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster and other materials and all oil and grease; adhesive labels, and foreign materials shall be removed. Surfaces shall be carefully wiped.
      b. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
      c. All piping shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves, and similar items shall be thoroughly cleaned.
      d. Gas, air, and oil piping shall be blown out with clean compressed air or inert gas.
      e. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of the work.
   2. DEFICIENCY LISTS: Correct all deficiencies listed at time of Substantial Completion.
   3. OWNER'S OPERATING AND SERVICE MANUAL: Submit, at least ten days prior to Final Acceptance, one copy of the Owner's Manual to the Engineer for his acceptance. Following the Engineer's acceptance, prepare three copies of bound, indexed, Owner's Manual to be delivered at time of Final Acceptance, which shall include but not be limited to the following:
      a. System operating instructions.
      b. System piping and valving diagram.
      c. System control drawings.
      d. System interlock drawings.
      e. System maintenance instructions.
      f. Material and equipment lists.
      g. Serial numbers of all principal pieces of equipment.
      h. Manufacturer's, suppliers', and subcontractors' names, addresses, and telephone numbers; both local representatives and manufacturers' service headquarters.
      i. Equipment operating and maintenance instructions and parts lists.
      j. Certified performance curves.
      k. Manufacturer's certification.
      l. Balancing and performance test report.
      m. Oiling, lubrication, and greasing data.
      n. Complete electrical load data from operation test.
      o. Belt sizes, types and lengths.
      p. Valve chart.
   4. INSTRUCTIONS:
      a. All verbal instructions as herein specified shall have been performed.
      b. Provide the following:
         1) System operating instructions.
         2) System piping and valving diagram.
         3) System control drawings.

4) System interlock drawings.

5. CERTIFICATIONS: Provide three bound copies containing the following:
   a. Balancing and Performance Test Report.
   b. Manufacturer's certifications.
   c. Contractor's guarantees.
   d. Owner's acknowledgment of receipt of instruction, enumerating items in Owner's Manual. List of manufacturers' guarantees executed by the Contractor (those extending beyond one year.)
6. RECORD DRAWINGS: Deliver the specified record drawings to the Engineer.
7. Furnish the services of an Engineer or Technician acceptable to the Engineer to instruct the Owner's authorized representative in the complete and detailed operation of each and every system and piece of equipment. Instructions shall be conducted for the period of time necessary to thoroughly familiarize Owner's personnel and to accomplish the desired results. Upon completion of these instructions to the Owner, provide a letter to the Owner signed by him stating dates and names of personnel giving instruction and those receiving instruction. NOTE: One copy of these letters shall be included in data to be furnished for final acceptance and shall be sent directly to the Engineer.

## 1.40 GUARANTEES AND WARRANTIES

A. The Contractor shall guarantee to the Owner that all labor, materials furnished, and work performed are in accordance with the contract, contract drawings, specifications, authorized alterations, and additions. Should any defect develop during the contract guarantee period due to improper materials, workmanship, or arrangement, the same together with any other work affected in correcting such defect shall be made good by the Contractor without expense to the Owner.

B. The materials and equipment shall be warranted to be free from defects by the manufacturer. Any defect that develops or failure that occurs during the contract guarantee period together with any other work affected in correcting such defect or failure shall be made good by the Contractor without expense to the Owner. Manufacturer and Contractor shall include cost of labor in the warranty of all equipment.

C. The contract guarantees and warranty periods shall be from the date the complete facility is accepted by the Owner, unless other dates are mutually agreed upon between Owner and Contractor.

D. The Contractor's work shall be guaranteed for a minimum of one year unless noted otherwise in specific sections of these specifications.

E. The materials and equipment shall be warranted for a minimum of one year. Some components may be specified with or normally have longer standard warranty periods. In this case, the longer warranty period shall be provided by the Contractor.

## 1.41 DEMOLITION AND RELOCATION (WHERE APPLICABLE)

A. The Contractor shall remove and/or relocate, modify, or reinstall all items as indicated on drawings or required by the installation of new materials, equipment, and outlets. All removal and/or salvage and all materials and equipment shall remain the property of the Owner and shall be stored at such locations on site as designated by the Owner.

B. All waste, trash, debris and other such unusable items shall be promptly removed from the site and disposed by the Contractor.

C. All items of equipment to be relocated shall be thoroughly cleaned, inspected, and reinstalled in a proper manner by workmen skilled in the trade and in conformance with standard practice of trade involved. Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore item to good operation. Should equipment designated for relocation be found to be damaged and/or unsuitable for

relocation, it shall be called to the attention of the Engineer prior to dismantling for further instructions before removal. Items damaged during removal and/or storage are the responsibility of the Contractor and shall be replaced or repaired by him in a manner acceptable to the Owner. After reinstallation, items shall be “fire-tested” and/or given operational tests and put back into proper working order. Service piping and/or wiring to items to be removed or relocated shall be removed to points at which reuse is to be continued or service is to remain. Services not reused shall be capped, sealed, or otherwise cut-off or disconnected in a safe manner acceptable to the Owner and shall be done in such a manner to result in a minimum of interruption to services of adjacent occupied areas. Services to existing occupied areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specified acceptance of the Owner and a time schedule accepted by him for the cut-off period.

D. The Contractor shall be responsible for the loss or damage of existing facilities caused by him or his workmen and shall be responsible for repairing all damage and the replacement of such losses. The Contractor shall erect such temporary barricades, with necessary safety devices as required, to protect working personnel and/or others from injury and shall remove such temporary protection upon completion of the project. Where existing construction is removed to provide working access to existing utilities and where partitions, walls, floors, and ceilings are removed, the Contractor shall remove and reinstall in locations accepted, all devices required for the complete final system in each and every respect. Contractor shall provide temporary service facilities to all equipment which must remain in operation during the construction period and shall make such necessary arrangements, send proper notices, and perform all such services as required to maintain in service operation all plumbing, air conditioning and ventilation systems in all new and existing areas as required for the continuing operation of the facility being remodeled.

E. The Contractor shall be responsible for proper operation of existing facilities in the existing buildings after water or gas services have been cut off and/or systems have been drained for necessary changes or additions to systems. The Contractor shall check all flush valves and other water consuming devices and shall clean and service any items which are malfunctioning due to dirt or trash entering pipe. Any stuck flush valves shall be serviced. The Contractor shall survey entire area where gas is cut off and shall relight all pilots on all equipment upon restoration of gas and shall restore all gas fired equipment to normal operation.

## PART 4COORDINATION

### 2.01 EMBEDS AND BLOCKOUTS

A. All trade Contractors requiring any embedded items to be cast into the precast concrete wall panels shall review the wall panel shop drawings and indicate the exact location and piece mark of the embedded item on the panel elevations. These items include, but are not limited to: hollow metal door frames, channel frames, steel plates, sleeves, blockouts, conduit, junction boxes, and any other equipment required by other trades. The wall panel shop drawings shall be reviewed and returned to the precast panel manufacturer with cut sheets and any special instructions pertinent to the placement of the embedded items.

B. All openings and embeds required for proper installation of Contractor’s equipment not shown on shop drawings marked up by Contractor shall be provided by responsible Contractor at no additional cost to the project.

### 2.02 DELIVERY AND INSTALLATION

A. All trade Contractors shall furnish and deliver any embedded items required for their trade to the precast plant manufacturer. These Contractors shall have a technician present at the precast manufacturing plant to supervise this work at no charge to the precast manufacturer.

**2.03 SCHEDULE**

A. The review and return of the embed placement submittal drawings and the delivery of embedded items shall be done in a timely manner that will not delay the production schedule of the precast manufacturer. Any item not delivered in time for casting into the wall panels shall be rectified by the trade requiring that item at their expense. In a case where embedded items are not delivered in time for casting into a wall panel, the precast manufacturer shall provide a blockout based on sizes furnished by the trades requiring them.

**END OF SECTION**

# SECTION 23 0513
# COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

### 1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

C. NEMA MG 00001 - Motors and Generators; 2024.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 5 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

B. Comply with NFPA 70.

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

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

### 1.06 WARRANTY

A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

## PART 2 PRODUCTS

### 2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to Drawings for required electrical characteristics.

B. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
   4. Motors with frame sizes 215T and larger: Energy efficient type.

C. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

### 2.02 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

### 2.03 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

### 2.04 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To NEMA MG 00001.

K. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

L. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

**END OF SECTION**

This page intentionally left blank

# SECTION 23 0553
# IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

### 1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Project Record Documents: Record actual locations of tagged valves.

## PART 2 PRODUCTS

### 2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags. Key to control schematic.

B. Control Panels: Nameplates.

C. Dampers: Ceiling tacks, where located above lay-in ceiling.

D. Ductwork: Nameplates.

E. Major Control Components: Nameplates.

F. Piping: Pipe markers.

G. Relays: Tags.

H. Small-sized Equipment: Tags.

I. Thermostats: Nameplates.

### 2.02 NAMEPLATES

A. Letter Color: Black.

B. Letter Height: 1/4 inch.

C. Background Color: Light Contrasting Color.

D. Plastic: Comply with ASTM D709.

### 2.03 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

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

**2.04 STENCILS**

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
   4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
   5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
   6. Ductwork and Equipment: 2-1/2 inch high letters.

B. Stencil Paint: As specified, semi-gloss enamel, colors conforming to ASME A13.1.

**2.05 PIPE MARKERS**

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

**2.06 CEILING TACKS**

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.
   4. Plumbing valves: Green

**PART 3 EXECUTION**

**3.01 PREPARATION**

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

B. Prepare surfaces in accordance with Division 9 for stencil painting.

**3.02 INSTALLATION**

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Division 9.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

I. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

This page intentionally left blank

# SECTION 23 0593
# TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

### 1.02 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008 (Reaffirmed 2017).

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, with Errata (2017).

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

### 1.03 SUBMITTALS

A. Submit under provisions of Division 1.

B. Submit name of adjusting and balancing agency for approval within 60 days after award of Contract.

C. Field Reports: Submit under provisions of Division 1.

D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

G. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

H. Include detailed procedures, agenda, sample report forms prior to commencing system balance.

I. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.

J. PROJECT RECORD DOCUMENTS
   1. Submit under provisions of Division 1.
   2. Record actual locations of flow measuring stations balancing valves and rough setting.

K. QUALITY ASSURANCE
   1. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance; ASHRAE 111; or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

L. QUALIFICATIONS

1. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience.
2. Perform Work under supervision of AABC Certified Test and Balance Technician or NEBB Certified Testing, Balancing and Adjusting Supervisor.

M. SEQUENCING
1. Sequence work under the provisions of Division 1.
2. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

N. SCHEDULING
1. Schedule work under the provisions of Division 1.
2. Schedule and provide assistance in final adjustment and test of life safety and smoke evacuation system with Fire Authority.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
   a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
   b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
   c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

### 3.02 EXAMINATION

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

12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

**3.03 PREPARATION**

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect or Engineer/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

**3.04 ADJUSTMENT TOLERANCES**

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

**3.05 RECORDING AND ADJUSTING**

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

F. Check and adjust systems approximately six months after final acceptance and submit report.

**3.06 AIR SYSTEM PROCEDURE**

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. On fan powered VAV boxes, adjust air flow switches for proper operation.

**3.07 WATER SYSTEM PROCEDURE**

**3.08 SCOPE**

A. Test, adjust, and balance the following:
1. Sprinkler Air Compressor.
2. Electric Water Coolers.
3. Plumbing Pumps.
4. HVAC Pumps.
5. Forced Air Furnaces.
6. Direct Fired Furnaces.
7. Reciprocating Water Chillers.
8. Air Cooled Refrigerant Condensers.
9. Packaged Terminal Air Conditioning Units.
10. Unit Air Conditioners.
11. Air Coils.
12. Terminal Heat Transfer Units.
13. Air Handling Units.
14. Fans.
15. Air Filters.
16. Air Terminal Units.
17. Air Inlets and Outlets.
18. Controls Compressor.

**3.09 MINIMUM DATA TO BE REPORTED**

A. Electric Motors:
1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Driven sheave, diameter and RPM.
   4. Belt, size and quantity.
   5. Motor sheave diameter and RPM.
   6. Center to center distance, maximum, minimum, and actual.

C. Pumps:
   1. Identification/number.
   2. Manufacturer.
   3. Size/model.
   4. Impeller.
   5. Service.
   6. Design flow rate, pressure drop, BHP.
   7. Actual flow rate, pressure drop, BHP.
   8. Discharge pressure.
   9. Suction pressure.
   10. Total operating head pressure.
   11. Shut off, discharge and suction pressures.
   12. Shut off, total head pressure.

D. Cooling Coils:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Entering air DB temperature, design and actual.
   7. Entering air WB temperature, design and actual.
   8. Leaving air DB temperature, design and actual.
   9. Leaving air WB temperature, design and actual.
   10. Water flow, design and actual.
   11. Water pressure drop, design and actual.
   12. Entering water temperature, design and actual.
   13. Leaving water temperature, design and actual.
   14. Saturated suction temperature, design and actual.
   15. Air pressure drop, design and actual.

E. Heating Coils:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Water flow, design and actual.
   7. Water pressure drop, design and actual.
   8. Entering water temperature, design and actual.
   9. Leaving water temperature, design and actual.
   10. Entering air temperature, design and actual.
   11. Leaving air temperature, design and actual.

12. Air pressure drop, design and actual.

F. Electric Duct Heaters:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

G. Induction Units:

H. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

I. Return Air/Outside Air:
1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

J. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.

5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

K. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

L. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

M. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

N. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.

4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

**END OF SECTION**

# SECTION 23 0713
# DUCT INSULATION

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

C. Jacketing and accessories.

### 1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

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

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

### 1.04 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

### 1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

## PART 2 PRODUCTS

### 2.01 REGULATORY REQUIREMENTS

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

### 2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' value: 0.25 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 250 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure-sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, white color.

F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

### 2.03 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 250 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent.
   4. Maximum Density: 3 lb/cu ft.

B. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.04 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with two coats of vapor barrier mastic and glass tape.

C. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

D. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

### 2.04 JACKETING AND ACCESSORIES

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.

1. Lagging Adhesive:
    a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 36 lb/square.

C. Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.025 inch sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

## 2.05 DUCT LINER

A. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
2. Service Temperature: Up to 250 degrees F.
3. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
4. Minimum Noise Reduction Coefficients:
    a. 1-1/2 inches Thickness: 0.60.
    b. 2 inch Thickness: 0.70.

B. Adhesive: Waterproof, fire-retardant type, ASTM C916.

C. Liner Fasteners: Galvanized steel, welded with press-on head.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

## 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

G. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

H. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

**3.03 SCHEDULES**

A. Combustion Air Duct:
1. Flexible Glass Fiber Duct Insulation: 2" inches thick.
2. Rigid Glass Fiber Duct Insulation: 2" inches thick.

B. Exhaust Ducts Exposed to Outdoor Air: 2" Duct Wrap with Vapor Barrier

C. Outside Air Intake Ducts: 2" Duct Wrap with Vapor Barrier

D. Supply Ducts:
1. Rectangular ductwork: 1-1/2" duct liner
2. Round ductwork (concealed): 1-1/2" fiberglass duct wrap
3. Round ductwork (visible): double wall douctwork with 1" liner and perforated inner surface

E. Return Ducts: 1-1/2" duct liner

F. Ducts Exposed to Outdoors: 2" Duct Wrap with Vapor Barrier

**END OF SECTION**

# SECTION 23 0923
# DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. System description.

B. Operator interface.

C. Power supplies and line filtering.

D. System software.

E. Controller software.

F. HVAC control programs.

### 1.02 REFERENCE STANDARDS

A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2016.

B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:
   1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
   2. List connected data points, including connected control unit and input device.
   3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
   4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   5. Indicate description and sequence of operation of operating, user, and application software.
   6. Ensure terminology used in submittals conforms to [ASME MC85.1] [NEMA EMC1].

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Include submittals data in final "Record Documents" form.

F. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
   3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

A. Perform work in accordance with NFPA 70.

B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience.

**1.05 WARRANTY**

A. Correct defective Work within a one year period after Substantial Completion.

B. Provide five year manufacturer's warranty for field programmable micro-processor based units.

**1.06 PROTECTION OF SOFTWARE RIGHTS**

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
   1. Limiting use of software to equipment provided under these specifications.
   2. Limiting copying.
   3. Preserving confidentiality.
   4. Prohibiting transfer to a third party.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

A. Honeywell International, Inc.

B. Trane Controls

**2.02 SYSTEM DESCRIPTION**

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based unitswith communications to Building Management System.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

**2.03 OPERATOR INTERFACE**

A. PC Based Work Station:

1. Resides on high speed network with building controllers.
2. Connected to server for full access to all system information.

B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.

C. BACnet protocol to comply with ASHRAE Std 135.

**2.04 CONTROLLERS**

A. Building Controllers:
1. General:
a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
c. Share data between networked controllers.
d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
e. Utilize real-time clock for scheduling.
f. Continuously check processor status and memory circuits for abnormal operation.
g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
h. Communication with other network devices to be based on assigned protocol.
2. Communication:
a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
b. Perform routing when connected to a network of custom application and application specific controllers.
c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within waterproof enclosures.
2) Rated for operation at 40 to 150 degrees F.
b. Conditioned Space:
1) Mount within dustproof enclosures.
2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Input/Output Interface:

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

## 2.05 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:
   1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   2. Limit connected loads to 80 percent of rated capacity.

3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
a. Dielectric strength of 1000 volts minimum.
b. Response time of 10 nanoseconds or less.
c. Transverse mode noise attenuation of 65 dB or greater.
d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

**2.06 LOCAL AREA NETWORK (LAN)**

A. Provide communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 19.2 Kb.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

**2.07 SYSTEM SOFTWARE**

A. Operating System:
1. Concurrent, multi-tasking capability.
a. Common Software Applications Supported: Microsoft Excel.
b. Acceptable Operating Systems: Windows 10.
2. System Graphics:
a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
b. Animation displayed by shifting image files based on object status.
c. Provide method for operator with password to perform the following:
1) Move between, change size, and change location of graphic displays.
2) Modify on-line.
3) Add, delete, or change dynamic objects consisting of:
(a) Analog and binary values.
(b) Dynamic text.

(c) Static text.
(d) Animation files.

3. Custom Graphics Generation Package:
   a. Create, modify, and save graphic files and visio format graphics in PCX and TIFF formats.
   b. HTML graphics to support web browser compatible formats.
   c. Capture or convert graphics from AutoCAD.

B. Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
      2) Printers.
      3) Modems.
      4) Network connections.
      5) Building management panels.
      6) Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.

2) Alarm limit differentials.
3) States.
4) Reactions for each object.

8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1) Source.
      2) Location.
      3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
       1) Sampled and stored on the building controller panel.
       2) Archivable on hard disk.
       3) Retrievable for use in reports, spreadsheets and standard database programs.
       4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
       5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
       1) Menu.
       2) Graphics.
       3) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
       1) Allows operator to select, modify, or create reports.
       2) Definable as to data content, format, interval, and date.
       3) Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.

d. Set to be printed on operator command or specific time(s).

14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.
            (b) System messages.
            (c) System events.
            (d) Trends.
    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.
        7) Facility name.
    c. Tenant Override:
        1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2) Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1) Electrical Meter(s):
            (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
            (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
        2) Fuel Meter(s):
            (a) Monthly showing daily natural gas consumption for each meter.
            (b) Annual summary showing monthly consumption for each meter.
        3) Weather:
            (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:
    1. Provide editing software for each system application at PC workstation.
    2. Downloaded application is executed at controller panel.
    3. Full screen editor for each application allows operator to view and change:
        a. Configuration.
        b. Name.
        c. Control parameters.
        d. Set-points.
    4. Scheduling:
        a. Monthly calendar indicates schedules, holidays, and exceptions.
        b. Allows several related objects to be scheduled and copied to other objects or dates.
        c. Start and stop times adjustable from master schedule.

5. Custom Application Programming:
    a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
    b. Programming Features:
        1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
        2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
        3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
        4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
        5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
        6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
        7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
        8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.
        9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

## 2.08 CONTROLLER SOFTWARE

A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. System Security:
    1. User access secured via user passwords and user names.
    2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
    3. User Log On/Log Off attempts are recorded.
    4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
    1. Weekly Schedules Based on Separate, Daily Schedules:
        a. Include start, stop, optimal stop, and night economizer.
        b. 10 events maximum per schedule.
        c. Start/stop times adjustable for each group object.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
    1. Binary object is set to alarm based on the operator specified state.
    2. Analog object to have high/low alarm limits.
    3. All alarming is capable of being automatically and manually disabled.
    4. Alarm Reporting:

a. Operator determines action to be taken for alarm event.
b. Alarms to be routed to appropriate workstation.
c. Reporting Options:

F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

G. Sequencing: Application software based upon specified sequences of operation in Section 23 0993.

H. PID Control Characteristics:
1. Direct or reverse action.
2. Anti-windup.
3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.

I. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
2. Order of equipment startup is user selectable.

J. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

K. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
2. Allows minimum on-time and off-time to be selected.

L. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

M. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
2. Provides operator with capability to assign high run-time alarm.

## 2.09 HVAC CONTROL PROGRAMS

A. General:
1. Support Inch-pounds and SI (metric) units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:

a. Define term schedule.
b. Add/delete fan status point.
c. Add/delete outside air temperature point.
d. Add/delete mass temperature point.
e. Define heating/cooling parameters.
f. Define mass sensor heating/cooling parameters.
g. Lock/unlock program.
h. Request optimal run time control summary.
i. Request optimal run time mass temperature summary.
j. Request HVAC point summary.
k. Request HVAC saving profile summary.

7. Control Summary:
   a. HVAC Control system begin/end status.
   b. Optimal run time lock/unlock control status.
   c. Heating/cooling mode status.
   d. Optimal run time schedule.
   e. Start/Stop times.
   f. Selected mass temperature point ID.
   g. Optimal run time system normal start times.
   h. Occupancy and vacancy times.
   i. Optimal run time system heating/cooling mode parameters.
8. Mass temperature summary:
   a. Mass temperature point type and ID.
   b. Desired and current mass temperature values.
   c. Calculated warm-up/cool-down time for each mass temperature.
   d. Heating/cooling season limits.
   e. Break point temperature for cooling mode analysis.
9. HVAC point summary:
   a. Control system identifier and status.
   b. Point ID and status.
   c. Outside air temperature point ID and status.
   d. Mass temperature point ID and point.
   e. Calculated optimal start and stop times.
   f. Period start.

C. Supply Air Reset:
1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
   a. Raising cooling temperatures to highest possible value.
   b. Reducing heating temperatures to lowest possible level.
3. Operator commands:
   a. Add/delete fan status point.
   b. Lock/unlock program.
   c. Request HVAC point summary.
   d. Add/Delete discharge controller point.
   e. Define discharge controller parameters.
   f. Add/delete air flow rate.
   g. Define space load and load parameters.

h. Request space load summary.

4. Control summary:
   a. HVAC control system status (begin/end).
   b. Supply air reset system status.
   c. Optimal run time system status.
   d. Heating and cooling loop.
   e. High/low limits.
   f. Deadband.
   g. Response timer.
   h. Reset times.
5. Space load summary:
   a. HVAC system status.
   b. Optimal run time status.
   c. Heating/cooling loop status.
   d. Space load point ID.
   e. Current space load point value.
   f. Control heat/cool limited.
   g. Gain factor.
   h. Calculated reset values.
   i. Fan status point ID and status.
   j. Control discharge temperature point ID and status.
   k. Space load point ID and status.
   l. Air flow rate point ID and status.

D. Enthalpy Switchover:
1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:
   a. Add/delete fan status point.
   b. Add/delete outside air temperature point.
   c. Add/delete discharge controller point.
   d. Define discharge controller parameters.
   e. Add/delete return air temperature point.
   f. Add/delete outside air dew point/humidity point.
   g. Add/delete return air dew point/humidity point.
   h. Add/delete damper switch.
   i. Add/delete minimum outside air.
   j. Add/delete atmospheric pressure.
   k. Add/delete heating override switch.
   l. Add/delete evaporative cooling switch.
   m. Add/delete air flow rate.
   n. Define enthalpy deadband.
   o. Lock/unlock program.
   p. Request control summary.
   q. Request HVAC point summary.
3. Control summary:
   a. HVAC control system begin/end status.
   b. Enthalpy switchover optimal system status.
   c. Optimal return time system status.
   d. Current outside air enthalpy.

e. Calculated mixed air enthalpy.
f. Calculated cooling cool enthalpy using outside air.
g. Calculated cooling cool enthalpy using mixed air.
h. Calculated enthalpy difference.
i. Enthalpy switchover deadband.
j. Status of damper mode switch.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

### 3.02 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.

C. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

D. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

### 3.03 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

C. Provide basic operator training for 2 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

### 3.04 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

### 3.05 MAINTENANCE

A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

B. Provide four complete inspections per year, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

C. Provide complete service of systems, including call backs.

**END OF SECTION**

This page intentionally left blank

# SECTION 23 0993
# SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Building HVAC systems.
   2. Central refrigeration systems.
   3. Electrical rooms and telephone rooms.
   4. Evaporative Coolers
   5. Elevator machine rooms.
   6. Heating water zone control.
   7. Kitchen Grease/Pot Wash/Dishwasher Exhaust Fans
   8. Split DX Heat Pump Systems/Packaged Terminal Heat Pump Units.
   9. Unit heaters.

### 1.02 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.

C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
   1. Label with settings, adjustable range of control and limits.
   2. Include flow diagrams for each control system, graphically depicting control logic.
   3. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

D. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

### 1.03 QUALITY ASSURANCE

A. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 BUILDING HVAC SYSTEMS

A. Buildings operating seven days a week, twenty-four hours per day shall run continuously. The Contractor shall coordinate with the owner to develop occupancy schedules for the other buildings and optimally start/stop systems.

B. Safety Devices:
   1. Freeze Protection: Stop fans and close outside air dampers if temperature downstream of preheat coil is below 37 degrees F (3 degrees C); signal alarm.
   2. High Temperature Protection: Stop fans and close outside dampers if temperature in return air is above 300 degrees F (150 degrees C); signal alarm.
   3. Smoke Detector: Stop fans, and close dampers if smoke is detected; signal alarm.

C. If space temperature falls below 50 +/- degrees F, energize HVAC system to maintain building setback temperature.

D. Outside Air Damper: When supply fan is running, open outside air damper.

E. Outside and Return Dampers:
   1. When supply fan is not running, outside and return dampers are closed.
   2. When supply fan is running, dampers are open.

F. Modulate variable frequency drive, preheat coil valve, and cooling coil valve in sequence to maintain constant discharge temperature on variable volume units.

G. Modulate preheat coil valve and cooling coil valve in sequence to maintain space temperature on constant volume units.

H. For fan coil units, modulate preheat coil valve and cooling coil valve in sequence to maintain space temperature.

I. Start building chilled or hot water pump based on outdoor temperature. Modulate building blending station to provide optimum water temperatures.

J. Locate housing unit thermostats in return air duct.

K. Display:
   1. System graphic.
   2. System on/off indication.
   3. System day/night mode.
   4. System fan on/off indication.
   5. Return fan on/off indication.
   6. Chilled/Hot pump on/off indication.
   7. Outside air temperature indication.
   8. Fan discharge air temperature indication.
   9. Fan discharge temperature control point adjustment.
   10. System on/off auto switch.
   11. Supply fan on/off switch.

**3.02 CENTRAL REFRIGERATION SYSTEMS**

**3.03 ELECTRICAL ROOMS AND TELEPHONE ROOMS**

A. On room temperatures above 90 degrees F start exhaust/supply fan.

**3.04 ELEVATOR MACHINE ROOMS**

**3.05 EVAPORATIVE COOLERS**

A. Local switch energizes evaporative cooler with/without water pump depending on switch position. Interlock associated roof supply fan.

**3.06 HEATING WATER ZONE CONTROL**

**3.07 KITCHEN GREASE/POT WASH/DISHWASHER EXHAUST FANS**

A. Local switch energizes exhaust fan and make-up, if applicable. Interlock pot wash fan with grease hood fans.

**3.08 SPLIT DX HEAT PUMP SYSTEMS/PACKAGED TERMINAL HEAT PUMP UNITS**

A. Maintain constant space temperature with local thermostat.

**3.09 UNIT HEATERS**

A. Single temperature electric room thermostat maintains constant space temperature of 68 degrees F by cycling unit fan motor.

B. Single temperature thermostat on return heating water line from floor mounted cabinet heaters de-energizes unit on temperatures below 68 degrees F.

C. Single temperature room thermostat set at 68 degrees F maintains constant space temperature by cycling unit fan motor and energizing electric heating elements.

D. Integral thermostat continues fan operation until element temperature falls below 68 degrees F.

**END OF SECTION**

This page intentionally left blank

# SECTION 23 3100
# HVAC DUCTS AND CASINGS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

C. Nonmetal ducts.

D. Air plenums and casings.

E. Ducts for kitchen exhaust applications.

### 1.02 RELATED REQUIREMENTS

A. Section 23 0130.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.

B. Section 23 0713 - Duct Insulation: External insulation and duct liner.

C. Section 23 3300 - Air Duct Accessories.

D. Section 23 3319 - Duct Silencers.

### 1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

I. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.

J. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

K. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.

L. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

### 1.04 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data for duct materials, duct liner, and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for 4 in (1000 kPa) pressure class and higher systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

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

## 1.05 QUALITY ASSURANCE

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

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

## 1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

# PART 2 PRODUCTS

## 2.01 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 3319.

D. Duct Shape and Material in accordance with Allowed Static Pressure Range:

E. Duct Sealing and Leakage in accordance with Static Pressure Class:
   1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
      a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
      b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
      c. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
      d. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.
      e. Heating or Combustion Air: 1/2 in-wc pressure class, galvanized steel.
      f. Transfer-air and Sound Booths: 1/2 in-wc pressure class, fibrous glass.
   2. Low Pressure Service: Up to 2 in-wc:
      a. Seal: Class C, apply to seal off transverse joints.
      b. Leakage:
   3. Medium and High Pressure Service: Above 3 in-wc:
      a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
      b. Leakage:

F. Duct Fabrication Requirements:
   1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
   2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
   3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
   4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

## 2.02 METAL DUCTS

A. Material Requirements:
   1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages,reinforcing, and sealing for operating pressures indicated.

## 2.03 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:
   1. Fabricate acoustic plenum or casing with reinforcing turned inward.
   2. Provide 16 gauge, 0.059-inch sheet steel back facing and 22 gauge, 0.029-inch perforated sheet steel front facing with 3/32-inch diameter holes on 5/32-inch centers.
   3. Construct 3-inch panels packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16 gauge, 0.059-inch sheet steel.
   4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.

C. Access Doors:
   1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
   2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
   3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

## 2.04 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

A. Provide ductwork, fittings, and appurtenances per NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.

B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm.

C. Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.

D. Design, fabricate, and install liquidtight preventing exhaust leakage into building.

E. Kitchen Hood and Grease Exhaust Duct:
   1. Fabricate in accordance with ductwork manufacturer's instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

D. Duct sizes indicated are inside precise dimensions. For lined ducts, maintain sizes inside lining.

E. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

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

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

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

I. Connect terminal units to supply ducts directly or with 1-foot maximum length of flexible duct. Do not use a flexible duct to change direction.

J. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

K. Set plenum doors at 6 to 12 inches above the floor. Arrange door swings so that fan static-pressure holds the door in a closed position.

**3.02 CLEANING**

A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

B. Clean thoroughly each duct system as indicated within Section 23 0130.51.

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

**END OF SECTION**

# SECTION 23 3300
# AIR DUCT ACCESSORIES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Combination fire and smoke dampers.

D. Duct access doors.

E. Duct test holes.

F. Fire dampers.

G. Flexible duct connectors.

H. Smoke dampers.

I. Volume control dampers.

### 1.02 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

B. NFPA 92 - Standard for Smoke Control Systems; 2018.

C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

G. UL 555C - Standard for Safety Ceiling Dampers; 2014 (Revised 2017).

H. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

D. Project Record Drawings: Record actual locations of access doors and test holes.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fusible Links: Two of each type and size.

### 1.04 QUALITY ASSURANCE

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

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

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with removable key operator.

### 2.02 BACKDRAFT DAMPERS - METAL

A. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

### 2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

B. Provide factory sleeve and collar for each damper.

C. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

D. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft.

E. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.

F. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.

G. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

H. Access Doors: Provide duct access doors for maintenance. Coordinate to provide access doors in ceilings. See Architectural drawings and specifications for type. Access doors in fire rated ceilings must be fire rated.

### 2.04 DUCT ACCESS DOORS

A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.

B. Access doors with sheet metal screw fasteners are not acceptable.

### 2.05 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.06 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Ceiling (Radiation) Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame and 16 gauge, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
   1. Rated for three hour service in compliance with UL 555C.

C. Horizontal Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

G. Access Doors: Provide duct access doors for maintenance. Coordinate to provide access doors in ceilings. See Architectural drawings and specifications for type. Access doors in fire rated ceilings must be fire rated.

## 2.07 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
   2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

## 2.08 SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.

C. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

D. Access Doors: Provide duct access doors for maintenance. Coordinate to provide access doors in ceilings. See Architectural drawings and specifications for type. Access doors in fire rated ceilings must be fire rated.

## 2.09 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Splitter Dampers:
   1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
   2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

C. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

### 3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.

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

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

I. Use splitter dampers only where indicated.

J. Provide balancing dampers on high velocity systems where indicated. See Section 23 3600 - Air Terminal Units.

K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

**END OF SECTION**

# SECTION 23 3423
# HVAC POWER VENTILATORS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Roof exhausters.

B. Wall exhausters.

C. Cabinet exhaust fans.

### 1.02 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005 (Reaffirmed 2012).

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

G. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

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

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: Two sets for each individual fan.

### 1.04 QUALITY ASSURANCE

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

### 1.05 FIELD CONDITIONS

A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

## PART 2 PRODUCTS

### 2.01 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.02 ROOF EXHAUSTERS**

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Kitchen Exhaust Fan Unit: V-belt or direct driven as indicated, with upblast spun aluminum with grease tray housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

C. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, ventilated double wall, hinged curb adapter, and factory installed nailer strip.

D. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.

E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

**2.03 WALL EXHAUSTERS**

A. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.

B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, motor operated or automatic as scheduled.

D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm can be reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

**2.04 CABINET EXHAUST FANS**

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

B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.

C. Grille: Molded white plastic or Aluminum with baked white enamel finish.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Secure roof/wall exhausters with cadmium plated steel lag screws to roof curb/structure.

C. Extend ducts to roof/wall exhausters into roof curb/structure. Counterflash duct to roof/wall opening.

D. Hung Cabinet Fans:

1. Install fans with resilient mountings and flexible electrical leads, see Section 23 0548.
2. Install flexible connections specified in Section 23 3300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Provide sheaves required for final air balance.

F. Install backdraft dampers on inlet to roof and wall exhausters.

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

**END OF SECTION**

This page intentionally left blank

# SECTION 23 3700
# AIR OUTLETS AND INLETS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Diffusers:

B. Registers/grilles:

### 1.02 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (Reaffirmed 2011).

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

### 1.03 SUBMITTALS

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

### 1.04 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

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

## PART 2 PRODUCTS

### 2.01 CEILING, SIDEWALL DIFFUSERS, GRILLES, AND REGISTERS

A. Type: See schedule on drawings.

B. Frame: As applicable for the ceiling construction.

C. Fabrication: Steel with baked enamel off-white finish.

D. Accessories: Damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 9123.

**END OF SECTION**

This page intentionally left blank

# SECTION 23 7413
# PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Packaged roof top unit.

B. Unit controls.

C. Roof mounting curb and base.

### 1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

### 1.04 QUALITY ASSURANCE

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

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

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site in a clean, dry place protected from construction traffic until roof mounting curbs are in place, ready for immediate installation of units.

B. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

### 1.06 WARRANTY

A. Provide one year limited parts warranty on 3 to 5 Ton units.

B. Provide three year limited parts warranty on 6 to 25 Ton units.

C. Provide a five year warranty to include coverage for refrigeration compressors indoor fans, outdoor fans, controls, condenser and evaporative coils, components, etc.

D. Provide a fifteen year warranty to include coverage for stainless steel heat exchangers.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. AAON unless prior approval from owner..

### 2.02 MANUFACTURED UNITS

A. General: Roof mounted units having gas burner and electric refrigeration.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Additional Features: Refer to construction documents for additional information on equipment requirements including, but not limited to, economizer, demand control ventilation, powered exhaust building pressure management, hot gas reheat / dehumidification, and mounting configuration.

D. Electrical: Refer to construction documents for electrical characteristics and additional reqiurements.

### 2.03 FABRICATION

A. Cabinet: Galvanized steel, heavy guage, zinc coated with hinged access doors and hail guards.

B. Heat Exchangers: Stainless steel, of welded construction.

C. Supply Fan:
   1. 3 thru 5 Ton units: Forward curved centrifugal type, direct drive. Isolate complete fan assembly.
   2. 6 thru 25 Ton units: Plenum fan - backward curved type, direct drive. Isolate complete fan assembly.

D. Air Filters:
   1. 2 inch (50 mm) thick glass fiber filters and filter rack.

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

### 2.04 BURNER

A. Stainless steel tubular heat exchanger with induced draft combustion blower and direct spark ignition system.

B. Units shall be suitable for use with natural gas or propane.

### 2.05 EVAPORATOR COIL

A. Provide copper tube aluminum fin coil assembly with drain connection to drain pan. Drain pan to be stainless steel or composite (no galvanized drain pans).

### 2.06 COMPRESSOR

A. Provide hermetic direct-drive scroll compressors with centrifugal oil pumps. Refer to equipment schedules for compressor number and cooling stages.

### 2.07 CONDENSER COIL

A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

### 2.08 OPERATING CONTROLS - SINGLE ZONE UNITS

A. Room thermostat located as indicated on plans :
   1. Automatic switching from heating to cooling.
   2. 7-day programmable setpoints for four separate temperatures per day.
   3. Temporary override with display.
   4. Relative humidity
   5. Display programmed setpoints, actual room conditions, system operation (heat, cool, auto, off, fan auto, fan on) and current stage of operation.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that proper power supply is available.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

**END OF SECTION**

©the.**stacy**.group

This page intentionally left blank

# SECTION 23 8126.13
# SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor air handling (fan and coil) units for ducted systems.

C. Controls.

### 1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants; 2019.

D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.

E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 54 - National Fuel Gas Code; 2018.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

I. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.

J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. Division 1 - Submittals: Procedures for submittals.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual locations of components and connections.

### 1.04 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience and approved by manufacturer.

## 1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

# PART 2 PRODUCTS

## 2.01 SYSTEM DESIGN

A. Split-System Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
   1. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
   2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.
   1. Efficiency:
      a. Comply with ASHRAE Std 90.1.

## 2.02 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
   1. Air Flow Configuration: Upflow.
   2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

## 2.03 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Comply with AHRI 210/240.
   2. Refrigerant: R-410A.
   3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.

D. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

## 2.04 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
   1. Automatic switching from heating to cooling.
   2. Preferential rate control to minimize overshoot and deviation from setpoint.
   3. Instant override of setpoint for continuous or timed period from one hour to 31 days.
   4. Short cycle protection.
   5. Programming based on weekdays, Saturday and Sunday.
   6. Thermostat Display:
      a. Actual room temperature.

b. Programmed temperature.
c. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
B. Verify that proper power supply is available and in correct location.
C. Verify that proper fuel supply is available for connection.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
B. Install in accordance with NFPA 90A and NFPA 90B.
C. Install gas fired furnaces in accordance with NFPA 54.
D. Provide vent connections in accordance with NFPA 211.
E. Install refrigeration systems in accordance with ASHRAE Std 15.
F. Pipe drain from humidifiers to nearest floor drain.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 0500
# BASIC ELECTRICAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to other Electrical Sections, in addition to Division 01 - General Requirements.

B. If conflicts occur between Basic Electrical Requirements and Division 01, the provisions of Division 01 shall normally dictate; however, the more stringent of the two shall be followed and the Contractor shall indicate the differences in written form and submit to the Engineer for clarification.

### 1.02 REGULATORY REQUIREMENTS

A. Obtain and pay for permits and inspection fees for work included in this phase of the Contract. Comply in every respect with requirements of local inspection departments, National Fire Protection Association, and Local and State Ordinances and Codes. However, this requirement does not relieve the Contractor of the responsibility of complying with these specifications and drawings where specific conditions are of a higher quality and quantity than the requirements for complying with the most stringent of the codes, rules, ordinances or the specifications. Reference to standards is intended to be the latest revision of the standard.

B. The applicable portions of the following listed codes and standards are hereby made a part of this specification, except where requirements are exceeded in these specifications and drawings.
   1. National Fire Protection Association (NFPA).
   2. Codes and Ordinances of the Local Authority Having Jurisdiction (AHJ).
   3. International Building Code, with City Amendments, if applicable.
   4. National Electrical Code, (NFPA-70), with City Amendments, if applicable.
   5. National Electrical Safety Code (NESC).

### 1.03 APPLICABLE STANDARDS

A. The following organizations are hereinafter referenced as those whose standards are the basis for the designs, and manufactured items purchased shall conform to these standards where applicable.
   1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI).
   2. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS, INC. (ASHRAE).
   3. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM).
   4. ELECTRICAL TESTING LABORATORIES, INC. (ETL).
   5. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA).
   6. AMERICANS WITH DISABILITIES ACT (ADA).
   7. CERTIFIED BALLAST MANUFACTURERS (CBM).
   8. UNDERWRITERS' LABORATORIES, INC. (UL).
   9. ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA).

B. The following construction standards are required for the installations of this project:
   1. DEPARTMENT OF LABOR: OCCUPATIONAL SAFETY AND HEALTH STANDARDS (OSHA), LATEST REVISIONS.

### 1.04 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications shall be considered complementary to each other and work referenced in one and not included in the other shall be furnished complete as though included in both.

B. If floor plans, detail drawings, schedules, or specifications are not sufficiently detailed or explained, or if there are any discrepancies between floor plans, specifications, schedules, or detail drawings, the Contractor shall notify the Engineer of same in writing, prior to bid opening.

The Engineer will then inform the Contractor, in writing, which document takes precedence and/or furnish such information, drawings, etc., as required; after which the Contractor shall comply with same as part of this contract.

C. If the Contractor deems it necessary to make departures from the drawings, details of such departures and reasons for same shall be submitted for acceptance. No departures shall be made without prior written acceptance by the Engineer.

D. The Contractor shall be responsible for properly using the information on the Architectural, Structural, Civil, Mechanical and Electrical Drawings. All dimensional information shall be obtained from the appropriate drawings for new construction, and by taking actual measurements at the site for work to existing facilities. In no case shall drawings be scaled for dimensions. Should there be a discrepancy in figures, drawings, and/or specifications, the Engineer shall be notified immediately and shall determine the necessary adjustments.

E. Contractors shall visit the site, verify all existing items indicated on plans and/or in specifications and familiarize themselves with existing conditions and local requirements. The Contractor shall accept conditions as they exist and each proposal shall reflect all costs occasioned by these conditions. The lack of specific information on drawings shall not relieve the Contractor of this responsibility, nor be reason for any extra charges. The submission of bids shall be considered an acknowledgment on the part of the bidder of his site visitation.

F. Unless otherwise expressly agreed to in writing, all rights to the specifications and drawings prepared by CEC Corporation shall belong to CEC Corporation. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been met, including the payment of fees. Each page of the drawings, if prepared in whole or in part by CEC Corporation, and all pages of Electrical Sections of the Specifications are covered by copyright and may not be reproduced, published or used in any way without the permission of CEC Corporation.

G. References made herein to materials, equipment, devices, or methods and procedures such as cleaning or testing, shall refer to the new items which are a part of this Contract, and shall not pertain to existing systems or material, etc., which are not being changed or rerouted under this Contract.

**1.05 ADEQUACY OF WORK**

A. Drawings are diagrammatic and cannot show every connection in detail or every line of conduit in its exact location. Details are subject to the requirements of ordinances and also structural and architectural conditions. Carefully investigate structural and finish conditions affecting the work, and arrange the work accordingly; furnish all such fittings and accessories as may be required to meet the conditions to give satisfactory operation.

B. By submitting a bid on this work, the Contractor sets forth that his personnel has the necessary technical training and ability and that they will install this work in a satisfactory and workmanlike manner, up to the best standard of the trade, complete and in good working order.

C. Should any discrepancy or apparent difference occur between Drawings and Specifications, or should an error occur in the work of others affecting the electrical work, the Contractor shall notify the Engineer at once. If the Contractor proceeds with the work affected without instructions from the Engineer, he shall make good any resultant damage or defect. All misunderstandings of the Drawings and Specifications shall be clarified by the Engineer.

**1.06 WORKMANSHIP AND MATERIALS**

A. Workmanship shall be the best quality and performed by mechanics skilled in their trades. The Contractor shall furnish the services of an experienced superintendent who will be constantly in charge of the erection of the work until completed and accepted. Included in the work shall be proper unloading, installing, connecting, adjusting, starting, and testing of work involved, including equipment and materials furnished by others and the Owner.

B. Unless otherwise hereinafter specified, all materials and equipment under the Electrical Sections of the Specifications shall be new, of best grade, and as listed in the printed catalogs of the manufacturer. Each article of its kind shall be the standard product of a single manufacturer.

C. The Engineer shall have the right to accept or reject material, equipment and/or workmanship, and determine when the Contractor has complied with the requirements herein specified.

D. The Contractor shall coordinate with all trades in determining that various phases of work will not interfere with the final efficient operation or use of materials or equipment installed under this Contract. Interference shall be called to the attention of the Engineer before installation is made. The Engineer shall then instruct the Contractor to make such changes and corrections as deemed necessary.

**1.07 EQUIPMENT: GENERAL**

A. Manufacturers' published instructions shall be followed in making all installations, erecting, cleaning, and operating of all materials and equipment. Rotating equipment shall be statically and dynamically balanced for minimum vibration and low operating noise level.

B. Equipment capacities shall not be less than specified or scheduled.

C. All equipment and major components thereof shall be equipped with a permanently attached nameplate bearing manufacturer's name, address, catalog number and serial number. For equipment installed where exposed to the weather, the nameplate shall be corrosion-resistant metal with information engraved or stamped.

D. All moving parts, belts, pulleys, and other rotating parts shall be provided with suitable guards or enclosures in accordance with Federal, State, and local regulations.

E. All equipment to be installed shall be the standard catalog products of the manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall be products which have been in satisfactory use at least three years, unless otherwise accepted by the Engineer.

F. The installation of any materials and equipment not meeting the specified standards shall be removed and all new materials or equipment meeting the approval of the Engineer shall then be installed at no cost to the Owner.

G. Design is based on equipment as described in these specifications and equipment schedules. Any change in foundation bases, electrical wiring, conduit, circuit breakers, disconnects, connections, piping, controls, and openings that are required by alternate equipment submitted and accepted shall be the responsibility of the Contractor.

H. The Contractor shall be responsible for placing equipment or apparatus too large to pass through doors or stair wells, etc. within the building prior to completion of the enclosing structures. Properly protect the equipment from damage from normal construction processes and/or the elements after installation within the structure.

**1.08 DELIVERY, STORAGE AND HANDLING**

A. Materials and equipment shall not be stored at the site until ready for installation or until there is suitable space provided to properly protect equipment from the elements. Equipment shall be delivered and stored in original containers and shall be continuously protected from damage. Any damaged materials or equipment shall be replaced with new equipment or repaired to the satisfaction of the Engineer. Repainting of equipment will be required where damaged in shipment or by improper protection at the site. Rotating equipment stored on the site shall be turned through two full rotations a minimum of once a month.

**1.09 SUBSTITUTION OF MATERIALS, FIXTURES & EQUIPMENT**

A. Where equipment is specified by a manufacturer's name and catalog number only, or where a specified manufacturer or manufacturers are named as being acceptable, provided all design and space requirements are met, and subject to acceptance by the Engineer, no substitution or other equipment will be allowed.

B. Where materials, fixtures, or equipment are specified by manufacturer's name and catalog number, and the words "or equal approved" or similar wording is used, such specification shall be deemed to establish style, type, and quality of the equipment required and may include certain desirable technical features. The Contractor may offer, for acceptance, any material, item, or equipment or process which he believes is equal to or better in every respect to that indicated or specified as a substitution, provided it also meets space and capacity requirements.

C. Any alternate proposal for substitute equipment, or use of equipment not specified by catalog number, shall include all necessary changes and additions to other work occasioned by this substitute equipment. Additionally, each alternate proposal shall stipulate that the substitute product will fit the space allotted to the specified items and will provide equal or greater clearances for services, maintenance and/or removal. The Contractor shall be allowed only one substitution proposal; if the substitute items are not acceptable to the Engineer, the specified items or products shall be installed without change in cost.

D. Acceptance of a proposed substitution shall not be held to have relieved the Contractor of responsibility for the proper execution of the work, nor from guarantee and maintenance requirements imposed by the Contract Documents. Where no substitutions are proposed or accepted in conformity with the provisions of this article, then no deviation from the material or equipment specified will be allowed.

E. Unless specifically requested hereinafter, prior approval of substitute items will not be considered by the Engineer during the bidding phase.

**1.10 SUBMITTAL DATA AND SHOP DRAWINGS**

A. GENERAL: PDF versions of brochures, shop drawings, and material lists as required by the specifications, shall be prepared and submitted to the Engineer for review within thirty days after award of the Contract. No work indicated on any one shop drawing shall be started until such drawings have been reviewed and accepted by the Engineer.

B. Space is critical; therefore, equipment of larger sizes than shown, even though of an acceptable manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

C. Where equipment manufacturers named as equivalent or accepted as equal are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected. Contractor shall submit, for acceptance, 1/4 inch scale shop drawings for equipment rooms, plan and section, roof plan, etc.

**1.11 PRODUCT DATA**

A. Contractors shall submit complete product data of all equipment to be installed.

B. Contractors shall submit a list of all material as specified not covered by brochures or shop drawings.

C. Submittal shall be indexed by specification section with table of contents. Data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification sections and paragraphs. No consideration will be given to partial submittals. No submittal shall be accepted directly from supply house or manufacturer's representatives nor will substitutions be discussed with anyone other than the successful Contractor after the contract is awarded.

D. All materials and equipment shall be submitted by manufacturer, trade name, and model number. The submittal shall include data requested in the individual sections. The Contractor shall not assume that applicable catalogs are available to the Architect's or Engineer's office. Maintenance and operating manuals and coded order forms are not suitable submittal material. Each sheet of printed material shall be clearly marked (using arrows, underlining, or circling) to show the particular sizes, types, model numbers, ratings, capacities, and options

actually being proposed. Non-applicable material shall be crossed out. All specified features must be specifically noted on the submittal.

E. Where the item is a substitution, the submittal must be complete with adequate proof of its quality equal to the item specified. Substitutions made because of installation problems, non-availability, later delivery, etc., shall be explained in the transmittal letter accompanying the submittal. Substitute items shall be accepted only under the following conditions: “Should the material or equipment fail or perform unsatisfactorily during the warranty period, this material and/or equipment shall be replaced with material or equipment specified by name in these specifications, at no additional cost to the Owner. Contractor shall PERSONALLY bring a sample of the substitute item to the Engineer office for his inspection at time submittals are made if Engineer requests same.”

F. When items are omitted from the submittal or if submittal is not received by the Engineer within thirty days of Contract date, it shall be construed to mean that only items specified by name and number shall be installed and no substitutions shall be accepted.

G. In the event that submitted materials, appliances, etc., are not, in the opinion of the Engineer, in conformity with the specifications, the Engineer reserves the right to reject this equipment.

H. If items other than those specified or approved as submitted are found installed on the project, they shall be removed and the specified items shall be installed at no cost to the Owner.

I. Submittals shall be reviewed by the Engineer for conformance with design concept only. Review will not include deviations from detail requirements unless these deviations are specifically listed by the Contractor in writing and attached to the data. The Contractor’s responsibility includes, but is not limited to, obtaining and aptly applying all field measurements; construction criteria including all means and methods, materials, catalog numbers, and similar data for checking and coordinating with the requirements of the work. Quantities of materials and equipment will not be checked by the Engineer.

**1.12 SHOP DRAWINGS**

A. Contract drawings are diagrammatic design drawings and are not intended as installation drawings. Each Contractor shall, within thirty days after award of contract, and prior to beginning any installations, prepare NEW AND ORIGINAL detailed shop drawings for the following as applicable to the project:
   1. Control Wiring Diagrams
   2. Interlock Wiring Diagrams
   3. Kitchen Electrical Rough-Ins
   4. Electrical Rooms, 1/4" scale, plan and sections.
   5. Electrical Trenches and routing of site electrical services (not less than full scale for site routing).
   6. Detail shop drawings for main switchgear.
   7. Special electrical systems such as fire alarm, sound systems, lightning projection, C.C.T.V., telephone, intercom, paging, etc.,
   8. and other critical spaces as directed by the Engineer, showing the exact location and dimensions, spacing and location of each piece of equipment, piping, and conduit. Reproduction of Engineer’s design drawings shall not be considered as shop drawings.

B. The Contractor shall coordinate to ascertain that there are no conflicts. The Contractor is responsible for rearrangement and revision required to dimensions, connection sizes, special installment requirements, horsepower, voltage, and phase of all equipment.

C. Each trade, in cooperation with all other trades, shall determine, prior to commencing work, the sequence of the installation of all trades.

D. In no case will wire to wire or terminal type of wiring diagrams for control system be included or checked as submittal; they shall be included as information only. Temperature control function diagram and written description only shall be accepted by the Engineer.

E. The Contractor's responsibility includes, but is not limited to, obtaining and aptly applying all field measurements, construction criteria including means and methods, and materials and necessary coordination data for making all installations complete and operating to the full intent of the Contract Drawings and Specifications.

F. Shop drawings shall be submitted to and approved by the Engineer prior to beginning of any installations. The Engineer will assist in resolving installation problems and conflicts only when furnished with complete shop drawings prepared by the Contractor for all phases of the work and only when the Contractor cannot solve a problem. When installations are made without submitting shop drawings, the Contractor is responsible for immediate correction at his own cost for conflicts and to installations contrary to the intent of design drawings.

## 1.13 CONSTRUCTION RECORD DRAWINGS

A. Each Contractor shall purchase or obtain from the Architect/Engineer one complete set of final design documents of the Contract Drawings and shall record on these drawings all locations, dimensions, and depths of all buried and concealed piping and conduits, plugged outlets, and equipment. The master copy shall be maintained at the job site at all times and shall be marked daily as construction progresses. These drawings shall not be used for reference or construction but shall be available for the Engineer's review. No backfilling of trenches will be permitted until Record Drawings are approved as up-to-date.

B. Depth of duct banks and other underground conduit prints shall be from a permanent bench mark which shall be shown on drawings.

C. At completion of the work, the data on these prints shall be given to the Engineer of record and transferred electronically to CAD drawing format (if included in Engineer's scope of work). The electronic files shall then be copied to a CD for reproducible prints by the Contractor or building Owner, dated, marked "Record Drawings".

## 1.14 MANUFACTURER'S INSPECTION

A. At the completion of work and before acceptance, an authorized representative of the manufacturers of electrical equipment shall personally inspect the installation and operation of his equipment to determine that it is properly installed and in good operating order. If equipment is to be concealed, the representative shall make his checks during the course of installation. The Contractor shall submit to the Engineer a statement signed by each manufacturer's accordance with the manufacturer's recommendations and is operating properly.

B. Inspection shall include new distribution equipment, electrical gear, fire alarm, lighting controls, special systems, and such items as are specifically designated by the Engineer.

## 1.15 TESTING LABORATORY CERTIFICATION

A. All equipment and materials where applicable shall be listed by Underwriters' Laboratories and shall bear the Underwriters' Laboratories label.

B. All material, equipment, products furnished and installed on this project shall bear the label, symbol and other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled and/or listed equipment or material and whose listing of labeling states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner, when such label, symbol, or listing is available.

## 1.16 FIRE AND SMOKE DEVELOPMENT RATINGS OF MATERIALS

A. All materials and products installed on this project shall have published fire and smoke developed ratings that conform with U.L. classifications and NFPA 90A and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less and a fuel contribution rating of 50 or less.

## 1.17 ASBESTOS

A. No product which contains asbestos shall be incorporated into any component of this Project.

B. If asbestos is encountered in any existing installations, Contractor shall stop work immediately and notify the Owner. No work shall be commenced in the area containing asbestos until complete removal or abatement has been accomplished by Owner.

**1.18 EXISTING UTILITY ELECTRICAL SERVICES**

A. The drawings indicate all known utility and drainage piping existing on the site of the work. Location of said piping is in accordance with information furnished to the Engineer by the Owner. Responsibility for locating, uncovering, disposing, or maintaining all existing utility conduit shall rest solely with the Contractor, who shall plan and conduct his operations in such a manner to insure safe conditions for the entire construction period.

B. Existing underground electrical services shall be maintained in service unless otherwise noted. Contractor shall promptly repair all electrical services to be maintained in service, at no expense to the Owner, in the event that they are damaged as a result of his work of this project. All pull boxes, manholes, or other appurtenances of utilities which are to remain in service shall be raised or lowered to meet new finished grades as indicated on appropriate drawings.

C. Make arrangements for connections to utilities required for the work as shown on drawings and pay all charges and fees in connection with any service connections, making installations complete in all aspects.

D. Each Contractor shall furnish and install all materials, equipment, and labor required for finished, complete, and operating service connections. Contractors shall be responsible for making personal contact with proper officials of utility companies prior to bid opening and obtaining all details of service requirements and for including ALL costs for ALL requirements for complete services.

E. Any detail requirements for utility metering and/or connections is specified hereinafter in the appropriate section.

F. Existing utility conduit which is to be abandoned shall be completely removed where it occurs in the area of excavation. Abandoned conduit shall be plugged or capped in a manner acceptable to the Engineer. Existing manholes shown to be abandoned shall be filled with sand.

G. Any minor adjustment in location or alignment of new work to avoid or to connect to existing utilities shall be performed as directed by the Engineer without additional cost to the Owner.

**1.19 EXCAVATION AND BACKFILL**

A. Provide all excavation and backfill required for work of this section, in accordance with applicable requirements of Division 31 - Earthwork Section. Coordinate disposition of building materials to avoid interference with all other work.

B. Provide barricade protection and shoring as required for safety.

C. Do not backfill until after testing and inspection of installed conduit work.

D. All plants, turf, and surfacing that occur in the areas of the excavation shall be carefully removed and placed where they will not be damaged. After the excavations are filled, the plants, turf, and surfacing shall be replaced as directed. All sidewalks, driveways, or other cement or asphalt surfaces which are damaged during excavating shall be repaired to match the adjacent work in material and finish and in accordance with requirements established by authorities having jurisdiction over subject walks, lawns, or streets.

E. Provide clearance (12 inches minimum) under suspended conduit under the building. The Contractor shall be responsible for necessary excavation to obtain such clearance and if such clearance is not found to exist at the completion of the project, the Contractor shall excavate as required to meet this specification.

F. Conduit trenches not under the building shall be parallel to building lines unless otherwise noted on drawings.

G. Trenches shall be cut a minimum of six inches (6") below required depth to allow for bedding material. All conduit shall have a minimum cover of 24 inches unless otherwise noted or accepted. Trenches shall be a minimum of SIX inches (6") wide and not less than FOUR

inches (4") wider than outside diameter of a single conduit being installed. When more than one conduit is installed in a trench, the trench shall be widened appropriately to allow the conduit to be laid side-by-side with a minimum of FOUR inches (4") of sand between each conduit. In no case shall different services be installed one above the other. Piping and/or conduit of various trades shall NOT be installed in same trench unless permission in granted by the Engineer. Where required by depth and/or type of soil, trenches shall be properly and adequately shored to prevent cave-ins and slides.

H. Properly backfill, flood, and tamp all excavations to the finished grade AFTER the conduit has been observed and accepted. The backfill for all conduit may be excavation material, except that at least six inches (6") of clean pit run sand shall be placed over the pipe and six inches (6") of sand below the pipe. A minimum of 12 inches of sand is required for all conduit. Backfill shall be placed in six inch (6") layers, wetted and compacted to the density of adjacent soil. Continue this process until trenches are completely backfilled. Surplus materials shall be hauled from the project. Where trench backfill settles below finished grade during the one year guarantee period, the Contractor shall take necessary steps to correct same as accepted by the Engineer.

I. Trenches backfilled prior to observation of conduit by the AHJ shall be reopened as directed by the AHJ.

**1.20 OPENINGS: CUTTING, REPAIRING**

A. Holes in Concrete: Sleeves shall be furnished, accurately located, and installed in forms before pouring of concrete. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the acceptance of the Structural Engineer prior to cutting or drilling. No cutting or boring of structural members shall be done without WRITTEN permission of the Structural Engineer.

B. Verify that all chases and openings are properly located.

C. Damage to existing facilities shall be repaired as required to restore these facilities to their original condition. All openings through floor, ceilings, walls, etc., shall be sealed rat and insect-proof, whether exposed to view or within walls, with a fire resistant sealant.

**1.21 CONCRETE WORK**

A. Provide concrete equipment bases for switchboards, power distribution panels, motor control centers, floor mounted electrical panels, transformers, etc. Provide anchors and all conduit supports in trenches.

B. Furnish all required templates for anchor bolts and dimension drawings for housekeeping pads. All concrete shall be in accordance with that specified under Division 03 - Concrete of the Specifications.

**1.22 MANNER OF RUNNING PIPE AND CONDUIT**

A. All conduits shall be concealed in chases, walls, furred spaces, or above the ceilings unless otherwise noted.

B. In mechanical/electrical rooms, janitor’s closets, or other storage spaces, where necessary, conduit may be run exposed. Exposed conduit shall be run in the neatest, most inconspicuous manner and parallel to building lines. Conduit shall be run high as possible when exposed in rooms.

C. No conduit shall be installed in structural concrete slabs, beams, walls, or concrete structure without prior approval unless specifically noted on the drawings.

**1.23 EQUIPMENT AND CONNECTIONS**

A. All apparatus, equipment, devices, and appliances which are indicated to have electrical connections shall be so equipped.

## 1.24 MOTORS AND CONTROLS

A. Motors less than one horsepower shall be 115 volts or 200/230 volts, single phase, with built-in thermal protection and shall be furnished with manual or magnetic starters as required, unless otherwise noted on drawings.

B. The Contractor shall furnish a suitable motor starter with the necessary number of auxiliary contacts required for the use with the proper type of switch controls in the cover. Motor starters shall be equal to Furnas, Siemens, General Electric, Cutler-Hammer, or Square D, with three leg overload protection; except special requirements for motor starters shall be specified under the particular piece of equipment requiring starter. Mounting of motor starters and wiring shall be installed under Electrical Division.

## 1.25 ELECTRICAL WIRING OF TEMPERATURE CONTROL EQUIPMENT

A. The Contractor shall be responsible for complete installation of all the automatic temperature control wiring. All power wiring, interlock wiring as required, starter connections, and disconnect switches shall be installed under Electrical Division. Control wiring shall be a minimum of No. 18 AWG and shall be copper with THW or THWN-THHN insulation. Control wiring shall be installed in EMT conduit when above grade, PVC when below. See applicable section for conduit specifications.

B. Mechanical contractor shall provide necessary wiring diagrams showing power wiring, interlock wiring, and temperature control wiring which shall be used for making the control wiring and interlock wiring installations.

C. At the completion of all construction work, there shall be a meeting at the job site of all parties involved, who shall inspect, test, and check each control circuit, interlock circuit, and power circuit for all equipment and shall determine by mutual agreement that all equipment is properly wired for the operations intended. A letter to this effect, signed by all three parties, shall be furnished to the Engineer at the time of final inspection. This letter shall read as follows:

1. “We, the undersigned authorized representatives of the Contractor, hereby certify that we have met together at the site and have by test and check found that entire temperature control system and interlock wiring systems are properly installed and wired and all items are functioning in accordance with design requirements and Contract Drawings and Specifications.”

## 1.26 CLEAN-UP

A. All unused material and debris resulting from the performance of work shall be removed from the premises as it accumulates.

## 1.27 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. Furnish hoisting facilities to set materials and equipment in place and provide scaffolding, ladders, and facilities for equipment installations and for adjustment and balancing, installation of grilles, and cleaning of fixtures and devices. Provide transportation to deliver materials, equipment, tools and labor to perform the work.

## 1.28 SLEEVES FOR ALL CONDUITS

A. For conduits through outside walls above grade, install Schedule 40 GALVANIZED steel pipe sleeves having an inside diameter of 1-1/2 inches greater than the outside diameter of piping being installed. Sleeves shall be flush with each wall surface.

B. Where conduits pass through floors not on fill, 22 gage GALVANIZED sheet metal sleeves shall be used. In concrete floors they shall extend one inch above the floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least one inch (1") greater than outside diameter of insulation. Sleeves shall be set before concrete is poured.

C. Sleeves in footings, grade beams, under sidewalks, drives, and elsewhere noted on drawings shall be Schedule 40 PVC plastic pipe with chemical weld joints. Use long sweep ells where conduit turns are made.

D. Where conduit passes through a concrete wall, beam, or floor below grade or below ground water level, a through-wall or floor seal shall be installed. Sealing fitting shall be installed in concrete forms before concrete is poured. Fitting shall be O-Z / Gedney Type FSK where sealing is required on one side of wall only and Type WSK where sealing on both sides of wall is required. Installation shall be in accordance with manufacturers' instructions.

E. The annular space around conduits and sleeves shall be filled with a fire resistant sealant as specified hereinafter. Both sides of wall, floor, ceiling, or roof shall be sealed to the satisfaction of the Engineer whether exposed to view or within walls. ALL openings around conduits shall be insect, vermin, and rodent proof.

**1.29 ROOF PENETRATIONS AND FLASHINGS**

A. Refer to Specification Division 07 – Thermal and Moisture Protection.

**1.30 SEALING OF PENETRATIONS (FIRE STOPPING)**

A. Seal all small openings in floors, walls, ceilings, etc. around conduit, cables, etc. with Dow Corning Fire Stop Sealant System, 3M Fire Barrier 2000+ Silicone Sealant Systems, or approved equal, in conformance with U.L. testing procedures.

B. Seal all openings larger than 1/4" around conduit, etc., through roof, walls and floors above grade with a two-part foam, or one-part sealant material approved by the Engineer, at least 1-1/2" thick, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 deg. F. for two hours. Fire and smoke barrier will be required in all floors above grade of multi-story buildings and in all walls of fireproof construction. All empty holes and all large openings around conduit, cables, etc., shall also be filled with two-part fire stopping materials. One-part may be used for single penetrations at sleeves and fire rated expansion joints.

C. The firestopping system shall be materials that expand to fill cavities or provide adhesion to substrates, and that will maintain seal under normal expected movement of substrates. MATERIAL SHALL NOT REQUIRE A RISE IN TEMPERATURE TO INSTALL OR ACTUATE THE SEAL. Fire Stop Systems shall utilize materials that are UL Classified as "Fill, Void, or Cavity Materials" and "Through Penetration Firestop Systems." Materials shall have been tested in accordance with ASTM E814 "Methods for Fires Tests of Through-Penetration Firestops" and UL 1479 "Fire Tests of Through-Penetration Firestops."

D. Mineral fiber board, mineral fiber matting and mineral fiber putty may be used as forming and damming for the foam and may be left in place as an integral part of the seal if of a fire rated material. Plywood, particle board, or other combustible foaming and damming materials shall be removed after foaming is completed.

E. Foam exposed in finished areas shall be neatly trimmed flush with the finish surface. In traffic areas, foam sealed areas shall be covered with a traffic surface approved by the Architect.

F. Application of foam in penetrations shall be made in accordance with the manufacturer's recommended procedure. Upon completion of the installation, the openings around all penetrations shall be airtight to prevent passage of water, smoke, fire or vermin. Proper installation shall be verified by proper color change and cell structure of cured foam.

G. Damming materials shall be removed after foam has cured for 24 hours if of other than fire sensitive materials. Seal all voids that have developed in foam with Dow Corning RTV sealant as required to provide full coverage.

H. Inspect penetration seals after 24 hours and inject additional foam where required for a tight seal. Reinspect after added foam has cured 24 hours. Cut and trim cured foam with sharp knife as required for finished appearance.

I. Nelson Flameseal Putty, Flamemaster (Flamastic 77), and Thomas & Betts Flamesafe Fire Stop System may be acceptable products for sealing of penetrations provided they are installed according to manufacturer's recommendations and are approved by the Engineer prior to installation.

### 1.31 FLOOR AND CEILING PLATES

A. Furnish and install chromium plated escutcheon plates around conduits passing exposed through walls, floors, or ceilings. Plates shall be sized to fit outside of pipe or sleeves and/or insulation and shall fit snugly. Plates shall fit around sleeves where they extend through the floor. Solid chromium plated plates with set screws shall be installed on any conduit where split ring or compression type plates will not stay in position.

B. Where bus ducts or cable trays pass through walls, floors, or ceilings, install sheet metal collars to cover the void around the duct where fire barrier is not required.

### 1.32 TESTS AND ADJUSTMENTS

A. No conduit work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer, who shall be notified a minimum of 48 hours in advance. All work shall be completely installed, tested as required by this section and the City and State Ordinances, and shall be repeated upon request to the satisfaction of the Engineer's representative.

B. Test gages shall have been calibrated for accuracy within three (3) months of date tests are made. Evidence of calibration shall be available to Engineer upon request.

C. Test gages shall have a range such that the test pressure will fall at mid-range of dial.

D. Test Procedures shall be applied for minimum periods noted and until tests are complete.

E. The Engineer shall be notified 48 hours prior to each test and other specification requirements requiring action by the Engineer. All tests shall be made in presence of the City Inspector and/or Engineer's representative.

F. Maintain written logs of all tests specified above.

### 1.33 OPERATION TEST

A. At completion of installations, Contractor shall operate all electrical and special systems for a period of at least two days of eight hours each to demonstrate fulfillment of the requirements of the Contract. During this time, all adjustments shall be made to the equipment until the entire system is in satisfactory operating condition acceptable to the Engineer.

### 1.34 FINAL OPERATION AND INSTRUCTION

A. Upon completion of the installation of the equipment and after final acceptance, and on Engineer's request, the Contractor shall place a competent person at the building who shall operate the plant for a period of one eight hour day, instructing the Owner in all details of operation and maintenance. This requirement is in addition to "Operation Test" specified above.

B. Any required instructions from manufacturer's representatives shall be given during this period. The time specified under "Operation Test" will not substitute for the one day of final operation and instruction.

### 1.35 OPERATION

A. The Owner may require operation of parts of all of the installation for beneficial occupancy prior to final acceptance.

B. Cost of utilities for such operation shall be paid by the Owner. Said operation shall not be construed as acceptance of the work; however, Contractor shall obtain written agreement with Owner regarding beginning date for warranty and guarantee purposes. Unless such agreement is obtained, warranties and guarantees shall go into effect upon completion.

### 1.36 DAMAGE BY LEAKS

A. The Contractor shall be responsible for damages to the grounds, walks, roads, buildings, piping systems, electrical systems and their equipment and contents, caused by leaks by this Contractor as a part of this Contract. He shall repair, at his expense, all damage so caused. All repair work shall be done as directed by the Engineer.

## 1.37 EMERGENCY REPAIRS

A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities during the Contract period.

## 1.38 REQUIREMENTS FOR FINAL ACCEPTANCE OF PROJECT

A. All of the following items must be completed prior to final acceptance of project. No exceptions will be made and no final acceptance of payment will be made until all items are completed.
   1. CLEANING EQUIPMENT AND PREMISES:
      a. Thoroughly clean all parts of the conduit and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster and other materials and all oil and grease; adhesive labels, and foreign materials shall be removed. Surfaces shall be carefully wiped.
      b. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
      c. Electrical device covers shall not be installed until finish coat of paint is completed. Device handles and receptacles shall be covered and/or protected during the painting operation to preserve the original factory finish.
   2. DEFICIENCY LISTS: Correct all deficiencies listed at time of Substantial Completion.
   3. OWNER'S OPERATING AND SERVICE MANUAL: Submit, at least ten days prior to Final Acceptance, one copy of the Owner's Manual to the Engineer for his acceptance. Following the Engineer's acceptance, prepare PDF manual and one paper copy of bound, indexed, Owner's Manual to be delivered at time of Final Acceptance, which shall include but not be limited to the following:
      a. System operating instructions.
      b. System control drawings.
      c. System interlock drawings.
      d. System maintenance instructions.
      e. Material and equipment lists.
      f. Serial numbers of all principal pieces of equipment.
      g. Manufacturer's, suppliers', and subcontractors' names, addresses, and telephone numbers; both local representatives and manufacturers' service headquarters.
      h. Equipment operating and maintenance instructions and parts lists.
      i. Certified performance curves.
      j. Manufacturer's certification.
      k. Balancing and performance test report.
      l. Complete electrical load data from operation test.
   4. INSTRUCTIONS:
      a. All verbal instructions as herein specified shall have been performed.
      b. Provide the following:
         1) System operating instructions.
         2) System control drawings.
         3) System interlock drawings.
   5. CERTIFICATIONS: Provide PDF and one bound copy containing the following:
      a. Performance Test Report.
      b. Manufacturer's certifications.
      c. Contractor's guarantees.
      d. Owner's acknowledgment of receipt of instruction, enumerating items in Owner's Manual. List of manufacturers' guarantees executed by the Contractor (those extending beyond one year.)
   6. RECORD DRAWINGS: Deliver the specified record drawings to the Engineer.
   7. Furnish the services of an Engineer or Technician acceptable to the Engineer to instruct the Owner's authorized representative in the complete and detailed operation of each and every system and piece of equipment. Instructions shall be conducted for the period of

time necessary to thoroughly familiarize Owner's personnel and to accomplish the desired results. Upon completion of these instructions to the Owner, provide a letter to the Owner signed by him stating dates and names of personnel giving instruction and those receiving instruction. NOTE: One copy of these letters shall be included in data to be furnished for final acceptance and shall be sent directly to the Engineer.

**1.39 GUARANTEES AND WARRANTIES**

A. The Contractor shall guarantee to the Owner that all labor, materials furnished, and work performed are in accordance with the contract, contract drawings, specifications, authorized alterations, and additions. Should any defect develop during the contract guarantee period due to improper materials, workmanship, or arrangement, the same together with any other work affected in correcting such defect shall be made good by the Contractor without expense to the Owner.

B. The materials and equipment shall be warranted to be free from defects by the manufacturer. Any defect that develops or failure that occurs during the contract guarantee period together with any other work affected in correcting such defect or failure shall be made good by the Contractor without expense to the Owner. Manufacturer and Contractor shall include cost of labor in the warranty of all equipment.

C. The contract guarantees and warranty periods shall be from the date the complete facility is accepted by the Owner, unless other dates are mutually agreed upon between Owner and Contractor.

D. The Contractor's work shall be guaranteed for a minimum of **one year** unless noted otherwise in specific sections of these specifications.

E. The materials and equipment shall be warranted for a minimum of one year. Some components may be specified with or normally have longer standard warranty periods. In this case, the longer warranty period shall be provided by the Contractor.

**1.40 DEMOLITION AND RELOCATION (WHERE APPLICABLE)**

A. The Contractor shall remove and/or relocate, modify, or reinstall all items as indicated on drawings or required by the installation of new materials, equipment, and outlets. All removal and/or salvage and all materials and equipment shall remain the property of the Owner and shall be stored at such locations on site as designated by the Owner.

B. All waste, trash, debris and other such unusable items shall be promptly removed from the site and disposed by the Contractor.

C. All items of equipment to be relocated shall be thoroughly cleaned, inspected, and reinstalled in a proper manner by workmen skilled in the trade and in conformance with standard practice of trade involved. Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore item to good operation. Should equipment designated for relocation be found to be damaged and/or unsuitable for relocation, it shall be called to the attention of the Engineer prior to dismantling for further instructions before removal. Items damaged during removal and/or storage are the responsibility of the Contractor and shall be replaced or repaired by him in a manner acceptable to the Owner. After reinstallation, items shall be "fire-tested" and/or given operational tests and put back into proper working order. Service piping and/or wiring to items to be removed or relocated shall be removed to points at which reuse is to be continued or service is to remain. Services not reused shall be capped, sealed, or otherwise cut-off or disconnected in a safe manner acceptable to the Owner and shall be done in such a manner to result in a minimum of interruption to services of adjacent occupied areas. Services to existing occupied areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specified acceptance of the Owner and a time schedule accepted by him for the cut-off period.

D. The Contractor shall be responsible for the loss or damage of existing facilities caused by him or his workmen and shall be responsible for repairing all damage and the replacement of such losses. The Contractor shall erect such temporary barricades, with necessary safety devices

as required, to protect working personnel and/or others from injury and shall remove such temporary protection upon completion of the project. Where existing construction is removed to provide working access to existing utilities and where partitions, walls, floors, and ceilings are removed, the Contractor shall remove and reinstall in locations accepted, all devices required for the complete final system in each and every respect. Contractor shall provide temporary service facilities to all equipment which must remain in operation during the construction period and shall make such necessary arrangements, send proper notices, and perform all such services as required to maintain in service operation all electrical and special systems in all new and existing areas as required for the continuing operation of the facility being remodeled.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

# SECTION 26 0519
# LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Wire pulling lubricant.

### 1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop and/or NEC required deratings.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

### 1.05 QUALITY ASSURANCE

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

## PART 2 PRODUCTS

### 2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Metal-clad cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
   2. In addition to other applicable restrictions, may not be used:
      a. Unless approved by Owner.
      b. Where not approved for use by the authority having jurisdiction.

c. Where exposed to view.
d. Where exposed to damage.
e. For damp, wet, or corrosive locations.

**2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS**

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Provide new conductors and cables manufactured not more than one year prior to installation.

C. Comply with NEMA WC 70.

D. Conductor Material:
1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.

E. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
a. Exceptions:
1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
4) Intent is to limit branch circuit voltage drop (panel to device) to 3% or less..
2. Control Circuits: 14 AWG.

F. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

G. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
a. 480Y/277 V, 3 Phase, 4 Wire System:
1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral/Grounded: Gray with white stripe.
b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White with black stripe.
c. 240/120 V, 1 Phase, 3 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Neutral/Grounded: White.
d. Equipment Ground, All Systems: Green.
e. Travelers for 3-Way and 4-Way Switching: Pink.
f. For control circuits, comply with manufacturer's recommended color code.

**2.03 SINGLE CONDUCTOR BUILDING WIRE**

A. Manufacturers:

1. Copper Building Wire:
    a. Encore Wire Corporation: www.encorewire.com/#sle.
    b. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
    c. Southwire Company: www.southwire.com/#sle.
    d. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
    a. Size 10 AWG and Smaller: Solid.
    b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    a. Size 4 AWG and Larger: Type XHHW-2.
    b. Installed Underground: Type XHHW-2.

## 2.04 METAL-CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Grounding: Full-size integral equipment grounding conductor.

G. Armor: Aluminum or steel, interlocked tape.

H. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

## 2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
1. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC; _____: www.burndy.com/#sle.
      b. Thomas & Betts Corporation: www.tnb.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC; _____: www.burndy.com/#sle.
      b. Thomas & Betts Corporation: www.tnb.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.06 ACCESSORIES

A. Electrical Tape:
   1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
   2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant:
   1. Listed and labeled as complying with UL 267.
   2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   3. Suitable for use at installation temperature.

# PART 3 EXECUTION

## 3.01 EXAMINATION

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

B. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

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

## 3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

## 3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

6. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

H. Install conductors with a minimum of 12 inches of slack at each outlet.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

K. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Wet Locations: Use heat shrink tubing.

M. Insulate ends of spare conductors using vinyl insulating electrical tape.

N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

O. Identify conductors and cables in accordance with Section 26 0553.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

## 3.04 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective conductors and cables.

**END OF SECTION**

# SECTION 26 0526
# GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

### 1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

## PART 2 PRODUCTS

### 2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect or Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 10 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method or alternate test described in IEEE 81.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    a. Provide continuous grounding electrode conductors without splice or joint.
    b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
    a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
    b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
    c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:
    a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
    a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
    a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
    b. Space electrodes not less than 10 feet from each other and any other ground electrode.
    c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
    b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
    c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

F. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
    a. Transformers (except autotransformers such as buck-boost transformers).
    b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
    c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system,

where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
    c. Metal process piping.
8. Provide bonding for metal building frame.

H. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from building grounding electrode system to each communications room or backboard and provide ground bar for termination.
    a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
    c. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
    d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

I. Lightning Protection Systems:
1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

J. Pole-Mounted Luminaires: Also comply with Section 26 5600.

K. Static Control Flooring: Provide bonding of static control flooring provided in accordance with Section 09 6500.

## 2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: 1/4" x 4" x 24" unless otherwise indicated or required.
   3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

# PART 3 EXECUTION

## 3.01 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

F. Reference grounding details on drawings for additional information.

**3.02 FIELD QUALITY CONTROL**

A. Inspect and test in accordance with NETA ATS except independant testing is not required.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 0529
# HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

### 1.02 QUALITY ASSURANCE

A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.2. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   6. Do not use wire, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:
   1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
   2. Comply with MFMA-4.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Plastic and lead anchors are not permitted.
3. Hammer-driven anchors and fasteners are not permitted.

## PART 3 EXECUTION

### 3.01 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect or Engineer, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect or Engineer, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
   2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3.5 in high concrete pad constructed in accordance with Section 03 3000.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: See Section 26 0533.13 for additional requirements.

I. Cable Tray Support and Attachment: See Section 26 0536 for additional requirements.

J. Box Support and Attachment: See Section 26 0533.16 for additional requirements.

K. Busway Support and Attachment: See Section 26 2513 for additional requirements.

L. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.

M. Exterior Luminaire Support and Attachment: See Section 26 5600 for additional requirements.

N. Secure fasteners in accordance with manufacturer's recommended torque settings.

O. Remove temporary supports.

### 3.02 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

# SECTION 26 0533.13
# CONDUIT FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Galvanized steel intermediate metal conduit (IMC).

C. PVC-coated galvanized steel rigid metal conduit (RMC).

D. Flexible metal conduit (FMC).

E. Liquidtight flexible metal conduit (LFMC).

F. Galvanized steel electrical metallic tubing (EMT).

G. Rigid polyvinyl chloride (PVC) conduit.

### 1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 8400 - Firestopping.

C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.

D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

E. Section 26 0529 - Hangers and Supports for Electrical Systems.

F. Section 26 0533.16 - Boxes for Electrical Systems.

G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
   4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
   5. Notify Architect or Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

### 1.05 QUALITY ASSURANCE

## PART 2 PRODUCTS

### 2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, request additional information from engineer.

C. Underground and Slab-on-Grade:
   1. Minimum Size: 1 inch. (1/2 inch when crossing within concrete slabs)
   2. Use nonmetallic conduit.
   3. PVC coated Rigid Galvinized Steel Rigid Metal Conduit Sweeps and Risers for all conduit greater than 1" in diameter.
   4. Under Slab on Grade: Use rigid PVC conduit.
   5. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
   6. Where rigid polyvinyl (PVC) conduit is provided, transition to rigid conduit of appropriate type where emerging from underground.
   7. Where rigid polyvinyl (PVC) conduitlarger than 1 inch trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
   8. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use PVC corrosion protection tape or factory-applied corrosion protection coating acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.

D. Embedded Within Concrete:
   1. Within Slab on Gradewhen slab thickness greater than 5 inches.: Use nonmetallic conduit.
   2. Within Slab Above Groundwhen slab thickness greater than 5 inches: Use nonmetallic conduit. EMT is allowed when not in direct contact with earth..

E. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit, galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

F. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
      b. Where exposed below 20 feet in warehouse areas.

G. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

H. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or stainless steel intermediate metal conduit (IMC).

I. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.

J. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit.

K. Flexible Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit (FMC).
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

L. Dry Locations:
   1. Concealed: Use electrical metallic tubing.

## 2.02 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

C. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 3/4 inch (21 mm) trade size.
2. Branch Circuit Homeruns: 3/4-inch trade size.
3. Control Circuits: 1/2-inch trade size.
4. Flexible Connections to Luminaires: 3/8-inch trade size.
5. Underground, Interior: 1 inch (27 mm) trade size.
6. Underground, Exterior: 1-inch trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

## 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## 2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## 2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## 2.06 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

## 2.07 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. ABB; Ocal: www.electrification.us.abb.com/#sle.
   2. Calbond, a division of Atkore International www.calbond.com/#sle
   3. Robroy Industries: www.robroy.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

D. PVC-Coated Boxes and Fittings:
   1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
   2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
   3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
   4. Material: Use steel or malleable iron.
   5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.

E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

## 2.08 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

## 2.09 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

## 2.10 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   3. Connectors and Couplings: Use set-screw type.
      a. Do not use indenter type connectors and couplings.
   4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.
   5. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are not acceptable.

### 2.11 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Connectors and Couplings: Use compression/gland or set-screw type.

### 2.12 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

### 2.13 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

E. Sealing Systems for Concrete Penetrations:
   1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
   2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

F. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

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

### 3.02 INSTALLATION

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

B. Install conduit in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.

F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
   a. Electrical rooms.
   b. Mechanical equipment rooms.
   c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
   a. Across floors.
   b. Across roofs.
   c. Across top of parapet walls.
   d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in same area on common rack.
15. Coordinate routing of exposed conduit routing with owner/architect prior to instalation.

H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.

K. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 0553.

L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Maximum Conduit Size: 3/4-inch trade size unless otherwise approved.
2. Install conduits within middle one third of slab thickness.
3. Secure conduits to prevent floating or movement during pouring of concrete.

M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated; see Section 03 3000.

N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

O. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
   a. Where conduits enter building from outside.
   b. Where service conduits enter building from underground distribution system.
   c. Where conduits enter building from underground.

d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

P. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

Q. Provide grounding and bonding; see Section 26 0526.

R. Identify conduits; see Section 26 0553.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

**3.04 CLEANING**

A. Clean interior of conduits to remove moisture and foreign matter.

**3.05 PROTECTION**

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

**END OF SECTION**

**SECTION 26 0533.16**
**BOXES FOR ELECTRICAL SYSTEMS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Underground boxes/enclosures.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Additional requirements for locating boxes for wiring devices.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

**1.05 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

**PART 2 PRODUCTS**

**2.01 BOXES**

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use suitable concrete type boxes where flush-mounted in concrete.
   5. Use suitable masonry type boxes where flush-mounted in masonry walls.
   6. Use raised covers suitable for the type of wall construction and device configuration where required.
   7. Use shallow boxes where required by the type of wall construction.
   8. Do not use "through-wall" boxes designed for access from both sides of wall.
   9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   13. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
      b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
      c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
   14. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
      a. Indoor Clean, Dry Locations: Type 1, painted steel.

b. Outdoor Locations: Type 3R, painted steel.

3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Provide lockable hinged covers, all locks keyed same as panelboards unless otherwise indicated.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may not be used.
1. Manufacturers:
   a. Hubbell Incorporated: www.hubbell.com/#sle.
   b. Legrand.

E. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron or nonmetallic floor boxes within slab on grade.
3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

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

### 3.02 INSTALLATION

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

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
2. Locate boxes as required for devices installed under other sections or by others.
   a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
3. Locate boxes so that wall plates do not span different building finishes.
4. Locate boxes so that wall plates do not cross masonry joints.
5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

7. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
8. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
9. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

Q. Close unused box openings.

R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

S. Provide grounding and bonding in accordance with Section 26 0526.

T. Identify boxes in accordance with Section 26 0553.

## 3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

## 3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION**

# SECTION 26 0553
# IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

### 1.04 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

## PART 2 PRODUCTS

### 2.01 IDENTIFICATION REQUIREMENTS

A. Identification for electrical equipment
1. See drawings for typical identification nameplate detail.
2. Use identification nameplate or identification label to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
a. Panelboards:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) If short circuit rating was determined by series rating per manufacturer tables, identify such panelboard as "SERIES RATED"
4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
5) For power panelboards without a door, use identification label to identify load(s) served for each branch device. Do not identify spares and spaces.
b. Transformers:
1) Identify power source and circuit number. Include location when not within sight of equipment.
2) Identify load(s) served. Include location when not within sight of equipment.
c. Enclosed switches and circuit breakers rated 60A or greater:
1) Identify voltage and phase.

2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

3. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
   b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
4. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
   a. Provide red lock-on clip equal to Space Age Electronics #ELOCK-FA.
6. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a. Service equipment.
   b. Motor control centers.
   c. Elevator control panels.
7. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
   a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
   b. Service Equipment: Include the following information in accordance with NFPA 70.
      1) Nominal system voltage.
      2) Available fault current.
      3) Date label applied.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
   2. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
      a. At each source and load connection.
      b. Within boxes when more than one circuit is present.
   3. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:
   1. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
   2. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:
   1. Use voltage markers or color coded boxes to identify systems other than normal power system.
      a. Color-Coded Boxes: Field-painted in accordance with Section 09 9123 and 09 9113 per the following color code:
         1) Fire Alarm System: Red.
   2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

a. For exposed boxes in public areas, provide identification on inside face of cover.

E. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 1000.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
3. Use identification label to identify fire alarm system devices.
4. Use identification label to identify serving branch circuit for all receptacles.
a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

## 2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

## 2.03 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

## 2.04 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

### 3.02 INSTALLATION

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

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.
   10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

### 3.03 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

**END OF SECTION**

# SECTION 26 0573
# POWER SYSTEM STUDIES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

### 1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

F. IEEE 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations; 2018, with Errata (2019).

G. NEMA MG 00001 - Motors and Generators; 2024.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.

### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect or Engineer.

### 1.05 SUBMITTALS

A. Study reports, stamped or sealed and signed by study preparer.

B. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.

1. Identify modifications made in accordance with studies that:
    a. Can be made at no additional cost to Owner.
    b. As submitted will involve a change to the contract sum.

C. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

D. Site-specific arc flash hazard warning labels.

E. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

F. Project Record Documents: Revise studies as required to reflect as-built conditions.
1. Include hard copies with operation and maintenance data submittals.
2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

## 1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
1. Perform analysis of new electrical distribution system.
2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    a. Known Operating Modes:
        1) Utility as source.
        2) Generator as source.
        3) Bus tie breaker open/close positions.
        4) Maintenance settings.

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
        1) Obtain up-to-date information from Utility Company.
        2) Utility Company: As indicated on drawings.
    b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
    d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    e. Protective Devices:
        1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
        2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).

f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
a. Maximum utility fault currents.
b. Maximum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination for all life safety panels and best-possible coordination on all other gear; while providing adequate protection for equipment and conductors.
a. Full selective coordination shall be defined as the localization of an overcurrent condition to restrict outages to the circuit or equipment affected for both of the following conditions:
1) The full range of available overcurrents from overload up to the available fault current, even if the available fault current is within in protective device's instantaneous region.
2) The full range of protective device opening times (i.e. down to 0.01 seconds).

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
b. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 using single phase bolted fault current, yielding conservative results.
3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
a. Maximum and minimum utility fault currents.
b. Maximum and minimum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
a. Identify date of study and study preparer.
b. Identify study methodology and software product(s) used.

c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
d. Identify base used for per unit values.
e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
f. Include conclusions and recommendations.

2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.
      2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus. Plot and label 3-phase bolted fault current and ground fault current on each curve.
      3) Conductors: Damage curves.
      4) Transformers: Inrush points and damage curves.
      5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
      6) Motors: Full load current, starting curves, and damage curves.
      7) Capacitors: Full load current and damage curves.
   c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      2) Include ground fault pickup and delay.
      3) Include fuse ratings.
      4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
   d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
   a. For the worst case for each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.
   b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
   c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

### 1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
   1. Products:
      a. SKM Systems Analysis, Inc: www.skm.com/#sle.

## PART 2 PRODUCTS

### 2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section 26 0553.
   2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include the following information:
         1) Arc flash boundary.
         2) Available incident energy and corresponding working distance.
         3) Nominal system voltage.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 26 0553.

### 3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Adjust equipment and protective devices for compliance with studies and recommended settings.

C. Notify Architect or Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.

### 3.03 CLOSEOUT ACTIVITIES

A. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
   1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 0923
# LIGHTING CONTROL DEVICES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Outdoor motion sensors.

C. Outdoor photo controls.

D. Lighting Relay Panels

E. Accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0533.16 - Boxes for Electrical Systems.

B. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
   1. Includes finish requirements for wall controls specified in this section.
   2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with supply diffusers, millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
      Notify Architect or Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

### 1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Operation and Maintenance Data: Include detailed information on device programming and setup.

### 1.05 QUALITY ASSURANCE

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

### 1.06 WARRANTY

A. Provide five year manufacturer warranty for all components.

### 1.07 EXTRA PARTS

A. Furnish three (3) spare of each occupancy sensor type, power pack, and/or replacable relay.

B. Furnish one (1) spare exterior photocell.

## PART 2 PRODUCTS

### 2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

**2.02 OCCUPANCY SENSORS**

A. Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
2. Hubbell Incorporated: www.hubbell.com/#sle.
3. Legrand North America, Inc: www.legrand.us/#sle.
4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
5. Sensor Switch Inc: www.sensorswitch.com/#sle.
6. WattStopper: www.wattstopper.com/#sle.
7. Leviton.
8. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Occupancy/Vacancy sensor types and application.
   a. Dual Technology to be utilized in open office, restrooms with stalls, and similar areas without direct line of sight between occupants and sensor.
   b. Passive Infrared (PIR) to be utilized in all cases, other than dual technology areas listed above.
   c. All ultrasonic sensors or dual technology sensors shall remain at least 5ft from any supply air diffuser to reduce nuisance tripping.
   d. Care should be given to limit sensors from sensing motion through open doors. i.e. Utilize a corner mount sensor rather than a ceiling mount sensor.
3. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
4. Sensitivity: Field adjustable.
5. Compatibility (Non-Dimming Sensors): Suitable for controlling LED lighting, incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
6. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
7. Where wired sensors are indicated, wireless sensors are not acceptable without prior approval of Architect.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
   b. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
3. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:

1. General Requirements:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
    b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
    a. Description: Low profile occupancy sensors designed for ceiling installation.
    b. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
    a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

F. Power Packs for Wireless Occupancy Sensors:
1. Input Supply Voltage: Dual rated for 120/277 V ac.

## 2.03 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Button Type Outdoor Photo Controls
1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

## 2.04 LIGHTING RELAY PANELS

A. Equal to Hubbell CX series relay panels. See LCP or LRP schedule on plans for additional information.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

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

**3.02 PREPARATION**

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

**3.03 INSTALLATION**

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
   2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect or Engineer to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.

E. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

F. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

**3.04 FIELD QUALITY CONTROL**

A. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.

B. Test outdoor photo controls to verify proper operation, including time delays where applicable.

C. Correct wiring deficiencies and replace damaged or defective lighting control devices.

**3.05 ADJUSTING**

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect or Engineer.

C. Adjust position of directional occupancy sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) occupancy sensor lenses to block undesired motion detection.

E. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect or Engineer.

### 3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### 3.07 COMMISSIONING

A. Manufacturer shall provide field startup and commissioning on all lighting control systems.

### 3.08 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Architect or Engineer, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   4. Location: At project site.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 2200
# LOW-VOLTAGE TRANSFORMERS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. General purpose transformers.

B. Buck-boost transformers.

C. Small power centers.

### 1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

### 1.05 QUALITY ASSURANCE

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

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

### 1.07 FIELD CONDITIONS

A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.

1. Greater than 10 kVA: 104 degrees F maximum.
2. Less than 10 kVA: 77 degrees F maximum.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

### 2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet.
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F.
      b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

### 2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

F. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

G. Sound Levels: Standard sound levels complying with NEMA ST 20

H. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.

3. Larger than 75 kVA: Suitable for floor or column mounting as detailed.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:
   1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
   2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
   3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
   4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

K. Identify transformers in accordance with Section 26 0553.

### 3.02 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

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

### 3.03 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

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

**END OF SECTION**

This page intentionally left blank

# SECTION 26 2416
# PANELBOARDS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

E. Section 26 4300 - Surge Protective Devices.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. If requested on plans, include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.
3. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

### 1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

### 1.06 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Basis of Design: Schneider Electric; Square D Products; [NF or NQ]: www.schneider-electric.us/#sle.

B. Other acceptable manufacturers:
   1. ABB/GE: www.electrification.us.abb.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Schneider Electric; Square D Products; NF or NQ: www.schneider-electric.us/#sle.
   4. Siemens Industry, Inc: www.usa.siemens.com/#sle.

C. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

### 2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

C. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Bolt-on. Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
      b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
   3. Fronts:
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

K. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

L. Load centers are not acceptable.

## 2.03 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
      c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   5. Do not use tandem circuit breakers.
   6. Do not use handle ties in lieu of multi-pole circuit breakers.

## 2.04 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

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

## 3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Install all field-installed branch devices, components, and accessories.

J. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

K. Provide filler plates to cover unused spaces in panelboards.

## 3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 80 amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Correct deficiencies and replace damaged or defective panelboards or associated components.

## 3.04 ADJUSTING

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

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

## 3.05 CLEANING

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

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

**END OF SECTION**

**SECTION 26 2726**
**WIRING DEVICES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates and covers.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0533.16 - Boxes for Electrical Systems.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Notify Architect or Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes are complete.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
   1. Wall Dimmers: Include derating information for ganged multiple devices.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Keys for Locking Switches: Two of each type.
   2. Extra Wall Plates: Two of each style, size, and finish.

### 1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

## PART 2 PRODUCTS

### 2.01 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Wiring Device Applications:
   1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
   2. Receptacles Installed in public lobbies, dwelling units, childcare facilities, dormitory rooms, clinics, hotels, assisted living facilities and other spaces indicated in NEC 406.12: Use tamper-resistant receptacles.
   3. Provide GFCI protection for:
      a. Receptacles installed within 6 feet of sinks.
      b. Receptacles installed in kitchens.

c. Electric drinking fountains via GFCI-type circuit breaker.

4. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.
5. Flush Floor Service Fittings in Tile Floors: Use tile rings.
6. Flush Floor Service Fittings in Carpeted Floors: Use carpet flanges.

C. Wiring Device Finishes:
1. Provide wiring device finishes as described below, unless otherwise indicated.
2. Wiring Devices, Unless Otherwise Indicated: **White with stainless steel wall plate.**
3. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.
4. Wiring Devices Connected to Emergency Power: Red with stainless steel wall plate factory engraved with text "Emergency".
5. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.
6. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

## 2.02 WALL SWITCHES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
1. Industrial specification grade, 20A, 125V
2. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

## 2.03 WALL DIMMERS

A. Manufacturers:
1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C. Provide suitable companion dimmer when multiple line voltage wall box dimmers are indicated on plans.

D. Control: Slide control type with slide on/off control.

E. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

## 2.04 RECEPTACLES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
1. Industrial specification grade, 20A, 125V

2. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
3. NEMA configurations specified are according to NEMA WD 6.

C. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

D. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (One Type A and One Type C) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.

E. Special and/or Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

## 2.05 WALL PLATES AND COVERS

A. Manufacturers:
1. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

E. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

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

## 3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

## 3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
   1. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   2. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect or Engineer to obtain direction prior to proceeding with work.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Identify wiring devices in accordance with Section 26 0553.

## 3.04 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

### 3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

### 3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 2813
# FUSES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Fuses.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 2816.16 - Enclosed Switches: Fusible switches.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
      a. Fusible Enclosed Switches: See Section 26 2816.16.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect or Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fuses: One set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.
   4. Spare Fuse Cabinet Keys: Two.

### 1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

### 2.02 APPLICATIONS

A. Service Entrance:
   1. Fusible Switches up to 600 Amperes, 250V L-L or less: Class RK1, time-delay.
   2. Fusible Switches up to 600 Amperes, greater than 250V L-L: Class J, time-delay.
   3. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits and Single Phase Motors: Class RK5, time delay.
   1. Where appropriate fuse holders are provided, Class CC fuses are acceptable.

D. Individual Motor Branch Circuits: Class RK5, time-delay.

E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

F. Primary Protection for Control Transformers: Class CC, time-delay.

**2.03 FUSES**

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Provide the following accessories where indicated or where required to complete installation:

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

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

**3.02 INSTALLATION**

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Identify spare fuse cabinet in accordance with Section 26 0553.

**END OF SECTION**

# SECTION 26 2816.16
# ENCLOSED SWITCHES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Enclosed safety switches.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

### 1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

### 2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Horsepower Rating: Suitable for connected load.

D. Voltage Rating: Suitable for circuit voltage.

E. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Provide with switch blade contact position that is visible when the cover is open.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.

J. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

K. Heavy Duty Switches:
   1. Comply with NEMA BS 31047.
   2. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

L. Provide the following features and accessories where indicated or where required to complete installation:
   1. Hubs: As required for environment type; sized to accept conduits to be installed.
   2. Integral fuse pullers.
   3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

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

### 3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Identify enclosed switches in accordance with Section 26 0553.

### 3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

### 3.04 ADJUSTING

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

### 3.05 CLEANING

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

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

**END OF SECTION**

This page intentionally left blank

# SECTION 26 4113
# LIGHTNING PROTECTION

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Strike (air) terminals and interconnecting conductors.

B. Grounding and bonding for lightning protection.

### 1.02 RELATED REQUIREMENTS

A. Section : Electrical system grounds.

B. Surge Protection for Wiring Systems: Specified in individual system requirements.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing.

B. Preinstallation Meeting: Convene a meeting at least prior to commencement of any work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

### 1.04 SUBMITTALS

A. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
   1. Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least prior to start of construction.
   2. Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.

B. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.

C. Installation Certification: Submit copy of certification agency's approval.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in lightning protection equipment with minimum years experience.

B. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with documented experience.

C. Installer Qualifications: Capable of providing the specified certification of the installed system.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

## PART 2 PRODUCTS

### 2.01 LIGHTNING PROTECTION SYSTEM

A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.
   1. Reference lightning protection scope note on electrical plans cover sheet for project specific scope/coverage.
   2. Coordinate with other grounding and bonding systems specified.
   3. All downleads shall be in conduit and concealed from view. Structural steel may be used as downlead path.
   4. Determine ground resistance by field measurement.
   5. Provide copper, bronze, or stainless steel components, except where aluminum is allowed by NFPA 780.
   6. Provide system certified by .

## 2.02 COMPONENTS

A. All Components: Complying with applicable requirements of UL 96.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Coordinate work with installation of roofing and exterior and interior finishes.

## 3.02 INSTALLATION

A. Install in accordance with referenced system standards.

B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

## 3.03 FIELD QUALITY CONTROL

A. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.

B. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.

C. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

**END OF SECTION**

# SECTION 26 4300
# SURGE PROTECTIVE DEVICES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 2416 - Panelboards.

### 1.03 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect or Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

### 1.05 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.

### 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

### 1.08 WARRANTY

A. Manufacturer's Warranty: Provide minimum ten year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices (Utilize for retrofit or as noted on drawings only):
   1. ABB/GE; _____: www.electrification.us.abb.com/#sle.
   2. Current Technology; a brand of Thomas & Betts Power Solutions; _____: www.tnbpowersolutions.com/#sle.

3. Schneider Electric; Square D Brand Surgelogic Products; _____: www.surgelogic.com/#sle.
4. Surge Suppression, LLC (SSI); _____: www.surgesuppression.com/#sle.

B. Factory-installed, Internally Mounted Surge Protective Devices:
1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

## 2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide factory-installed, internally-mounted SPDs.

C. All life safety panelboards shall have SPDs according to NEC article 700.

D. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

E. Protected Modes:
1. Wye Systems: L-N, L-G, N-G, L-L.
2. Single Split Phase Systems: L-N, L-G, N-G, L-L.

F. UL 1449 Voltage Protection Ratings (VPRs):
1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
2. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

G. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

H. UL 1449 Nominal Discharge Current (I-n): 20 kA

I. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

J. Provide all modes of protection L-N, L-G, and L-L. i.e. 10 modes for 3-phase wye services.

K. Protection Ratings
1. Service Entrance
   a. 0-1000A Services: 160kA per mode
   b. >1000A Services: 240kA per mode
2. Distribution Switchboard and Panelboards
   a. 120kA per mode
   b. If upstream SPD exists, reduce to 80kA per mode
3. Specific Branch Circuits
   a. 80kA or as indicated on drawings

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

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

## 3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

C. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

D. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

**END OF SECTION**

This page intentionally left blank

# SECTION 26 5100
# INTERIOR LIGHTING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Interior luminaires.

B. Ballasts and drivers.

C. Accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0533.16 - Boxes for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 5600 - Exterior Lighting.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Notify Architect or Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

### 1.04 SUBMITTALS

A. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

C. Samples:
   1. Provide one sample(s) of each specified luminaire where indicated.
   2. Provide one sample(s) of each luminaire proposed for substitution upon request.
   3. Provide one sample(s) of each product finish illustrating color and texture upon request.

D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
   2. Extra Ballasts/Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

### 1.05 QUALITY ASSURANCE

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

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.06 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

### 1.07 WARRANTY

A. Provide five year manufacturer warranty for LED luminaires, including drivers.

B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

## PART 2 PRODUCTS

### 2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See lighting fixture schedule notes. If substitution intent is not noted, contractor shall assume equals will be evaluated during the submittal phase..

### 2.02 LUMINAIRES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

D. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

E. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

F. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

### 2.03 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing provided from the factory; finish shall match the fixture. Coordinate the exact length during submittals. No field cutting of stems.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

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

**3.02 PREPARATION**

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

**3.03 INSTALLATION**

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Suspended Ceiling Mounted Luminaires:
1. Do not use ceiling tiles to bear weight of luminaires.
2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
4. Secure pendant-mounted luminaires to building structure.
5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
6. In addition to ceiling support wires, suspended life safety egress light fixtures shall be provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

G. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

H. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

J. Install accessories furnished with each luminaire.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.

M. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

N. Install lamps in each luminaire.

O. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

### 3.04 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect or Engineer.

### 3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect or Engineer. Secure locking fittings in place.

### 3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### 3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect or Engineer, and correct deficiencies or make adjustments as directed.

B. Just prior to Substantial Completion, replace all lamps that have failed.

### 3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**

# SECTION 26 5600
# EXTERIOR LIGHTING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. Luminaire accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

### 1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notify Architect or Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Drivers/Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
   2. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
   3. Touch-Up Paint: 1 gallons, to match color of pole finish.

C. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

### 1.05 QUALITY ASSURANCE

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

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

### 1.07 WARRANTY

A. Provide five year manufacturer warranty for all LED luminaires, including drivers.

## PART 2 PRODUCTS

### 2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See light fixture schedule notes on drawings.

### 2.02 LUMINAIRES

A. Provide products that are listed and labeled as complying with UL 1598, where applicable.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

D. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

E. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

F. Exposed Hardware: Stainless steel.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

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

### 3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

A. If required on the drawings, coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires in accordance with NECA/IESNA 501.

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

F. Pole-Mounted Luminaires:
   1. Foundation-Mounted Poles:
      a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
         1) Install anchor bolts plumb per template furnished by pole manufacturer.
         2) Position conduits to enter pole shaft.
      b. Install foundations plumb.

c. Install poles plumb, using leveling nuts as required to adjust to plumb.
d. Tighten anchor bolt nuts to manufacturer's recommended torque.
e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
f. Install anchor base covers or anchor bolt covers as indicated.

2. Grounding:
   a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
   b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
3. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
4. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 in designated poles.

G. Install accessories furnished with each luminaire.

H. Bond products and metal accessories to branch circuit equipment grounding conductor.

I. Install lamps in each luminaire.

## 3.04 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect or Engineer.

## 3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect or Engineer. Secure locking fittings in place.

## 3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

## 3.07 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**

This page intentionally left blank

# SECTION 27 0500
# LOW VOLTAGE SERVICE, PATHWAYS, AND WIRING

## PART 1GENERAL

### 1.01 SECTION INCLUDES

A. Telecom, AV, Access Control and CATV distribution cable raceway system.

B. Equipment and terminal backboards, and 120VAC and greater power for all systems.

### 1.02 REFERENCES

A. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces.

B. NFPA 70 - National Electrical Code.

C. Applicable individual utility company regulations and installation criteria.

### 1.03 GENERAL LOW VOLTAGE SCOPE

A. See electrical cover sheet for additional information regarding low voltage scope.

### 1.04 SYSTEM DESCRIPTION

A. Service Building Entrance Pathway: Underground nonmetallic conduit and/or overhead EMT conduit from point of existing or new low voltage service point or pedestal to new building service terminal main backboard as indicated on Drawings and as required. Main low voltage service into buildings shall be by low voltage utility company. Closely coordinate installation requirements with Owner and utility company. Contractor shall provide all pathways between main equipment board and sub equipment board locations.

B. Backbone Pathway: In conduit. Conform to EIA/TIA 569 using raceway as indicated and as specified.

C. Horizontal Pathway: Via J-Hooks and/or D-Rings when above ceiling. All wiring routing through exposed ceilings shall be run in conduit – paint to match. Conform to EIA/TIA 569, using raceway as indicated and as specified.

D. Premises Wiring: By Owner from low voltage equipment to each device outlet/coverplate (by Owner), using pull cords and complete raceway system by Contractor.

E. Active equipment (switches, routers, DVRs, etc.) shall be by Owner. Contractor shall provide 120VAC and greater power where required by Owner, coordinate.

### 1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations and sizes of all pathways and device outlet locations, and system type.

### 1.06 QUALITY ASSURANCE

A. Perform Work in accordance with Owner and applicable utility company rules and regulations.

### 1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish Products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2PRODUCTS

### 2.01 EQUIPMENT TERMINATION BACKBOARDS

A. Material: Plywood, grade BC, painted with matte white enamel as per Architect and Division 9.

B. Size: As indicated and as required by Owner and Utility (where applicable), 3/4 inch thick.

## PART 3EXECUTION

### 3.01 INSTALLATION

A. Coordinate with all low voltage system vendors to provide all required raceway, backbox, and 120V power prior to installation of low voltage system components. All rough-in is electrical contractor's responsibility.

B. Finish paint termination backboards with durable matte white enamel under the provisions of Division 9 prior to installation of Telecom equipment.

C. Support raceways, backboards, and cabinets under the provisions of Section 26 0529

D. Install termination backboards, and attach securely to building wall at each corner.

E. Install polyethylene pulling string in each empty system conduit over ten feet in length or containing a bend. Identify and label each end of all pull cords.

F. Mark all backboards and cabinets with the legend "TELECOM" or "CATV" under the provisions of Section 26 0553.

G. Coordinate with fire rated walls. All cabling passing through fire rated walls shall have a fire stop assembly equal to STI Easy Path.

H. All cabling passing through non-rated walls to deck shall be provided with conduit sleeves with bushings on each end.

**END OF SECTION**

# SECTION 28 4600
# FIRE DETECTION AND ALARM

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

### 1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

B. Section 21 1300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

### 1.03 SUBMITTALS

A. Prior to the start of work, the fire alarm contractor shall provide a complete and comprehensive set of design documents for review by the Engineer and Architect. The complete submittal shall include, but not be limited to, all of the following material:
   1. Power Calculations
   2. Battery capacity calculations shall be a minimum of 125% of the calculated requirement.
   3. Supervisory power requirements for all equipment.
   4. Alarm power requirements for all equipment.
   5. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst case condition plus 25% spare capacity.
   6. Voltage-drop calculations for wiring runs demonstrating worst case condition.
   7. Complete manufacturers catalog data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.
   8. Complete floorplan drawings.
   9. Provide the address, telephone number, and contact person(s) of the manufacturer's local service facility for normal and off-hour warranty issues.
   10. Evidence of designer qualifications.

B. Operating and Maintenance Data: Revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.
   2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
   3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
   4. List of recommended spare parts, tools, and instruments for testing.
   5. Replacement parts list with current prices, and source of supply.
   6. Detailed troubleshooting guide and large scale input/output matrix.
   7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
   8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

C. Project Record Documents: Have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.

3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

D. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Certificate of Occupancy.
4. Proposed maintenance contract.

E. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data.
2. Furnish the following:
a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
b. One copy, on jump drive, of all software not resident in read-only-memory.
c. Two percent spare of the following (minimum of two):
1) Smoke detectors
2) Relays
3) Stobes
4) Speakers
d. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

## 1.04 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
4. Contract maintenance office located within 50 miles of project site.
5. Certified in the State in which the Project is located as fire alarm installer.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

## 1.05 WARRANTY

A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Fire Alarm Control Units and Accessories must be compatible with the existing Edwards EST4 voice evacuation control panel.:

### 2.02 FIRE ALARM SYSTEM

A. Fire alarm system is a delegated design item. See Fire Alarm scope box note on the electrical plans cover sheet for general scope and requirements. Vendor to design and install a complete and code compliant system.

B. Spare Capacity:
   1. Speaker Amplifiers: Minimum 25 percent spare capacity.
   2. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

C. Power Sources:
   1. Primary: Dedicated branch circuits of the facility power distribution system.
   2. Secondary: Storage batteries.
   3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.

### 2.03 EXISTING COMPONENTS

A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

### 2.04 COMPONENTS

A. General:
   1. WHITE, ceiling-mounted, devices as possible when visible to public.
   2. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   3. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Locks and Keys: Deliver keys to Owner.
   1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 3 keys of each type

D. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

E. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.
   1. Locate as directed by Owner.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

### 3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

### 3.03 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
   1. Initial Training: 1 session pre-closeout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.
   2. Refresher Training: 1 session post-occupancy.

D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

### 3.04 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

### 3.05 MAINTENANCE

A. Provide to Owner, a proposal as an alternate to the base bid, for a maintenance contract for entire warranty period, to include the work described below; include the total cost of contract, proposal to be valid at least until 30 days after date of Substantial Completion.

B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.

3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

F. Comply with Owner's requirements for access to facility and security.

**END OF SECTION**

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. Protecting existing trees, vegetation to remain.
2. Removing existing trees, vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 1 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
3. Division 1 Section "Execution" for verifying utility locations and for recording field measurements.
4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Refer to Stormwater Pollution Prevention Plan.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Do not excavate within tree protection zones, unless otherwise indicated.

B. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Remove rootballs. Remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within tree protection zones.
   3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

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. Preparing subgrades for areas outside the building perimeter.
2. Excavating and backfilling for buildings and structures.
3. Subbase and base course for paving.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling for utility trenches.

B. Related Sections include the following:
1. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 UNIT PRICES

A. Unit prices for earthwork are included in Division 01 Section "Unit Prices." Unit price shall include cost for removal of soft materials and replacement of imported structural fill per cubic yard plus a unit price for rock removal per cubic yard.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Initial Backfill: Fill free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit and as defined by utility trench detail on the plans.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, or ripping, or blasting, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base course, drainage fill, or topsoil materials.

L. Utilities: Underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.5 SUBMITTALS

A. Product Data: For the following:
1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
4. Classification according to ASTM D 2487 of each soil material proposed for fill and backfill.
5. Laboratory compaction curve according to ASTM D 698 for each soil material proposed for fill and backfill.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient on site materials do not match the Geotech report for engineered fill.

B. Base Course: Naturally graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; conforming to ODOT Type “A” aggregate base.

C. Engineered Fill:
   1. Structural fill within the proposed building and pavement areas shall have the following properties and as specified in the geotechnical report:
      a. Material having a Plasticity Index (PI) OF 8 TO 18
      b. Material having a Liquid Limit (LL) of less than 40
      c. Maximum dry density in excess of 100 pounds per cubic foot
      d. Maximum particle size of 3 inches
      e. At least 15 percent of the material passing the No. 200 sieve, based on dry weight
      f. Shall be free of any organics
      g. Prior to any filling operations, samples shall be tested by and approved by the owner’s on-site geotechnical engineer.
   2. Portions of the onsite lower plasticity clay soils may be suitable for use as structural fill within the proposed building and pavement areas; however, the contractor shall delineate the area with lower plasticity lean clay soils and collect a bulk sample prior to start of placement for moisture-density relationship and soil classification testing to evaluate the suitability for use as fill within proposed building and pavement areas.
   3. Refer to geotechnical report for other uses of onsite materials as fill.

D. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. Or as defined by the utility trench details.

E. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

F. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf; ASTM D 4632.

4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
7. Survivability: Class 2; AASHTO M 288.
8. Grab Tensile Strength: 247 lbf; ASTM D 4632.
9. Sewn Seam Strength: 222 lbf; ASTM D 4632.
10. Tear Strength: 90 lbf; ASTM D 4533.
11. Puncture Strength: 90 lbf; ASTM D 4833.
12. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
13. Permittivity: 0.02 per second, minimum; ASTM D 4491.
14. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
1. Portland Cement: ASTM C 150, Type I, II or III.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495.

## 2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

## 3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches by providing adjacent dewatering trenches as required.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
3. It is anticipated that the groundwater will be perched within existing fill and/or underlying lower plasticity residual lean clay soils. Temporary perimeter drainage ditches, sumps, and pumps will be needed for removal of the perched water from open excavations and for the removal of additional surface rain water.

## 3.3 EXPLOSIVES

A. Explosives: No explosives are allowed.

## 3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsuitable soil materials and rock, replace with approved engineered fill materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
   a. 24 inches outside of concrete forms other than at footings.
   b. 12 inches outside of concrete forms at footings.
   c. 6 inches outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches beneath bottom of concrete slabs on grade.
   f. 6 inches beneath pipe in trenches.
3. Care should be exercised during excavation/undercut of the soils adjacent to the existing building to avoid possible influence on the existing structure. The bearing materials of the foundation supporting the adjacent building should be protected during excavation.

## 3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: undercut to a level of at least 18 inches below the design bearing elevation. Where fat clays (CH) soils are encountered, remove these soils within 18 inches of the bottom of the footing. After completion of undercutting, the footing elevations are to be brought back up to design elevation using approved and properly compacted lower plasticity

engineered fill, low strength lean concrete or quick set flowable fill. Overexcavation shall extend 8 inches beyond the edges of the footing for each foot of undercut depth

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
3. Overexcavate soils under the proposed building and other structures to a level of at least 48 inches below finished floor elevation and replace with approved lower plasticity structural fill. Overexcavation shall extend at least 5 feet beyond the building limits except where the planned buildings abut existing buildings or structures.

## 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

## 3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

## 3.8 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Architect or Engineer determines unsatisfactory soil is present based on the geotechnical engineer's recommendations, continue excavation and replace with compacted backfill or fill material as directed. Loose and disturbed materials, shall be removed from the subgrade before placing the geogrid. The subgrade shall be free of standing water when the geogrid is placed. Soil subgrades that become unstable due to inadequate construction dewatering or excessive subgrade disturbance shall be corrected by the contractor at no additional cost to the owner.

C. Existing uncontrolled fill and soft/unstable soils within the building and pavement areas shall be removed full-depth and replaced with properly compacted and approved lower plasticity engineered fill.

D. Refer to the soils report for minimum undercut depths from existing or finished subgrade and fill replacement requirements.

E. Building Areas – Refer to the soils report for structural fill and building pad requirements.

F. Pavement Areas - After stripping and completing any cuts, the exposed clay soils shall be scarified to a minimum depth of 8 inches, moisture conditioned to within a range of 2 percent below to 2 percent above the optimum moisture content and recompacted to at least 95% of the material's maximum dry density (ASTM D 698)

G. Following moisture conditioning and recompaction the exposed subgrade shall be proofrolled. Proof-roll subgrade under the observation of the geotechnical engineer, with a loaded, tandem-axle dump truck

weighing at least 25 tons, to locate any zones that are soft or unstable. The proofrolling should involve overlapping passes in mutually perpendicular directions. Where rutting or pumping is observed during proof-rolling, the unstable soils shall be over-excavated and replaced with low volume change soils. The project geotechnical engineer or a qualified representative shall observe the proofrolling operations. All unstable and/or soft materials identified during the subgrade evaluation need to be removed prior to the placement of fill or construction of building and pavements.

H. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated on-site suitable soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, sub-drainage, damp-proofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of , free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

E. Backfill voids while installing and removing shoring and bracing.

F. Place and compact final backfill to final subgrade elevation.

G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

H. Construct clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material shall consist of clay compacted at a water content at or above the soils optimum water content. The clay fill shall be placed to completely surround the utility line and be compacted to at least 95% standard proctor density.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use engineered fill or on-site material.
2. Under walks and pavements, use engineered fill or on-site material
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. Existing slopes steeper than 5 horizontal to 1 vertical (5:1) and located in fill areas shall be benched prior to fill placement. Benches shall be cut as the fill placement progresses and shall have a maximum bench height of 2 to 3 feet.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within range of 2 percent above to 2 percent below the material’s optimum moisture content, determined in accordance with ASTM D-698, (standard Proctor procedure).
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3. Both density and moisture requirements shall be met.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers between 8 and 12 inches in depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 :
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent and 95 percent for pavement areas.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches in unpaved areas, compact each layer of initial and final backfill soil material at 85 percent. In paved areas, compact utility trench backfill at 95 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks and Pavements: minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 BASE COURSES

A. Place base course on subgrade free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:
1. Where indicated, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape base course to required crown elevations and cross-slope grades.
3. Place base course in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D-698.

3.19 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Place drainage course in compacted thickness shown on plans in a single layer.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry relative density according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Contact Engineer for subgrade proofrolling.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Perform Atterberg limits tests on fly ash and cement kiln dust treated fill/backfill materials placed in the building area for the low volume change fill layer at frequency of at least 1 test per 5,000 SF of area with at least 2 test per lift. Intent or Atterberg limits testing is to determine if the soil has been effectively treated.

F. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

H. Density and moisture test shall be performed on each lift prior to placement of subsequent lifts.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion prior to placement of subsequent base course, paving, or foundations above. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste material, including unsuitable soil, trash, and debris, and legally dispose of it off Owner's property.

B. Transport surplus engineered fill to designated storage areas on Owner's property.

END OF SECTION 312000

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes
1. Installation of temporary and permanent erosion and sedimentation control systems.
2. Installation of temporary and permanent slope protection systems.

B. Related Sections
1. Section 3110 00 – Site Clearing
2. Section 3120 00 – Earth Moving

1.2 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent properties; any identified endangered or threatened species or critical habitat, any identified cultural or historic resources, and receiving water resources from erosion and sediment damage until final stabilization.

1.3 REFERENCES

A. Oklahoma Department of Transportation, Standard Specifications for Highway Construction, 2009 (including amendments, supplements and special provisions).

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sediment control devices as specified on the Construction Drawings. Specified items on the Construction Drawings shall comply with Section 221 of the ODOT Standard Specifications.

B. Rip-Rap as specified on the plans and in Section 31 37 00.

C. Temporary and permanent outfall structures as specified on the drawings.

PART 3 – EXECUTION

3.1 PREPARATION

A. Review the drawings and Storm Water Pollution Prevention Plan.

B. Revise SWPPP as necessary to address potential pollution from site.

C. Conduct storm water preconstruction meeting with Site Contractor, all ground-disturbing subcontractors, site engineer of record or someone from their office familiar with the site and SWPPP.

3.2 EROSION AND SEDIMENTATION CONTROL AND SLOPE PROTECTION IMPLEMENTATION

A. Place erosion and sediment control systems in accordance with the drawings and Storm Water Pollution Prevention Plan or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

B. Deficiencies or changes on the drawings or Storm Water Pollution Prevention Plan shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the Storm Water Pollution Prevention Plan and posted on the drawings (Erosion Control Plans).

C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.

D. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or Owner to control sediment until final stabilization. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to the Owner.

E. Contractor shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.

F. Unless required within a shorter timeframe by the applicable General Permit for Storm Water Discharges Associated with Construction Activity, disturbed areas that will not be graded or actively worked for a period of 14 days or more, shall be temporarily stabilized as work progresses with vegetation or other acceptable means. In the event it is not practical to seed areas, slopes must be stabilized with mulch and tackifier, bonded fiber matrix, netting, blankets or other means to reduce the erosive potential of the area.

END OF SECTION 132500

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. Soil treatment with termiticide.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood preservative treatment by pressure process.
2. Division 07 Section "Sheet Metal Flashing and Trim" for custom-fabricated metal termite shields.

1.3 PERFORMANCE REQUIREMENTS

A. Service Life of Soil Treatment: Soil treatment by use of a termiticide that is effective for not less than five years against infestation of subterranean termites.

1.4 SUBMITTALS

A. Product Data: For termiticide.

1. Include the EPA-Registered Label for termiticide products.

B. Product Certificates: For termite control products, signed by product manufacturer.

C. Qualification Data: For Installer of termite control products.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products through one source.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Termiticides:

a. Aventis Environmental Science USA LP; Termidor.
b. Bayer Corporation; Premise 75.
c. FMC Corporation, Agricultural Products Group; Talstar, Prevail FT, Torpedo.
d. Syngenta; Demon TC.

2.2 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION

## 1.1 SUMMARY

A. Section Includes:
   1. Drilling and cleaning pier holes.
   2. Slurry displacement-installed drilled piers.
   3. Underreaming pier holes.
   4. Dewatering of shafts and removal of spoil.
   5. Casing pier holes when required.
   6. Products installed, not furnished under this Section:
      a. Concrete and reinforcing steel.
      b. Anchor rods, templates and dowels.

B. Related Sections:
   1. Section 013200 - Construction Progress Documentation
   2. Section 015000 – Temporary Facilities and Controls
   3. Section 033000 – Cast-In-Place Concrete
   4. Section 311000 – Site Clearing

## 1.2 UNIT PRICES

A. Basis for Bids
   1. Base Contract Price on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft and the diameter of shaft. For bidding purposes only, assume piers are founded at the depth shown and with embedment depths specified on the Contract Drawings. Actual lengths may vary, to coincide with elevations where satisfactory bearing strata are encountered.
   2. Include temporary casing in Base Contract Sum for drilled piers.
   3. Include rock coring in Base Contract Sum for drilled piers

B. Unit prices are included in Section 012200 "Unit Prices."
   1. Piers: Add and deduct unit price per linear foot shorter or longer than bearing depth including temporary casings and rock coring.
   2. Unit prices include labor, materials, tools, equipment, overhead, taxes, profit and other items for complete drilled pier installation.

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed outside dimensions of drilled piers cast against rock. Unit prices for rock excavation include replacement with approved materials.

D. Trial Drilled Pier: Unit price as indicated for drilled pier, including backfilling.

## 1.3 SUBMITTALS

A. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Design Collective, PC. to review shop drawing submittals after the second time will be billed to the General Contractor at Wallace Design Collective, PC hourly rates.

B. Product Data: For each type of product indicated.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.
   1. Submit three bond sets of shop drawings for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will mark three sets with red and will return one set to the contractor through the Architect. The contractor shall make the number of photocopies required of the approved shop drawings for distribution to other parties, and the contractor shall be responsible for transmitting the original red-marked set to the fabricator for corrections.
   2. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.

E. Qualification Data: For qualified Installer.

F. Welding certificates.

G. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.

H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates.

I. Field quality-control reports.

J. Other Informational Submittals:
   1. Record drawings.

## 1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with at least 5 years of experience that has specialized in drilled-pier work in similar applications.
   1. Experience shall be relevant to anticipated subsurface materials, water conditions, shaft sizes and special techniques required.
   2. Demonstrate to Architect and Structural Engineer-of-Record dependability of equipment and techniques to be used, when requested.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code - Steel."

2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

D. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

E. Trial Drilled Pier: Construct trial drilled pier of diameter and depth and at location indicated or, if not indicated, of same diameter and depth as largest drilled piers, located at least three diameters clear of permanent drilled piers, to demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.
1. Excavate soil and rock socket, install reinforcement, fill with concrete, remove temporary casings, and terminate trial drilled pier 24 inches below subgrade and leave in place.
2. Install permanent casings, excavate bell, excavate rock socket, and place slurry, as required for permanent drilled piers.
3. If Architect determines that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.

F. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to drilled piers including, but not limited to, the following:
a. Review geotechnical report.
b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.

## 1.5 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner’s written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
2. The geotechnical report is included elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements required in the Contractor’s drilled pier log.
1. Record and maintain information required in the Contractor’s drilled pier log for each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1, and of adequate strength to withstand handling stresses and concrete and earth pressures, and shall be watertight.

B. Corrugated-Steel Pipe Casings: ASTM A 929, steel sheet, zinc coated.

C. Liners: Comply with ACI 336.1.

2.2 SLURRY

A. Slurry: Pulverized bentonite mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH.

2.3 SPACERS

A. Provide steel band spacers or precast concrete spacers to maintain position of cages within pier holes.

2.4 END BLOCKS

A. Provide precast concrete end blocks to maintain required clearance at bases of cages.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

B. Contractor shall maintain a separate independent Pier Log. For each pier record the following information.
1. Identification mark
2. Shaft diameter
3. Bottom of pier elevation
4. Steel reinforcing cage length, number and size of vertical bars and tie size and spacing
5. Depth and diameter of casing, where casing is required
6. Top of pier elevation
7. Date and time drilling is completed
8. Date and time concrete placement is begun and is completed
9. Plumbness variation
10. Condition of drilled hole before placement of concrete
11. Elevation of proper bearing stratum
12. Embedment into bearing stratum
13. Water depth from bottom of pier at time of concrete placement

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
   1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.

B. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:
   1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
   2. Special excavation includes excavation that requires special equipment or procedures above or below indicated depth of drilled piers where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.
      a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
      b. Earth seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with rock.
   3. Obstructions: Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.

C. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.
   3. Excavate rock sockets of dimensions indicated.
   4. Excavate and complete concreting of drilled pier on same day if possible, or redrill, clean and test slurry in excavation before concreting.

E. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
   1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
   2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.

F. End-Bearing Drilled Piers: Probe with auger to a depth below bearing elevation, equal to diameter of the bearing area of drilled pier. Determine whether voids, clay seams, or solution channels exist.
   1. Test first three drilled piers and one of every six drilled piers thereafter.
   2. Fill augur-probe holes with grout.

G. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

H. Slurry Displacement Method: Stabilize excavation with slurry maintained a minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft. Maintain slurry properties before concreting.
   1. Excavate and complete concreting of drilled pier on same day if possible, or redrill, clean, and test slurry in excavation before concreting.
   2. Clean bottom of each shaft before concreting.

I. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
   1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete, or leave temporary casings in place..

J. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances and those listed below, whichever are most stringent.
   1. Location of drilled pier shall be within 2 inches of planned position.
   2. Plumbness of drilled pier shall be within 1.5% of vertical.
   3. Shaft diameter shall be within plus 2 inches and minus 0 of diameter specified on contract documents.
   4. Top of pier elevation shall be within plus 1 inch and minus 3 inches or elevation specified on contract documents
   5. Diameter of underream shall be within plus 2 inches and minus 0 of that specified on contract documents.
   6. Bearing elevation shall be within plus 1 foot (deeper than specified) and minus 0 of the bearing elevation required per the contract documents.
   7. Placement of vertical dowels at tops of piers shall be within plus or minus 1 inch lateral and plus or minus 2 inches vertical of position specified on the contract documents.
   8. Placement of anchor bolts shall be within plus or minus 1/8” lateral from position specified on contract documents.
   9. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   10. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

## 3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Fabricate reinforcing cages in continuous stock lengths before drilling pier holes. Cut reinforcing cages to required lengths after final length of each drilled pier has been measured.

C. Do not splice vertical reinforcing.

D. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

E. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

F. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

G. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

H. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

## 3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
   1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
   2. Use tremie to within 10 feet of bottom of shaft for a maximum 10 foot fall.
   3. Consolidate top 60 inches of each pier with a mechanical vibrator.

C. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than 60 inches into concrete and that flow of concrete is continuous from bottom to top of drilled pier.

D. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60 inch head of concrete above bottom of casing.
   1. Consolidate top 60 inches of each pier with a mechanical vibrator after withdrawal of temporary casing.
   2. Do not rotate casing during removal

E. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

F. Where water rises to top of pier during placement, remove over-wetted concrete and replace with sound, dense material.

G. Remove and replace portions of concrete that become contaminated with mud or spoil during placement.

H. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

I. If hot-weather conditions exist that would impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

## 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Drilled piers.
   2. Excavation.
   3. Concrete.
   4. Steel reinforcement welding.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. The Testing Agency Inspector shall be present during all work in this section and shall inspect the drilling of each pier hole.

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
   1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
      a. Bearing Stratum Tests: Testing agency will take undisturbed hardpan or rock core samples from drilled-pier bottoms and test each sample for compression, moisture content, and density, and will report results and evaluations.

D. Concrete Tests and Inspections: refer to section 033000 “Cast-in-Place Concrete” for required concrete tests and inspections.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:
   1. Actual top and bottom elevations.
   2. Actual drilled-pier diameter at top, bottom.
   3. Top of rock elevation.
   4. Description of soil materials.
   5. Description, location, and dimensions of obstructions.
   6. Final top centerline location and deviations from requirements.
   7. Variation of shaft from plumb.
   8. Shaft excavating method.
   9. Design and tested bearing capacity of bottom.
   10. Depth of rock socket.
   11. Levelness of bottom and adequacy of cleanout.
   12. Properties of slurry and slurry test results at time of slurry placement and at time of concrete placement.
   13. Ground-water conditions and water-infiltration rate, depth, and pumping.
   14. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
   15. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
   16. Date and time of starting and completing excavation.
   17. Inspection report.

18. Condition of reinforcing steel and splices.
19. Position of reinforcing steel.
20. Concrete placing method, including elevation of consolidation and delays.
21. Elevation of concrete during removal of casings.
22. Locations of construction joints.
23. Concrete volume.
24. Concrete testing results.
25. Remarks, unusual conditions encountered, and deviations from requirements.

## 3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

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. Hot-mix asphalt paving.
2. Pavement-marking paint.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of state of Oklahoma DOT.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For manufacturer.

D. Material Test Reports: For each paving material.

E. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by ODOT of the state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with ODOT standard specifications for highway construction, latest addition.

D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of subgrade and preparatory work.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, per ODOT Standard Specifications, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, per ODOT Standard Specifications, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder, Asphalt Cement and Tack Coat in accordance with ODOT standard specifications for highway construction.

B. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Joint Sealant: ASTM D 3405, hot-applied, single-component, polymer-modified bituminous sealant.

D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than 45 minutes.
1. Color: As indicated.

E. Some formulations of waterborne emulsions are very quick drying, others less so; see manufacturer's literature.

F. Glass Beads: AASHTO M 247, Type 1.

G. Wheel Stops: Precast, air-entrained concrete, 3,000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
1. Dowels: Galvanized steel, 3/4-inch diameter, 12-inch minimum length.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.2 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course in lifts of 3” or less.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at minimum temperature of 250 deg F, or higher temperature as required by the grade of asphalt cement used.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.3 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3.4 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F, or higher temperature as required by the grade of asphalt cement used.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.6 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Marking-paint manufacturers caution that paint will bleed or tear surface of new asphalt unless asphalt is aged before painting. This aging period may vary from 30 to 90 days. If pavement marking must proceed immediately, consider revising to a phased application of a thin first coat followed by a thicker second coat once asphalt has aged. Verify that two-coat application is recommended by pavement-marking manufacturer.

C. Allow paving to age for 30 days before starting pavement marking.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal.

3.7 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.
1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

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 exterior cement concrete pavement for the following:
1. Curbs and gutters.
2. Walkways.
3. Ramps and steps.
4. Drives and roadways

B. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For manufacturer.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

F. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

H. Plain Steel Wire: ASTM A 82.

I. Deformed-Steel Wire: ASTM A 496.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed.

K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

P. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use one of cementitious materials, of the same type, brand, and source throughout the Project:
1. Portland Cement

B. Normal-Weight Aggregates: ASTM C 33, Class coarse aggregate, uniformly graded. Conform to ODOT specifications for highway construction. Provide aggregates from a single source.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures as allowed by ODOT specifications for highway construction.

F. Calcium chloride shall not be permitted in concrete mixtures.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
1. Products: Conform to ODOT.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
1. Products: Conform to ODOT.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
1. Products: Conform to ODOT.

## 2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
1. Color: As indicated by manufacturer's designation Match Architect's sample As selected by Architect from manufacturer's full range.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
1. Types I and II, non-load bearing IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
1. Products: Conform to ODOT.

## 2.6 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than 45 minutes.
1. Color: As indicated.

## 2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete to conform to ODOT specifications for highway construction for properties.
1. Compressive Strength (28 Days): 4,000 psi Maximum Water-Cementitious Materials
2. Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 5 to 7 percent

D. Chemical Admixtures: Conform to ODOT specifications for highway construction.
   1. Use water-reducing admixture high-range, water-reducing admixture high-range, water-reducing and retarding admixture plasticizing and retarding admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Cementitious Materials: Conform to the ODOT specifications for highway construction Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
   1. Fly Ash or Pozzolan: 25 percent.
   2. Ground Granulated Blast-Furnace Slag: 50 percent.
   3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

## 2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
   1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
   1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   2. For concrete mixes larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 50 tons.
   3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/4 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

## 3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by Figure 2.1.5 of ACI 305. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, monomolecular film evaporation retarders, fog spray, covering with polyethylene sheeting, or wet cover.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
   1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
   2. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   3. Provide tie bars at sides of pavement strips where indicated.
   4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade (within 12 hours of concrete pour), or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated and at construction joints. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

## 3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Place top layer of concrete, strike off, and screed.

1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

I. Screed pavement surfaces with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## 3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Initial floating operation is included in "Concrete Placement" Article.

C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

## 3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

## 3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
1. Elevation: 1/4 inch .
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

## 3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 21 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
   1. Spread glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

## 3.11 FIELD QUALITY CONTROL

A. Testing Agency: a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
   4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

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. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

B. Related Sections include the following:
1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

C. Qualification Data: For Installer.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than four pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet or covered with frost.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.03 COLD-APPLIED JOINT SEALANTS

A. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
1. Products:
a. Crafco Inc.; Road Saver Silicone SL.
b. Dow Corning Corporation; 890-SL.

2.04 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.05 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of backer materials.
   2. Do not stretch, twist, puncture, or tear backer materials.

3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

## 3.04 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

## 3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321373

**SITE FURNISHINGS SECTION 323300**

## PART 1 – GENERAL

### 1.1 SUMMARY

**A. This section includes the following:**

1. **Courtyard tables**

### 1.2 QUALITY ASSURANCE

**A. Installer Qualifications:** An experienced installer who has completed installation of similar furnishings.

**B. Source Limitations:** For consistent quality in appearance and physical properties obtain each product from a single manufacturer

**C. Product Options:** Drawings indicate size, shape and dimensional requirements of furnishings for the purpose of customer sourcing.

### 1.3 SUBMITTALS

**A. Product Data:** Include physical characteristics such as materials, specifications and finish.

**B. Drawings:** Show details including dimensions, materials, and options for each product.

**C. Samples for Verification:** Finish samples of the color and type of powder coat will be provided upon request.

**D. Maintenance Data:** For each product include the recommended methods for repairing damage to the powder coat and materials finish will be provided.

### 1.4 DELIVERY, STORAGE AND HANDLING

**A.** Store product(s) in original undamaged packaging and containers until ready for installation.

**B.** Handle powder coated product(s) with sufficient care to prevent any scratches or damage to the finish.

### 1.5 WARRANTY

**A.** Site furnishings carry a five year manufacturer's limited warranty against defects in materials and workmanship. The warranty period begins the date of substantial completion.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

**A.** Thomas Steele, a division of Graber Manufacturing, Inc.

**B.** Or preapproved equal

### 2.2 MATERIALS

**A. e-Steele™ Shot Blast / E-Coat Primer / TGIC Powder Coating:**

1. The site furnishing steel shall be completely shot blasted to white metal with cast iron media. Furnishings shall be treated with zinc phosphate and primed with an e-coat epoxy primer in an environmentally friendly closed loop 18 stage finishing process. Furnishings shall be cleaned with detergent and powder coated with super durable triglycidyl isocyanurate (TGIC) polyester powder. The coatings thickness shall not be

greater than 6 mils to ensure a durable finish that resists corrosion, chipping, abrasion, cracking and UV damage. (The use of silicone caulk for gap filling of joints shall not be allowed.)

2. Color as selected by architect from manufacturer's full range of standard colors.

## 2.3 TABLES

**A. Carnival™ Courtyard:** The courtyard table shall be the **CRT**-4F-SQP. Manufactured by Thomas Steele, a division of Graber Manufacturing, Inc.

1. Table Frame:
   a. Legs shall be constructed of 2 3/8" (60.4mm) diameter carbon steel tubing; 2" (50.8mm) square carbon steel tubing; and ¼" x 2 ½" (6.4mm x 63.5mm) carbon steel flat bar.
2. Table Top:
   a. Square top shall be constructed of 42" square 11 ga. spun metal with a 1 ½" reinforced rolled 'C' lip.
3. Seating Materials:
   a. Straps shall be constructed of ¼" x 1 ½" (6.4mm x 38.1mm) carbon steel flat bar.
   b. Cross tubes shall be constructed of 1 5/8" (41.3mm) diameter carbon steel tubing.
   c. Seat Support members shall be constructed of ¼" x 3" (6.4mm x 76.2mm) carbon steel flat bar; 5/8" (15.9mm) diameter carbon steel round bar; and ½" x 1 ½" (12.7mm x 38.1mm) carbon steel flat bar.

## 2.4 REFERENCES

**A. Flat Bar**

1. ASTM A36 Carbon Structural Steel

**B. Round Bar**

1. ASTM A36 Carbon Structural Steel

**C. Tubing**

**1.** ASTM A513 Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

**D. Stainless Steel**

1. ASTM A312 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

# PART 3 – EXECUTION

## 3.1 INSTALLATION

**A.** Install in accordance with manufacturer's instructions.
**B.** Surface mounting: Location and drilling of holes for inserts included.
**C.** Some assembly required.

**END OF SECTION**

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Preparation of planting surface.

B. Fertilizing.

C. Sod installation.

D. Maintenance service.

1.2 RELATED WORK

A. Section 329300 - Plants.

B. Section 328400 – Planting Irrigation.

C. Section 312216 – Fine Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this Section.

1.3 REFERENCES

A. Standardized Plant Names, 1942 Edition, American Joint Committee on Horticulture Nomenclature.

B. ASPA (American Sod Producers Association) - Guideline Specifications to Sodding.

C. FSO-F-241 - Fertilizers, Mixed, Commercial.

1.4 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermudagrass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Brome Grass.

1.5 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with a minimum of 5 years experience.

B. Sod: Root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.

C. Submit sod certification for grass species and location of sod source.

1.6 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.7 TESTS

A. Provide soils tests and recommendations for areas to be sodded. Obtain from approved testing agency. Such tests shall be a composite of random samples. Test areas exhibiting different soil types separately. Provide separate tests for each 10,000 sq. ft. of sodded area.

1.8 MAINTENANCE DATA

A. None required.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 24 hours.

1.10 COORDINATION

A. Coordinate the work of this Section with installation of underground sprinkler system and plant material as applicable.

1.11 MAINTENANCE SERVICE

A. Maintain sodded areas immediately after placement until grass is well established, has achieved complete coverage, and exhibits a vigorous growing condition or until Date of Substantial completion whichever is longer. Maintenance period shall include minimum of two mowings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sod: Cultivated grass sod; 419 Bermuda; with strong fibrous root system, free of stones, burned or bare spots, and weeds.

B. Fertilizer: Type recommended for grass; of proportions necessary to eliminate any deficiencies of topsoil as indicated in soils test or otherwise approved.

C. Soil Amendments: Lime, Sulphur, or other material recommended by soil test.

D. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

2.2 ACCESSORIES

A. Stakes: Equal to Dewitt 4” Biodegradable Staple. Green color.

2.3 HARVESTING

A. Machine cut sod and load on pallets in accordance with ASPA guidelines.

B. Cut sod with minimum 1/2 inch and maximum one-inch topsoil base.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.2 PREPARATION

A. Finish grade areas to be sodded so that the surface is smooth and is approximately 1 inch below adjoining sidewalks and other paved surfaces.

B. Remove all weeds and grasses from areas to be sodded.

C. Planting surface shall be made friable by approved method of scarification. Prepared surface shall be floated smooth and free of bumps and depressions. Remove stones and foreign matter over 2 inches in diameter from top 2 inches of sod bed. Plant immediately, thereafter, provided the bed has remained in a friable condition and has not become muddy or hard. If it has become hard, till to a friable condition again.

D. Apply fertilizer per soil tests recommendation. Apply fertilizer prior to installation of sod.

E. Apply fertilizer no more than 48 hours before laying sod.

F. Lightly water to aid the dissipation of fertilizer.

G. Prior to laying sod, incorporate soil amendments such as lime and Sulphur at rates recommended by soils tests to a 4-inch depth.

3.3 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Remove plastic netting from sod.

C. Lay sod immediately on delivery to site within 24 hours after harvesting to prevent deterioration.

D. Lay sod tight with no open joints visible and no overlapping; stagger end joints 12-inches minimum. Do not stretch or overlap sod pieces.

E. Finished sodding to be smooth and free of bumps and depression. Surface to be flush with adjoining grass areas if any. Place top elevation of sod approximately 1/2 inch below adjoining edging, paving and curbs. Grade planting surface as necessary to accomplish above.

F. On slopes 4 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive staples flush with soil portion of sod.

G. Water sodded areas deeply immediately after installation.

H. After sod and soil have dried sufficiently, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.4 WARRANTY

A. Sodded areas to be vigorously growing at time of final acceptance or if installation occurs during dormancy warranty to extend through first month of following growing season. At conclusion of initial warranty period

replace dead or unhealthy sod.

B. For a period of one year commencing upon the Date of Substantial Completion, resod or reseed bare areas until complete coverage is achieved. Repairs to be completed as specified in the Maintenance requirements below.

3.5 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches for Bermuda grass. Do not cut more than 1/3 of grass blade at any one mowing.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming.

D. Water sufficiently to ensure establishment and maintain vigorous appearance.

E. Roll and/or topdress surface as needed to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

G. Immediately replace sod in areas which show deterioration or bare spots. Any areas that have had topsoil washed away shall be filled to match specified grade with topsoil before resodding.

H. Protect sodded areas with warning signs during maintenance period.

I. Apply approved fertilizer at rate to provide 1-1/2 pounds of actual Nitrogen per 1000 square feet every 25 days during growing season.

J. For the purpose of establishing an acceptable standard, no bare areas will be permitted.

END OF SECTION

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 gravity-flow, nonpressure storm drainage outside the building, with the following components:
   1. Drains & pipes.
   2. Storm Inlets
   3. Precast concrete manholes.
   4. Concrete headwalls

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene-monomer rubber.

B. LLPE: Linear low-density, polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt tight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Catch Basins
   2. Pipe and fittings
   3. Manholes
   4. Stormwater Inlets
   5. ODOT concrete end sections

B. Shop Drawings: For the following:
   1. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.

C. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes, catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
   1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
   1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

C. Corrugated PE Pipe and Fittings NPS 56 and NPS 60: AASHTO MP7, Type S, with smooth waterway for coupling joints.
   1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.3 PVC PIPE AND FITTINGS

A. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40, socket-type fittings.

B. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

C. PVC Sewer Pipe and Fittings, NPS 18 (DN 450) and Larger: ASTM F 679, T-[1] [2] wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

D. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.4 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot or groove and tongue ends.
   1. Gasketed joints with ASTM C 443, rubber gaskets, “omni-flex” or equal
   2. Class III, Wall A.

2.5 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   1. Top-Loading Classification(s): Extra-heavy duty.
   2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.7 DRAINS

A. As specified on plans, or equivalent.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
   1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.9 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

2.10 PIPING INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

2.11 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

2.12 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

2.13 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

D. Embed channel sections and drainage specialties in 4-inch (102-mm) minimum concrete around bottom and sides.

E. Fasten grates to channel sections if indicated.

F. Assemble channel sections with flanged or interlocking joints.

G. Embed channel sections in 4-inch (102-mm) minimum concrete around bottom and sides.

2.14 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.

   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

   4. Re-inspect and repeat procedure until results are satisfactory.

2.15 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
   1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
      a. Shielded flexible couplings for same or minor difference OD pipes.
      b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
   2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

## 3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
   2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   3. Install piping with 36-inch minimum cover.
   4. Install piping below frost line.
   5. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
   6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
   7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

## 3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join corrugated PE piping according to CPPA 100 and the following:
      a. Use silt tight couplings for Type 1, silt tight joints.
   2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
   3. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   4. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints and proper tolerances for the Omni-flex gaskets.
   5. Join dissimilar pipe materials with nonpressure-type flexible couplings.

C. Join dissimilar pipe materials with pressure-type couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
   4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.8 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill according to piping manufacturer's written instructions.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
   1. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.10 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
   1. Use warning tape over piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping according to ASTM F 1417.
   c. Option: Test concrete piping according to ASTM C 924.
   d. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
   e. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

## 3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water as required.

END OF SECTION 334100