Project Manual:

City of Centerville
Benham's Grove Improvements Project

PROJECT SITE: Event Center & Campus Improvements
166 N. Main Street
250 N. Main Street
Centerville, Ohio 45459

OWNER City of Centerville
100 W. Spring Valley Road
Centerville, Ohio 45458

ARCHITECT LWC Incorporated
434 E. First Street
Dayton, Ohio 45402

LWC Incorporated
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VOLUME 2 (Division 21 – 33)

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DIVISION 21

FIRE SUPPRESSION

SECTION 210500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Above ground piping.

B. Pipe hangers and supports.

C. Piping specialties.

D. Pressure gauges.

E. Pressure relief valves.

1.02 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems 2015 (Reaffirmed 2020).

B. ASME B40.100 - Pressure Gauges and Gauge Attachments 2022.

C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.

D. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

F. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250 2021.

G. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.

H. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).

I. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use 2021.

J. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Sprinkler-based System:
   1. Comply with NFPA 13.
   2. See Section 211300.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 40, black.
   1. Steel Fittings: ASME B16.5 steel flanges and fittings.
   2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.

2.03 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.

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. Preaction Valve:
   1. Operated by detection system listed for releasing service and independent of building fire alarm system with provisions for indicated remote, local, and manual releases.
   2. Incorporate mechanical latching mechanism with valve clappers independent of system water pressure fluctuations.
   3. Provide test detection device for each actuation circuit adjacent to each controlled valve in accordance with NFPA 13.

C. Backflow Preventer: Reduced-pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.

D. Commercial Riser Manifold: Preassembled and tested riser manifold in accordance with NFPA 13.

E. Test Connections:
   1. Inspector's Test Connection for Preaction and Dry Pipe Systems:
      a. Provide test connections approximately 6 feet (2 m) above floor for each sprinkler system equipped with an alarm device, located at most remote part of each system.
      b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
      c. Supply discharge orifice with same size as corresponding sprinkler orifice.
      d. Limit vertical height of exterior wall penetration to 2 feet (0.61 m) above finished grade.
   2. Combination Inspector's Test Connection and Drain Valve:
      a. Provide test connections approximately 6 feet (2 m) above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
      b. Route combination test connection and drain valve to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
      c. Supply discharge orifice with same size as corresponding sprinkler orifice.
      d. Limit vertical height of exterior wall penetration to 2 feet (0.61 m) above finished grade.

F. Water Flow Switch: Vane-type switch for mounting horizontally or vertically, with two contacts; rated 10 A at 125 VAC and 2.5 A at 24 VDC.

2.05 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

2.06 PRESSURE RELIEF VALVES

A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

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

F. Pipe Hangers and Supports:
   1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

I. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

J. Escutcheons:
   1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
   2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
   3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

END OF SECTION

SECTION 211100
FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe.

B. Valves.

1.02 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

B. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250 2021.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

D. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).

E. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2023.

G. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service 2023.

H. AWWA C550 - Protective Interior Coatings for Valves and Hydrants 2017.

I. AWWA M11 - Steel Pipe - A Guide for Design and Installation 2017, with Addendum (2019).

J. FM (AG) - FM Approval Guide Current Edition.

K. UL (DIR) - Online Certifications Directory Current Edition.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Steel Pipe: Standard weight, zinc-coated, listed, ASTM A53/A53M.
   1. Fittings: Comply with ASME B16.3 Class 150, zinc-coated, threaded 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.

2.02 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 (2,760 kPa).
   4. Maximum Service Temperature: 180 degrees F (82.2 degrees C).
   5. Valve Coatings:
      a. Internally: 4 mils, 0.004 inch (0.10 mm) epoxy, minimum.
      b. Externally: Epoxy base then fire red enamel paint or heat-fused red epoxy paint.

B. Pressure Relief Valves:
   1. Additional Compliance: UL (DIR) listed and labeled.
   2. Function: Diaphragm actuated pressure relief valve field adjusted to relieve excess pressure from fire protection system discharge pipe side.
   3. 1/2 to 3/4 inch NPS (15 to 20 mm, DN): Spring and diaphragm globe valve with female threaded ends.
   4. 2 inch NPS (50 mm, DN) to 8 inch NPS (200 mm, DN), Class 150 flange ends.

a. Type: Full port, single chamber globe valve operated by differential pressure pilot regulator.
b. Construction:
1) Body: ASTM A536, ductile iron Grade 65-45-12.
2) Main Valve Seat Ring: ASTM B62, bronze.
3) Stem: Stainless steel.
4) Elastomers Diaphragms, Resilient Seats, and O-rings: Buna-N.
5) Pilot Control System: ASTM B62, bronze with stainless steel trim.

C. Reduced-Pressure Zone (RPZ) Device, Flanged End:
1. 2-1/2 inch NPS (65 mm, DN) to 10 inch NPS (250 mm, DN):
a. Construction:
1) Main Valve Body: ASTM A536 Grade 65-45-12 ductile iron, 300 Series stainless steel, or 304 Series stainless steel.
2) Relief Valve Body: ASTM A536 Grade 65-45-12 ductile iron, 300 Series stainless steel, or 304 Series stainless steel.
3) Coating (As Applicable): Fusion epoxy internal and external, AWWA C550.
4) Shutoff Valves: NRS resilient wedge gate valve, AWWA C509.
5) Check Seats: Stainless steel.
6) Disc Holder: Stainless steel.
7) Elastomer Disc: Silicone, PPE/polystyrene, EPDM, or Buna-N.
8) Spring: Stainless steel.
9) Inlet/Outlet Flow:
(a) Inlet:
(1) Orientation: Horizontal.
(2) Flow Direction: Up.
(b) Outlet:
(1) Orientation: Vertical.
(2) Flow Direction: Horizontal.

PART 3 EXECUTION

3.01 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 (900 mm) 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 (760 mm).

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. Steel Piping:
   a. Jointing:
      1) Flanged:
         (a) Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.
         (b) Align bolt holes for each flanged joint.
         (c) Use full-size bolts for the bolt holes; use of undersized bolts due to misalignment of bolt holes or for any other purpose will not be allowed.
         (d) Do not allow adjoining flange faces to be out of parallel to such a degree that the flanged joint cannot be made water-tight without straining the flange.
         (e) When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it with one of correct dimensions.
   b. Allowable Offsets:
   c. Pipe Anchorage:
      1) Provide concrete thrust blocks (reaction backing) for pipe anchorage, except where metal harness is indicated.
      2) Thrust blocks to be in accordance with the recommendations for thrust restraint in AWWA M11, except that size and positioning of thrust blocks are to be as indicated.
      3) Use ASTM C94/C94M concrete having a minimum compressive strength of 2500 psi (15 MPa) 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) Metal Harness:
         (a) Provide in accordance with the recommendations for joint harnesses in AWWA M11, except as otherwise indicated.
         (b) Fabricated by the pipe manufacturer and furnished with the pipe.

C. Valves:
   1. Set valves on solid bearing.
   2. Center and plumb valve box over valve.
   3. Set box cover flush with finished grade.

3.02 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.

3.03 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. See Section 014000 - Quality Requirements for additional requirements.
   2. Provide all labor, equipment, and incidentals required for field testing, except that water and electric power needed for field tests will be furnished as set forth in Section 015100 - Temporary Utilities.
   3. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently and at least 5 days after placing of concrete.
   4. Fill pipeline 24 hours before testing and apply test pressure to stabilize system, using only potable water.
   5. Pressure test piping to ____ psi (____ kPa).
   6. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
   7. Prepare reports of testing activities.

3.04 CLOSEOUT ACTIVITIES

END OF SECTION

SECTION 211300
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

1.02 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.01 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. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.02 SPRINKLERS

A. Suspended Ceiling Type: Recessed pendant type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

B. Exposed Area Type: Pendant type with guard.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

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. Place pipe runs to minimize obstruction to other work.

D. Place piping in concealed spaces above finished ceilings.

E. 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.

F. Flush entire piping system of foreign matter.

G. Hydrostatically test entire system.

H. Require test be witnessed by Fire Marshal.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Stencils.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Nameplates:
   1. Heat exchangers, water heaters, and other heat transfer products.
   2. Control panels, transducers, and other related control equipment products.
   3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.

2.02 NAMEPLATES

A. Description: Laminated piece with up to three lines of text.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch (6 mm).
   3. Background Color: Black.
   4. Nameplate Material:
      a. Flexible: Polycarbonate with adhesive backing per ASTM D709.
      b. Metal: Brass with center-side holes for screw fastening.

2.03 STENCILS

A. Pipe: Stencil size required per external insulated or uninsulated pipe diameter.
   1. 3/4 to 1-1/4 inch (20 to 30 mm) Range: 1/2 inch (15 mm) text over 8 inch (200 mm) long background.
   2. 1-1/2 to 2 inch (40 to 50 mm) Range: 3/4 inch (20 mm) text over 8 inch (200 mm) long background.
   3. 2-1/2 to 6 inch (65 to 150 mm) Range: 1-1/4 inch (30 mm) text over 12 inch (300 mm) long background.

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

END OF SECTION

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

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

2.02 GLASS FIBER

A. Manufacturers:
   1. CertainTeed Corporation
   2. Johns Manville Corporation
   3. Knauf Insulation
   4. Owens Corning Corporation

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 650 degrees F (343 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

2.03 CELLULAR GLASS

A. Insulation: ASTM C552, Type II, Grade 6.
   1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
   2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
   3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/Pa s m) maximum per inch.
   4. Water Absorption: 0.5 percent by volume, maximum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. 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.

E. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. Inserts and Shields:
   1. Application: Piping 1-1/2 inches (40 mm) 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 (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

END OF SECTION

SECTION 221005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet (1500 mm) of building.

B. Sanitary waste piping, above grade.

C. Domestic water piping, buried within 5 feet (1500 mm) of building.

D. Domestic water piping, above grade.

E. Storm drainage piping, buried within 5 feet (1500 mm) of building.

F. Storm drainage piping, above grade.

G. Pipe flanges, unions, and couplings.

H. Pipe hangers and supports.
   1. Ball valves.

I. Butterfly valves.

1.02 RELATED REQUIREMENTS

A. Section 220553 - Identification for Plumbing Piping and Equipment.

B. Section 220719 - Plumbing Piping Insulation.

C. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.

D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2022.

E. ASME B31.9 - Building Services Piping 2020.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.

G. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.

H. ASTM B32 - Standard Specification for Solder Metal 2020.

I. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes 2020.

J. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.

K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

L. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.

M. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.

N. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.

O. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings 2020a.

P. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter 2022.

Q. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.

R. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe 2021.

S. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2020.

T. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.

U. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

V. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.

W. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

X. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 2023.

Y. 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 2023b.

Z. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.

AA. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.

BB. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2018, with Editorial Revision (2020).

CC. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry 2018, with Editorial Revision (2020).

DD. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2017, with Editorial Revision (2020).

EE. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2023.

FF. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

GG. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

HH. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

II. NSF 372 - Drinking Water System Components - Lead Content 2022.

JJ. PPI TR-4 - PPI HSB 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 2021.

KK. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 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. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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 (1500 MM) OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

B. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
   2. Joints: ASTM B32, alloy Sn50 solder.

C. PVC Pipe: ASTM D2729.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

B. PE Pipe: ASTM D2239.
   1. Fittings: ASTM D2609, PE.
   2. Joints: Mechanical with stainless steel clamp.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

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

B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
   1. Manufacturers:
      a. Uponor, Inc: www.uponorengineering.com/#sle.
      b. Viega LLC: www.viega.us/#sle.
      c. Zurn Industries, LLC: www.zurn.com/#sle.
   2. PPI TR-4 Pressure Design Basis:
      a. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).

3. Fittings: Brass and engineered polymer (EP) ASTM F1960.
4. Joints: Mechanical compression fittings.
5. Joints: ASTM F1960 cold-expansion fittings.

2.06 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) 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.

2.07 STORM DRAINAGE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
   2. Joints: ASTM B32, alloy Sn50 solder.

2.08 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch (80 mm, DN) 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 (25 mm, DN):
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.09 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.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.

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.

2.10 BALL VALVES

A. Manufacturers:
   1. Apollo Valves
   2. Grinnell Products
   3. Nibco, Inc

B. Construction, 4 inch (100 mm, DN) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

PART 3 EXECUTION

3.01 EXAMINATION

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

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

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

H. 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.

I. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

J. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   3. Provide copper plated hangers and supports for copper piping.

K. 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 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

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.

3.05 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.

END OF SECTION

SECTION 221006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Backflow preventers.
F. Double check valve assemblies.
G. Water hammer arrestors.
H. Sanitary waste interceptors.
I. Mixing valves.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains 2019.
B. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent 2021.
C. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance 2011 (Reaffirmed 2016).
D. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
E. NSF 372 - Drinking Water System Components - Lead Content 2022.
F. PDI-WH 201 - Water Hammer Arresters 2017.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company
   2. Josam Company
   3. Zurn Industries, LLC
B. Floor Drain:
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

C. Floor Sink:
   1. Lacquered cast iron body with dome strainer and seepage flange.

2.03 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company
   2. Josam Company
   3. Zurn Industries, LLC

B. Cleanouts at Interior Finished Floor Areas:
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

2.04 HYDRANTS

A. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

2.05 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Apollo Valves
   2. Watts Regulator Company, a part of Watts Water Technologies
   3. Zurn Industries, LLC

2.06 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:
   1. Apollo Valves
   2. Cash Acme, a brand of Reliance Worldwide Corporation
   3. Watts Regulator Company, a part of Watts Water Technologies
   4. Zurn Industries, LLC

B. Double Check Valve Assemblies:
   1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.07 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company
   2. Watts Regulator Company, a part of Watts Water Technologies
   3. Zurn Industries, LLC

B. Water Hammer Arrestors:
   1. Stainless steel construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.08 SANITARY WASTE INTERCEPTORS

A. Grease Interceptors:
   1. Construction:
      a. Material: Epoxy coated fabricated steel.
      b. Rough-in: Fully recessed flush with floor (deep rough-in) with anchor flange.
      c. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port.

2.09 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

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. 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.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

END OF SECTION

SECTION 223000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water Heaters:
   1. Commercial gas fired.

1.02 SUBMITTALS

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

B. Shop Drawings:
   1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

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

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

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

B. 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.

1.04 WARRANTY

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

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Commercial Gas Fired:
   1. Type: Automatic, natural gas-fired, vertical storage.
   2. Accessories:
      a. Water Connections: Brass.
      b. Dip Tube: Brass.
      c. Drain valve.
      d. Anode: Magnesium.
   3. Certified For The Following Applications:
   4. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F (49 to 82 degrees C), automatic reset high temperature limiting thermostat factory set at 195 degrees F (90 degrees C), gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

END OF SECTION

SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.

B. Lavatories.

C. Sinks.

D. Mop sinks.

E. Under-lavatory pipe supply covers.

1.02 RELATED REQUIREMENTS

A. Section 221005 - Plumbing Piping.

B. Section 221006 - Plumbing Piping Specialties.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures 2011 (Reaffirmed 2022).

C. ASME A112.18.1 - Plumbing Supply Fittings 2018, with Errata.

D. ASME A112.19.2 - Ceramic Plumbing Fixtures 2018, with Errata.

E. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices 2020.

F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

G. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

H. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

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

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

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.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

2.03 TANK TYPE WATER CLOSETS

A. Tank Type Water Closet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.

B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, 16.5 inches (420 mm) high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.

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

2.04 LAVATORIES

A. Lavatory Manufacturers:
   1. American Standard, Inc
   2. Kohler Company

B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, with 4 inch (100 mm) high back, rectangular basin with splash lip, front overflow, and soap depression.
   1. Drilling Centers: 4 inch (100 mm).

C. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 0.5 gallon per minute (low-flow) (1.9 liters per minute (low-flow)), indexed handles.

D. Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.
   1. Manufacturers:
      a. Acorn Engineering Company: www.acorneng.com/#sle.
      b. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.

2.05 SINKS

A. Sink Manufacturers:
   1. American Standard, Inc
   2. Kohler Company

2.06 UNDER-LAVATORY PIPE SUPPLY COVERS

A. General:
   1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
   2. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
      a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
      b. Comply with ICC A117.1.
   3. Color: High gloss white.

2.07 MOP SINKS

A. Mop Sink Manufacturers:
   1. Just Manufacturing Company
   2. Zurn Industries, Inc
   3. Mustee

B. Type: Rectilinear.

C. Grid Strainer: Stainless steel; integral; removable.

D. Dimensions: As indicated on drawings.

E. Accessories:
   1. Hose clamp hanger.
   2. Mop hanger.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. 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 components level and plumb.

B. Install and secure fixtures in place with wall supports and bolts.

3.04 ADJUSTING

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

3.05 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

DIVISION 23

HVAC EQUIPMENT

SECTION 230513
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. NEMA MG 1 - Motors and Generators 2021.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. 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.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

C. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

2.03 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. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

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

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

A. ASTM 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 2023.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

D. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

F. MFMA-4 - Metal Framing Standards Publication 2004.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

D. Pipe Hangers: For a given pipe run use hangers of the same type and material.
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

E. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
   1. Pipe Diameter 6 inches (150 mm) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).

2. Pipe Diameter 8 inches (200 mm): Provide U-bolts with double nuts providing minimum clearance of 0.28 inch (7 mm).
3. Pipe Diameter 8 inches (200 mm): 0.625 inch (16 mm) U-bolt.
4. Pipe Diameter 10 inches (250 mm): 0.75 inch (19 mm) U-bolt.
5. Pipe Diameter 12 to 16 inches (300 to 400 mm): 0.875 inch (24 mm) U-bolt.
6. Pipe Diameter 18 to 30 inches (450 to 750 mm): 1 inch (25 mm) U-bolt.

F. Pipe Alignment Guides: Galvanized steel.
1. Pipe Diameter 8 inches (200 mm) and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches (250 mm) and Larger: Roller type.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Steel: Use beam clamps, machine bolts, or welded threaded studs.
4. Sheet Metal: Use sheet metal screws.
5. Wood: Use wood screws.
6. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   a. Comply with MFMA-4.
   b. Channel Material: Use galvanized steel.
   c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. 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.

G. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

SECTION 230553
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

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Control Panels: Nameplates.

C. Piping: Stencilled painting.

D. Small-sized Equipment: Tags.

2.02 NAMEPLATES

A. Letter Color: White.

B. Letter Height: 1/4 inch (6 mm).

C. Background Color: Black.

D. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

D. 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 (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
   2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
   3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

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.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch (20 mm) 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.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

A. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods 2016, with Errata.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems 2019.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

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

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      d. Final test report forms to be used.
      e. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
   3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   5. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

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.

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. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   3. Duct systems are clean of debris.
   4. Fans are rotating correctly.
   5. Fire and volume dampers are in place and open.
   6. Air coil fins are cleaned and combed.
   7. Air outlets are installed and connected.
   8. Service and balance valves are open.

3.03 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 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.

3.05 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. 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.

E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

3.06 SCOPE

A. Test, adjust, and balance the following:
   1. Fans.
   2. Air Terminal Units.
   3. Air Inlets and Outlets.

3.07 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. HP/BHP.

3. Phase, voltage, amperage; nameplate, actual, no load.

B. Air Cooled Condensers:
   1. Identification/number.

C. Exhaust Fans:
   1. Manufacturer.
   2. Model number.
   3. Air flow, specified and actual.
   4. Total static pressure (total external), specified and actual.
   5. Inlet pressure.
   6. Discharge pressure.

D. Duct Traverses:
   1. Area.
   2. Design velocity.
   3. Design air flow.
   4. Test velocity.
   5. Test air flow.

E. Air Distribution Tests:
   1. Room number/location.
   2. Design air flow.
   3. Test (final) air flow.
   4. Percent of design air flow.

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

1.02 RELATED REQUIREMENTS

A. Section 230553 - Identification for HVAC Piping and Equipment.

B. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

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:
   1. CertainTeed Corporation
   2. Johns Manville
   3. Knauf Insulation

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K (Ksi) value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
   1. CertainTeed Corporation
   2. Johns Manville
   3. Knauf Insulation

B. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K (Ksi) Value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.

2.04 DUCT LINER

A. Manufacturers:
   1. Armacell LLC
   2. CertainTeed Corporation
   3. Ductmate Industries, Inc, a DMI Company
   4. Johns Manville

B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
   1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
   2. Maximum Service Temperature: 180 degrees F (82 degrees C).
   3. Connection: Waterproof vapor barrier adhesive.

C. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; rigid board and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Duct and Plenum Liner Application:
   1. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
   2. Seal and smooth joints. Seal and coat transverse joints.

END OF SECTION

SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

C. Section 232300 - Refrigerant Piping: Placement of 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, with Editorial Revision (2023).

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.

E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation 2022.

F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2023).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

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, RIGID

A. Manufacturers:
   1. CertainTeed Corporation
   2. Johns Manville Corporation
   3. Knauf Insulation
   4. Owens Corning Corporation

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 850 degrees F (454 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-

inches (0.029 ng/Pa s m).

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 CELLULAR GLASS

A. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
   1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
   2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
   3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/Pa s m) maximum per inch.
   4. Water Absorption: 0.5 percent by volume, maximum.
   5. Density: A minimum of 6.12 lb/cu ft (98 kg/cu m).

B. Block Insulation: ASTM C552, Type I, Grade 6.
   1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
   2. Service Temperature: 800 degrees F (427 degrees C), maximum.
   3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/Pa s m) maximum per inch.
   4. Water Absorption: 0.5 percent by volume, maximum.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; Aerocel ULP
   2. Armacell LLC; AP Armaflex

B. 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 (Minus 40 degrees C).
   2. Maximum Service Temperature: 180 degrees F (82 degrees C).
   3. Connection: Waterproof vapor barrier adhesive.

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

2.05 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
      b. Maximum Service Temperature: 150 degrees F (66 degrees C).
      c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil (0.25 mm).
      e. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. 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.

D. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

END OF SECTION

SECTION 231123
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

A. Section 230553 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators 2019.

B. ANSI Z223.1 - National Fuel Gas Code 2021.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.

E. ASME B31.1 - Power Piping 2022.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023a.

H. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.

I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

J. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2018.

K. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry 2018, with Editorial Revision (2020).

L. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2017, with Editorial Revision (2020).

M. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ANSI Z223.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.02 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.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
   1. Fittings: ASME B16.26, cast bronze.
   2. Joints: Flared.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 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.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   2. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

2.05 BALL VALVES

A. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded ends.

PART 3 EXECUTION

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

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

H. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

I. Pipe Hangers and Supports:
   1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
   5. Provide copper plated hangers and supports for copper piping.

3.02 APPLICATION

A. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

END OF SECTION

SECTION 232300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

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

B. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

B. Pipe Supports and Anchors:
   1. Provide hangers and supports that comply with MSS SP-58.
      a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   4. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
   5. Vertical Support: Steel riser clamp.
   6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.03 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.04 VALVES

A. Diaphragm Packless Valves:
   1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).

B. Ball Valves:
   1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).

C. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.05 STRAINERS

A. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

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

F. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Insulate piping and equipment; refer to Section and Section 230716.

J. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Duct cleaning.

1.02 RELATED REQUIREMENTS

A. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

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

C. Section 233300 - Air Duct Accessories.

D. Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Round Ducts: Round lockseam duct with galvanized steel outer wall.
   1. Manufacture in accordance with SMACNA (DCS).

B. Flexible Ducts: Black polymer film supported by helically wound spring steel wire.
   1. Pressure Rating: 4 inches WG (1000 Pa) positive and 0.5 inches WG (175 Pa) negative.
   2. Maximum Velocity: 4000 fpm (20.3 m/sec).

3. Temperature Range: Minus 20 degrees F to 175 degrees F (Minus 28 degrees C to 79 degrees C).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

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

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

E. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

3.02 CLEANING

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

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backdraft dampers - metal.

B. Fire dampers.

C. Flexible duct connections.

D. Volume control dampers.

1.02 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.

C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.

D. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.

E. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.

F. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

A. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) 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 (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 FIRE DAMPERS

A. Manufacturers:
   1. Nailor Industries, Inc
   2. Ruskin Company

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) 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 (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.

E. Fusible Links: UL 33, separate at 165 degrees F (73.8 degrees C) with adjustable link straps for combination fire/balancing dampers.

2.03 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.04 VOLUME CONTROL DAMPERS

A. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
   2. Blade: 24 gage, 0.0239 inch (0.61 mm), minimum.

B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch (1.21 mm), minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.

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

C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

D. Demonstrate re-setting of fire dampers to Owner's representative.

E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

G. 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.

H. 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 233439
HIGH-VOLUME, LOW-SPEED PROPELLER FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High-volume, low-speed propeller fans.

1.02 REFERENCE STANDARDS

A. UL 507 - Electric Fans Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Manufacturer's Instructions: Indicate installation instructions.

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.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 507.

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

2.02 HIGH-VOLUME, LOW-SPEED PROPELLER FANS

A. Manufacturers:
   1. Big Ass Fans; Basic 6
   2. Blue Giant Equipment Corporation; _____
   3. Patterson Fan Company, Inc; _____
   4. Greenheck

B. Number of Fan Blades: Five.

C. Fan Diameter: 6 feet

D. Mounting Options: Structure.

E. Direct Drive Fan:
   1. Statically and dynamically balanced.
   2. Motors:
      a. Open drip-proof (ODP).
      b. Heavy duty ball bearing type.
      c. Mount on vibration isolators or resilient cradle mounts, out-of-airstream.
      d. Fully accessible for maintenance.

F. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least 25 percent over maximum cataloged operating speed.
   2. Bearings:
      a. Permanently sealed or pillow block type.
      b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
      c. 100 percent factory tested.

G. Fan Controllers:
   1. Shipped loose for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure fan with stainless steel lag screws to structure.

END OF SECTION

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets 2023.

1.03 SUBMITTALS

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

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carnes, a division of Carnes Company Inc

B. Krueger-HVAC

C. Price Industries

D. Titus, a brand of Air Distribution Technologies

2.02 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square, stamped, multi-core diffuser to discharge air in four way pattern with sectorizing baffles where indicated.

B. Connections: Round.

C. Frame: Provide surface mount and inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Color: As indicated.

2.03 CEILING SLOT DIFFUSERS

A. Type: Continuous 1/2 inch (13 mm) wide slot, two slots wide, with adjustable vanes for left, right, or vertical discharge.

B. Fabrication: Steel with factory clear lacquer finish.

C. Color: As indicated.

D. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket, mitered end border.

E. Plenum: Integral, galvanized steel, insulated.

2.04 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch (13 by 13 by 13 mm) grid core.

B. Fabrication: Grid core consists of steel with baked enamel finish.

C. Color: As indicated.

D. Frame: Channel lay-in frame for suspended grid ceilings.

2.05 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, single deflection.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.

C. Fabrication: Steel frames and blades, with factory baked enamel finish.

D. Color: As indicated on the drawings.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.07 WALL AND CEILING GYPSUM BOARD ACCESS PANELS

A. Description: Return air grille with full service access. Louvers to be fitted into a frameless door that is flush with drywall surface. Return air grille can be integrated with manufacturer's suggested access panel or installed directly in drywall surface.

B. Gypsum Board Access Panels: Provide rectangular access panel with recessed and gasketed aluminum perimeter frame that acts as finishing edge and having concealed mechanical touch-latch with safety cable.
   1. Panel Frame Size: 16 by 16 inch (406 by 406 mm) set within 1/2 inch (12.7 mm) thick gypsum board.
   2. Panel Frame: 1 inch (25.4 mm) margin with concealed countersunk screw mounting.

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. Refer to Section 099123.

END OF SECTION

SECTION 235400
FURNACES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Forced air furnaces.

B. Thermostats.

1.02 RELATED REQUIREMENTS

A. Section 231123 - Facility Natural-Gas Piping.

B. Section 230513 - Common Motor Requirements for HVAC Equipment: Additional requirements for fan motors.

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

1.03 REFERENCE STANDARDS

A. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces 2021.

B. 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.

C. ASHRAE Std 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers 2022.

D. NFPA 54 - National Fuel Gas Code 2021.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.

F. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances 2019.

1.04 SUBMITTALS

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

B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 WARRANTY

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

B. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation

B. Trane Inc

2.02 GAS FIRED FURNACES

A. Annual Fuel Utilization Efficiency (AFUE): 0.92 "condensing" in accordance with ASHRAE Std 103.

B. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, humidifier, and accessories; wired for single power connection with control transformer.
   1. Safety certified by CSA in accordance with ANSI Z21.47.
   2. Venting System: Direct.
   3. Combustion: Sealed.

4. Air Flow Configuration: Upflow and Downflow.
5. Heating: Natural gas fired.
6. Accessories:
   a. Condensate drain.
   b. Concentric roof termination kit.

C. Performance:
   1. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.

D. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner. If not certified for combustible flooring, please provide additional steel base.

E. Primary Heat Exchanger:
   1. Material: Hot-rolled steel.
   2. Shape: Tubular type.

F. Gas Burner:
   1. Atmospheric type with adjustable combustion air supply.
   2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
   3. Electronic pilot ignition, with electric spark igniter.
   4. Combustion air damper with synchronous spring return damper motor.
   5. Non-corrosive combustion air blower with permanently lubricated motor.

G. Gas Burner Safety Controls:
   1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
   2. Flame rollout switch: Installed on burner box and prevents operation.
   3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
   4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

H. Supply Fan: Centrifugal type rubber mounted with direct drive with adjustable variable pitch motor pulley.

I. Motor:
   1. 1750 rpm single-speed, permanently lubricated, hinge mounted.

J. Air Filters: 1 inch (25 mm) thick urethane, washable type arranged for easy replacement.

K. Operating Controls:
   1. Room Thermostat: Cycles burner to maintain room temperature setting.
   2. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low speed fan operation.

2.03 THERMOSTATS

A. Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:
   1. System selector switch (heat-off) and fan control switch (auto-on).
   2. Preferential rate control to minimize overshoot and deviation from setpoint.
   3. Programming based on weekdays, Saturday and Sunday.
   4. Thermostat Display:
      a. Time of day.
      b. Actual room temperature.
      c. Programmed temperature.
      d. Programmed time.
      e. 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 located correctly.

C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B. Install in accordance with NFPA 90A.

C. Install gas fired furnaces in accordance with NFPA 54.

D. Provide vent connections in accordance with NFPA 211.

END OF SECTION

SECTION 237223
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012, with Editorial Revision (2015).

C. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment 2018.

D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.02 SUBMITTALS

A. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Firm regularly engaged in manufacturing energy recovery units.
   2. Products in satisfactory use in similar service for not less than five years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store in manufacturer's unopened packaging.

B. Store products to be installed indoors in dry, heated area.

1.05 WARRANTY

A. Warranty ventilator to be free from defects in material and workmanship and of all parts for period of 1-1/2 years from date of Substantial Completion.

B. Warranty energy recovery wheel to be free from defects in material and workmanship for 3 years under circumstances of normal use.

C. Warranty motor to be free from defects in material and workmanship for 7 years under circumstances of normal use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Energy Recovery Ventilators:

B. Basis of Design: RenewAire: www.renewaire.com/#sle.
   1. HE Series ERV: Static-plate, heat and humidity transfer energy recovery ventilator.

2.02 ENERGY RECOVERY UNITS

A. Energy Recovery Units: Provide stationary core air-to-air exchanger; prefabricated packaged system designed by manufacturer.
   1. Provide unit with a AHRI 1060 (I-P) compliant air-to-air exchanger.
   2. Access: Hinged and/or screwed access panels on front.
   3. Lifting holes at the unit base.

4. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
5. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.03 CASING

A. Wall, Floor, and Roof Panels:
1. Construction: 1 inch (25 mm) thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
2. Exterior Wall: Galvanized steel sheet.
a. 0.040 inches (1 mm) thick aluminum.
3. Interior Wall: Galvanized sheet metal.
a. 22 gauge, 0.0299 inch (0.76 mm) galvanized sheet metal.
4. Insulation:
a. 1/2 inch (13 mm) insulated fiberglass.
b. Panel Cores: Mineral wool board.
c. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
d. Smoke Developed Index (SDI): 50, maximum, when tested in accordance with ASTM E84 or UL 723.
5. Roof Panel: Weatherproof.
6. Coating: Polyurethane enamel.

B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.

C. Doors:
1. Construct doors of same construction and thickness as wall panels.
2. Height: 80 inches (2032 mm).

2.04 FANS

A. Provide separate fans for exhaust and supply blowers.

B. Fans:
1. Individually driven with a dedicated motor.

C. Housings: 12 gauge, 0.1046 inch (2.66 mm) aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.

D. Motors:
1. Motors: Open drip proof.
2. Efficiency: High.
3. Speed: Single.
4. Control: Constant Speed.
5. Fan Motor: UL listed and labeled.

E. Drives:
1. Fans: Belt driven.
2. Horsepower: 7.5 hp (5.2 kW).
3. Service Factor: 1.2.

2.05 FILTERS

A. Efficiency: ____ MERV.

B. Exhaust and Fresh Air Streams: MERV 7 filters constructed to meet ASHRAE Std 52.2.

C. Mount 1/2-inch (13 mm) thick, permanent, aluminum, washable type filter in outside air hood and in return air plenum.

2.06 DAMPERS

A. Exhaust Back-Draft Damper: Factory installed, galvanized steel.

1. High performance, backdraft dampers suitable for application in HVAC systems with velocities to 3000 fpm (914 m/min).
2. Louvers, Dampers, and Shutters: AMCA 500-D and AMCA 500-L.
3. Damper Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.
4. Fabrication:
   a. Frame: 20 gauge, 0.0359 inch (0.91 mm), 3 inch (76 mm) roll formed galvanized steel channel with rear flange, prepunched mounting holes, and welded corner clips for maximum rigidity.
   b. Blades:
      1) Style: Single-piece, overlap frame.
      2) Material: Roll formed 28 gauge, 0.0149-inch (0.38 mm) galvanized steel.
      3) Width: Maximum 6 inches (152 mm).

B. Return Air Damper:
1. Factory installed, adjustable volume control, opposed blade damper for regulating airflow, based on external static pressure.
2. Return Air Damper: Structural hat channels, reinforced at corners.
3. Roll-formed Frames: Structurally superior to 13 gauge, 0.0897 inch (2.28 mm) U-channel frames.
4. Blades: Single skin, 16 gauge, 0.0598 inch (1.52 mm).

C. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
1. Type: Motorized two position parallel blade damper with blade seals.
2. Motorized Damper: Roll-formed structural hat channels, reinforced at the corners,
3. Blades: Single skin, 16 gauge, 0.0598 inch (1.52 mm).

2.07 POWER AND CONTROLS

A. Motor Control Panels: UL listed.

B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.

C. Install wiring in accordance with NFPA 70.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide openings for suitable ductwork connection.

3.02 SYSTEM STARTUP

A. Provide services of manufacturer's authorized representative to provide start up of unit.

END OF SECTION

SECTION 238126.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air cooled condensing units.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2022, with Errata (2023).

C. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant 2019.

D. 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.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.

G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Condensing units shall match associated indoor unit..

2.02 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Refrigerant: R-410A.
   2. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
   1. Condenser Fans: Direct-drive propeller type.
   2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.

D. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Photovoltaic wire.

D. Wiring connectors.

E. Electrical tape.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

H. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

E. Section 263100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers 2005 (Reapproved 2021).

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation 2018.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

I. NECA 104 - Standard for Installing Aluminum Building Wire and Cable 2012.

J. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.

K. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.

L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

N. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

O. UL 267 - Outline of Investigation for Wire-Pulling Compounds Most Recent Edition, Including All Revisions.

P. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

Q. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

R. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

S. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

T. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

U. UL 4703 - Standard for Photovoltaic Wire Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

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

B. 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.

C. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.
   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 (1.8 m).

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 260526.

H. Conductor Material:
   1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
      a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
         1) Services: Copper conductors size 1/0 AWG and larger.
      b. Where aluminum conductors are substituted for copper, comply with the following:
         1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
         2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
         3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
         4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
   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.
   4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

I. 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.
   3. Color Code:
      a. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.

4) Neutral/Grounded: White.
b. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation: www.generalcable.com/#sle.
d. Southwire Company: www.southwire.com/#sle.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Encore Wire Corporation: www.encorewire.com/#sle.
b. Southwire Company: www.southwire.com/#sle.
c. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
a. Size 4 AWG and Larger: Type XHHW-2.
b. Installed Underground: Type XHHW-2.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 METAL-CLAD CABLE

A. Manufacturers:
1. Encore Wire Corporation: www.encorewire.com/#sle.
2. 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: Steel, interlocked tape.

2.05 PHOTOVOLTAIC WIRE

A. Manufacturers:
1. Service Wire Co; ServiceSolar: www.servicewire.com/#sle.

B. Description: Sunlight-resistant, single-conductor, insulated photovoltaic wire listed and labeled as complying with UL 4703; specifically designed for interconnection wiring of photovoltaic power systems in accordance with NFPA 70.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: As required for photovoltaic power system voltage.

2.06 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 260526.

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.
   3. Connectors for Aluminum Conductors: Use compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   5. Aluminum Conductors: Use compression connectors for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Push-in Wire Connectors: Rated 600 V, 221 degrees F (105 degrees C).
   1. Manufacturers:
      a. Ideal Industries, Inc: www.idealindustries.com/#sle.

H. Mechanical Connectors: Provide bolted type or set-screw type.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.07 ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
   3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
   4. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).

B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

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.

D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

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

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

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

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

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install metal-clad cable (Type MC) in accordance with NECA 120.

F. 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.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. 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.

I. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC):

a. Use listed fittings.
b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet (1.5 m) of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. 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. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. 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.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 263100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 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. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

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 (3.0 m) at an accessible location not more than 5 feet (1.5 m) 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. 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 (3.0 m) from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
   5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
   6. 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 2 by 12 inches (6 by 50 by 300 mm) 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 (450 mm) above finished floor unless otherwise indicated.

F. 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.

G. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
   b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
   c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

H. Photovoltaic Systems: Also comply with Section 263100.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

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

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

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 260553.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 263100 - Photovoltaic Collectors: Photovoltaic module mounting systems.

C. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

D. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

E. Section 270529 - Hangers and Supports for Communications Systems.

1.03 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 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

D. MFMA-4 - Metal Framing Standards Publication 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

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

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 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. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. 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.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
   1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
   4. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

G. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

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

3.02 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
   2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Interior Luminaire Support and Attachment: See Section 265100 for additional requirements.

I. Exterior Luminaire Support and Attachment: See Section 265600 for additional requirements.

J. Secure fasteners in accordance with manufacturer's recommended torque settings.

K. Remove temporary supports.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Floor marking tape.

F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 099113 - Exterior Painting.

B. Section 099123 - Interior Painting.

C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 263100 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 70E - Standard for Electrical Safety in the Workplace 2024.

C. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Panelboards:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) 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 nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
c. Enclosed switches, circuit breakers, and motor controllers:
   1) Identify voltage and phase.
   2) Identify power source and circuit number. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location when not within sight of equipment.
d. Centralized Emergency Lighting Inverters:
   1) Identify input and output voltage and phase.
   2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location.

2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
4. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
5. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
   a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with Section 099123 and 099113.
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. Industrial control panels.
   c. Motor control centers.
   d. Elevator control panels.
   e. Industrial machinery.
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. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
   b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
   c. Service Equipment: Include the following information in accordance with NFPA 70.
      1) Nominal system voltage.
      2) Available fault current.
      3) Date label applied.
8. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with

the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
   3. 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. Within boxes when more than one circuit is present.

C. Identification for Raceways:
   1. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
   2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

D. Identification for Boxes:
   1. Use voltage markers to identify highest voltage present.
   2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
      a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:
   1. Use identification label or engraved wallplate 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. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F. Identification for Photovoltaic Systems: Comply with Section 263100

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 (1.6 mm); engraved text.
   3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
   4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
   5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) 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.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend:
   a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. Equipment Designation: 1/2 inch (13 mm).
5. Color:
   a. Normal Power System: White text on black background.
   b. Fire Alarm System: White text on red background.

D. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch (13 mm).
5. Color: Black text on yellow background unless otherwise indicated.

E. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

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 (3 mm).

F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

B. Minimum Size:
1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
2. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).

C. Legend:
1. Markers for Voltage Identification: Highest voltage present.

D. Color: Black text on orange background unless otherwise indicated.

2.05 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches (76 mm) wide, with alternating black and white stripes.

2.06 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

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

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. 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.
   1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262726 - 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.

F. Section 265100 - Interior Lighting.

G. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices current edition.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

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

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

D. Field Quality Control Reports.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

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.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 WARRANTY

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

B. Provide five year manufacturer warranty for all occupancy sensors.

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. Hubbell Incorporated; _____: www.hubbell.com/#sle.
   2. WattStopper; _____: www.wattstopper.com/#sle.
   3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
      b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
      c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
   6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in

selected areas.

7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
12. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
13. Wireless Sensors:
    a. RF Range: 30 feet (9 m) through typical construction materials.
    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    e. 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.
    f. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet (37.2 sq m).
4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

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. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    c. Manual-Off Override Control Capability: 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.
    d. 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.

e. Provide field adjustable dimming preset for occupied state.
f. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.

2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
d. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 square meters) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet (46.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet (92.9 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet (185.8 sq m) at a mounting height of 9 feet (2.7 m).
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.

F. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

G. Power Packs for Wireless Occupancy Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Rating: As required to control the load indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

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

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches (1.2 m) above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 260553.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

L. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. 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. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   3. Location: At project site.

END OF SECTION

SECTION 262100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262413 - Switchboards: Service entrance equipment.

F. Section 263100 - Photovoltaic Collectors: Photovoltaic system for interconnection with normal utility electrical supply.

1.03 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.04 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)) 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Project Record Documents: Record actual locations of equipment and installed service routing.

1.07 QUALITY ASSURANCE

A. Comply with the following:
1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.08 DELIVERY, STORAGE, AND HANDLING

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

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility:
1. Pad-Mounted Utility Transformers:
   a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
   b. Transformers: Furnished and installed by Utility Company.
   c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
   d. Primary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Utility Company.
   e. Secondary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
2. Pole-Mounted Utility Transformers:
   a. Utility Poles: Furnished and installed by Utility Company.
   b. Transformers: Furnished and installed by Utility Company.
   c. Transformer Grounding Provisions: Furnished and installed by Utility Company.
   d. Primary: Furnished and installed by Utility Company.
3. Terminations at Service Point: Provided by Utility Company.
4. Metering Provisions:
   a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.

b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
c. Metering Transformers: Furnished and installed by Utility Company.
d. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
e. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

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

3.02 PREPARATION

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment components in accordance with Section 260529.

E. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.

F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

END OF SECTION

SECTION 262413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262100 - Low-Voltage Electrical Service Entrance.

1.03 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers 2016.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 400 - Standard for Installing and Maintaining Switchboards 2007.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. NEMA PB 2 - Deadfront Distribution Switchboards 2011.

F. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less 2013.

G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

J. UL 891 - Switchboards Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances 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. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.

4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

E. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards - Basis of Design: Schneider Electric; Square D Products<>: www.schneider-electric.us/#sle..

B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

C. Source Limitations: Furnish switchboards 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 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.

E. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet (2,000 m).
      b. Ambient Temperature:
         1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
   2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:
   1. Minimum Rating: 65,000 rms symmetrical amperes.

G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

H. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   3. Phase and Neutral Bus Material: Aluminum.
   4. Ground Bus Material: Aluminum.

I. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:

J. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Finish: Manufacturer's standard unless otherwise indicated.

K. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
   2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.

L. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.

3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
   1. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2.04 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

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. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (10 mm) between switchboard and wall.

E. Provide required support and attachment in accordance with Section 260529.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 033000.

H. Provide grounding and bonding in accordance with Section 260526.

I. Install all field-installed devices, components, and accessories.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Provide filler plates to cover unused spaces in switchboards.

L. Identify switchboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.1.

E. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

F. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

G. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 ADJUSTING

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

B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

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

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

3.06 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Load centers.

D. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e, with Amendment (2017).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. NEMA PB 1 - Panelboards 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.

G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

K. UL 67 - Panelboards Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

M. UL 1053 - Ground-Fault Sensing and Relaying Equipment Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. 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.

D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 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. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide 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 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   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. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase and Neutral Bus Material: Aluminum.
   2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
   1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.

E. Enclosures:
   1. Provide surface-mounted enclosures unless otherwise indicated.
   2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Aluminum.
   3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 LOAD CENTERS

A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.

B. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Bus Material: Aluminum or copper.

C. Circuit Breakers: Thermal magnetic plug-in type.

D. Enclosures:
   1. Provide flush-mounted enclosures unless otherwise indicated.
   2. Fronts: Provide hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   7. Do not use tandem circuit breakers.
   8. Do not use handle ties in lieu of multi-pole circuit breakers.
   9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

2.07 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

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

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 260529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 260526.

K. Install all field-installed branch devices, components, and accessories.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

M. Provide filler plates to cover unused spaces in panelboards.

N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Emergency and night lighting circuits.
   2. Fire detection and alarm circuits.
   3. Communications equipment circuits.
   4. Intrusion detection and access control system circuits.
   5. Video surveillance system circuits.

O. Identify panelboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - 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 _____ 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.

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 262726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates and covers.

E. Floor box service fittings.

F. Access floor boxes.

1.02 RELATED REQUIREMENTS

A. Section 096900 - Access Flooring.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 260583 - Wiring Connections: Cords and plugs for equipment.

G. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification) 2014g, with Amendment (2017).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.

E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

L. UL 1310 - Class 2 Power Units Current Edition, Including All Revisions.

M. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

1.04 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. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect 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 and painting are complete.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

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

D. Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.

E. Project Record Documents: Record actual installed locations of wiring devices.

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. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

C. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.

D. Provide GFCI protection for receptacles installed in kitchens.

E. Provide GFCI protection for receptacles serving electric drinking fountains.

F. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

D. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.03 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. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

A. Manufacturers:
1. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
2. 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. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
1. Electronic Low-Voltage: 400 VA.

2.05 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.
4. 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. 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. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
4. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. 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.
   3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
   4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
   5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. 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 Noncombination Devices: Four-port (Type A); rectangular decorator style.

2.06 WALL PLATES AND COVERS

A. Manufacturers:
   1. Hubbell Incorporated; _____: www.hubbell-wiring.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.
   4. 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. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.

F. 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.

2.07 ACCESS FLOOR BOXES

A. Manufacturers - Access Floor Boxes:
   1. Hubbell Incorporated; _____: www.hubbell-wiring.com/#sle.
   2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.

B. Description: Metallic multi-service box suitable for mounting in access floor system specified in Section 096900.

C. Configuration:
   1. Power: Two standard convenience duplex receptacle(s).
   2. Voice and Data Jacks: Provided by others.

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 floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

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. 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 260533.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches (1200 mm) above finished floor.
      b. Wall Dimmers: 48 inches (1200 mm) above finished floor.
      c. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. 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.
   4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
   5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

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 (150 mm) 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 260553.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 260923 - Lighting Control Devices.
   1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.

E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

F. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.

D. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems 2006.

E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 2006.

F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.

J. UL 1598 - Luminaires Current Edition, Including All Revisions.

K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

D. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

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

B. Provide 5-year manufacturer warranty for LED luminaires, including drivers.

C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. 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.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.04 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single- or double-face as indicated or as required for installed location.
   2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
   1. Self-Powered Exit Signs:
      a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
      b. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
      c. Provide low-voltage disconnect to prevent battery damage from deep discharge.
      d. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.05 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.
      a. Wall Dimmers: See Section 262726.

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 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 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 260529.

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 pendant-mounted luminaires to building structure.
   4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   5. 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.
   3. Install canopies tight to mounting surface.

I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center 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 same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

M. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

N. Install lamps in each luminaire.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.04 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.05 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.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.07 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 265600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Ballasts.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 260923 - Lighting Control Devices.

E. Section 262726 - Wiring Devices: Receptacles for installation in poles.

F. Section 265100 - Interior Lighting.

1.03 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.

B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2000 (Reaffirmed 2006).

E. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 1598 - Luminaires Current Edition, Including All Revisions.

H. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

D. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

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

B. Provide 5-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.

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 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 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. Provide required support and attachment in accordance with Section 260529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. 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.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Install accessories furnished with each luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

J. Install lamps in each luminaire.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.04 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.05 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.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.07 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

DIVISION 27

COMMUNICATIONS

SECTION 270529
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 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 B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition 2022.

E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition 2019.

F. MFMA-4 - Metal Framing Standards Publication 2004.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. TIA-569 - Telecommunications Pathways and Spaces 2019e.

1.04 ADMINISTRATIVE REQUIREMENTS

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

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. TIA-569.
      b. NFPA 70.
      c. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
   1. 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.

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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

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

3.02 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners in accordance with manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

28

DIVISION

SECTION 284600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping: Materials and methods for work to be performed by this installer.

B. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

C. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 72 - National Fire Alarm and Signaling Code Most Recent Edition Cited by Referring Code or Reference Standard.

F. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

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

B. Evidence of designer qualifications.

C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.

10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
12. Certification by Contractor that the system design complies with Contract Documents.

D. Evidence of installer qualifications.

E. Evidence of maintenance contractor qualifications, if different from installer.

F. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

G. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

H. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

I. 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. Maintenance contract.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. 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.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1.06 WARRANTY

A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units and Accessories:
1. Provide control units made by the same manufacturer.

B. Initiating Devices and Notification Appliances:
1. Same manufacturer as control units.
2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
2. Protected Premises: Entire building shown on drawings.
3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
   a. ADA Standards.
   b. The requirements of the local authority having jurisdiction , which is the City of Centerville.
   c. Applicable local codes.
   d. Contract Documents (drawings and specifications).
   e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
7. Program notification zones and voice messages as directed by Owner.
8. Fire Command Center: Location indicated on drawings.
9. Fire Alarm Control Unit: New, located at storage room.

B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By remote supervising station.
2. Remote Supervising Station: UL-listed central station under contract to facility.
3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:

1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
3. Speaker Amplifiers: Minimum 25 percent spare capacity.
4. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
1. Sprinkler water control valves.
2. Dry-pipe sprinkler system pressure.
3. Dry-pipe sprinkler valve room low temperature.
4. Elevator shut-down control circuits.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
2. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
3. Duct smoke detectors.

C. Elevators:
1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.

D. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

2.04 COMPONENTS

A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Initiating Devices:
1. Addressable Systems:
a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

D. Notification Appliances:

E. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.

F. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

G. Locks and Keys: Deliver keys to Owner.

H. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 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.

3.04 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

D. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 13 13

EXPOSED AGGREGATE CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.02 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein.

B. The principal work of this Section includes, but may not be limited to the following:

1. Exposed Aggregate Portland Cement Concrete Pavement - Pedestrian
2. Exposed Aggregate Portland Cement Concrete Pavement - Vehicular

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 55 – Cast in Place Concrete

B. Section 31 20 00 – Earthwork

C. Section 32 11 00 – Base Courses (Pavements)

D. Section 32 14 40 – Stone Pavers

1.04 REFERENCES

A. Comply with applicable requirements of:

1. ASTM: American Society of Testing and Materials

2. AASHTO: American Association of State Highway and Transportation Officials.

3. ACI Standards: American Concrete Institute.

4. CRSI Standards: Concrete Reinforcing Steel Institute.

1.04 QUALITY ASSURANCE

A. Work under this Section shall be performed by workmen experienced with finished exposed aggregate concrete work and familiar with required construction procedures and under full time supervision of a qualified foreman.

1.05 SUBMITTALS

A. Submittals: in accordance with Section 01 33 00 – Submittals.

B. Design Data: submit:

1. laboratory test reports for concrete materials and design mix tests if trial batch method is used for proportioning concrete mixes.

2. records of strength tests if field experience method is used for proportioning concrete mixes.

3. statement of composition of concrete mix and evidence that mix meets specified quality in compliance ASTM C94-90.

C. Product Data: submit manufacturer's specifications and installation instructions for:

1. MBCC Group Decorative Concrete

2. Kafka Beige Blend Marble 3/8"-1/4" / Wax Polymer Pathway Mix

3. Preformed Joint Filler

4. Joint sealer

5. Backer rod

6. Top-Cast #50 Surface Retarder

7. Sealer

D. Shop Drawings: submit:

1. Layout and detailing of exposed aggregate paving with joints.

E. Samples: submit four samples of the following. Samples shall be sufficient to show full range of color, edge finish and texture variation to be expected in finished work.

1. MBCC Group Decorative Concrete – per Architect's Sample

2. Kafka Beige Blend Marbel 3/8"-1/4" / Wax Polymer Pathway Mix or per Architect's Sample

F. Composite sample panel: After receipt of Architect's approval of material samples, construct one four foot by four foot sample panel including joints and finishes to establish quality of workmanship. Sample panel to include all pavement and joint types. If the original sample is not approved, Contractor to provide additional samples as required at no cost to the Owner until an approved sample is obtained. The approved sample will become the standard for joint work for the entire job. Do not construct sample panel at a location becoming part of the final pavement and will remain undusturbed until all paving is completed and accepted. Remove panel upon completion and acceptance of the Work.

1.06 DELIVERY AND STORAGE

A. Store materials on raised platforms. Locate storage piles or stacks to avoid and be protected from traffic. Store materials under an approved roof or covered with waterproof tarpaulins, except when men are working and using materials.

B. Handle, store, mix and apply setting materials in strict compliance with manufacturer's recommendations and instructions.

1.07 PROTECTION

A. Protect paving surfaces from damage or defacement.

B. Protect adjacent surfaces from staining, soiling and other damage.

PART 2 – PRODUCTS

2.01 PORTLAND CEMENT CONCRETE MATERIALS AND PRODUCTS

A. Portland cement paving mixes: Design mix to be Class D, Type 11, 4,000 PSI according to the classification defined complying with requirements of Section 901 and M4 of Standard Specifications. 4,000 psi compressive strength at 28 days, 3/4 aggregate, 610 pounds per cubic yard cement content and 5% to 7% air-entrained with 2" to 4" maximum slump.

B. MBCC Group Decorative Concrete – per Architect's Sample

www.mbcc-group.com

C. Exposed Aggregate: Kafka Beige Blend 3/8"-1/4"/ Wax Polymer Pathway Mix, or per Architect's Sample

www.kafkagranite.com, Tel: 800-852-7415

D. Water: Clean and potable.

E. Surface Retardant: shall be Top-Cast #50 Surface Retarder or approved equal for exposed aggregate.

F. Sealer: Apply sealer to in accordance with the manufacturer's recommendations.

2.02 FORMWORK

A. Forms shall be strong enough to resist pressure of the concrete without springing, and tight enough to prevent leakage or mortar. Forms shall be staked, braced, or tied together to maintain their position and shape when concrete is compacted in place. Forms shall be clean and shall produce a smooth, even finish for exposed surfaces.

B. Forms shall be free from roughness and imperfections, substantially watertight and adequately braced and tied to prevent motion when concrete is placed. No wooden spreaders will be allowed in the concrete.

C. Wire ties will not be allowed. Metal ties or anchorages which are necessary within the forms shall be so constructed that the metal work can be removed for a depth of at least 1" (one inch) from the surface of the concrete without injury to such surface by spalling or otherwise. Forms shall be thoroughly cleaned before using and shall be treated with form release agent.

2.03 FIBROUS REINFORCING

A. Micro fiber reinforcing material shall meet ASTM C1116 and as manufactured by Propex Concrete Systems, 6025 Lee Highway, Suite 425, Chattanooga, TN 37422, phone # 800-621-1273 or NyCon Incorporated, 101Cross Street, Westerly, RI 02891-240, phone # 800-456 9266 or approved equal.

B. Mix fibrous reinforcement in accordance with manufacturer's instructions including product data and technical brochures.

1. Add fibrous reinforcement to concrete mix at the concrete batch facility.

2. Adding and mixing fibrous reinforcement at the job site will not be allowed.

C. Mix fibrous reinforcement in accordance with manufacturer's instructions including product data.

2.05 REINFORCEMENT

A. Comply with the following minimumsand as specified in Section 03 31 00 - Cast-in-Place Concrete:

1. Bars: ASTM A 615, Grade 60, deformed, unless otherwise shown on the Drawings.

2. Bending: ACI 318

B. Fabricate reinforcement to the required shapes and dimensions, within fabrication tolerances stated in the CRSI "Manual of Standard Practices."

C. Do not use reinforcement having any of the following defects:

1. Bar lengths, depths or bends exceeding the specified fabricating tolerances.
2. Bends or kinks not indicated on the Drawings or required for this Work.
3. Bars with cross-section reduced due to excessive rust or other causes.

2.06 JOINT FILLER

A. Preformed, nonbituminous type conforming to ASTM D1752, Type II, one piece for full depth and width of joint. Product similar to Sealtight Cork Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL. 60120, or one of the following:

1. APS Supply Company, 711 Cooper Street, Beverly, NJ 08010
2. Dodge-Regupol, Inc., Lancaster, PA 17608-0989
3. Or Approved Equivalent.

2.07 BACKER ROD

A. Continuous round rod of 100% closed cell polyethylene foam, complying with requirements of ASTM C-272.

2.08 JOINT SEALANT

A. Two or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C920, Fed. Spec. TT-S-00227E Type 1 Class A, having Shore A harness of not less than 40 + 5 when tested according to ASTM D2240, cured modulus of elasticity at 100% elongation of not more than 150 psi when tested according to ASTM D412, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D624.

1. Provide one of the following:

   a. Pecora Urexpan NR-200

   b. Tremco THC 900

   c. Sika 1A, SL

   d. Or Equal

2. Where joint surfaces contain bituminous materials, provide modified sealant compatible with bituminous materials encountered.

2.09 EXPANSION DOWELS AND SLEEVES

A. Stainless steel bars, complying with ASTM A276, Type 304, with smooth end cuts. Provide bar in dimensions and size indicated on Drawings. Provide expansion caps with compatible waxed tube sleeve which permit at least 1 inch movement.

2.10 GRAVEL

A. Gravel: as specified in Section 32 11 00 – Base Courses (Pavement).

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate layout and installation of paving with layout and installation of adjacent paving, curbing, walls and other site improvements to ensure proper alignments.

B. Make corrections as required to gravel provided under Section 32 11 00 – Base Courses (Pavement), to bring gravel to the proper sections and elevations.

3.02 PREPARATION OF GRAVEL BASE

A. Compact subgrade to achieve a 95% minimum compaction rate consistent throughout subgrade.

B. Place gravel base in 2" to 3" lifts and as specified in Section 32 11 00 – Base Courses (Pavement).

C. Compact to achieve a 95% minimum compaction rate consistent throughout gravel base.

D. Final surface of gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

3.03 PREPARATION FOR PAVING

A. Formwork; Set forms accurately to maintain specified tolerances. Remove loose material and clean forms immediately before concrete placement.

B. Reinforcing: Place reinforcing as detailed and in compliance with Section 03 30 55 - Cast-in-Place Concrete (Site). Provide reinforcing in longest practical lengths. Unroll wire mesh for reinforcement flat before placing in concrete. Minimum concrete covering of 2" over wire mesh and reinforcing bars. Secure reinforcing against displacement during concrete placement.

C. Concrete: Comply with requirements of Section 03 30 55 - Cast-in-Place Concrete (Site) for mixing,

placing and curing concrete. Use vibrators to consolidate concrete and to prevent honeycombs.

3.04 EXPOSED AGGREGATE PORTLAND CEMENT CONCRETE PAVING

A. Place base course concrete between expansion joints. Spread concrete thoroughly along forms and expansion joints. Tamp and screed to a dense mix. Strike off and bull float concrete surface 2" minimum below top grade of form to permit application of "Granite Tech" (top) surface Matrix Mix. As water dissipates from surface, aluminum rake leveled concrete surface for proper mechanical bonding between base concrete and surface matrix mix.

B. As water dissipates from surface, score with rake and place top matrix layer over concrete base.

C. Apply surface retardant per manufacturer's recommendations to provide a balanced surface.

D. Control joints: Cut with a power saw fitted with an abrasive diamond blade within 4 to 12 hours after walk was been placed and finished. The saw cuts shall be clean, and shall not extend into or injure any adjacent work. Locate control joints as shown on the drawings and strictly comply with patterning.

D. Expansion Joints: Provide expansion joints where concrete placement is interrupted for more than 1/2 hour and at end of placement and in grid pattern not more than 30 feet on center at locations approved by Architect. Provide shear dowels and expansion caps at not more than 16 inches on center to transfer vertical loads but permit horizontal movement. Extend joint filler full depth of joint and allow 1/2 inch minimum space at top for insertion of backer rod and sealant. Protect top edge of joint filler with metal cap or other temporary protection. Remove protection after concrete has been placed on both sides of joint.

E. Caulked Construction Joints: Provide caulked construction joints wherever concrete abuts dissimilar material at locations approved by Architect. Extend joint filler full depth of joint and allow 1/2 inch minimum space at top for insertion of backer rod and sealant. Protect top edge of joint filler with metal cap or other temporary protection. Remove protection after concrete has been placed on both sides of joint.

F. Pressure wash and scrub exposed aggregate surface to achieve the approved final finish texture.

G. Acid wash surface five to seven days after installation as per manufacturer's recommendations.

H. Sealer: Apply sealer to in accordance with the manufacturer's recommendations.

END OF SECTION 087100

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick pavers.
2. Asphalt-block pavers.
3. Stone pavers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. For the following:

a. Pavers.
b. Bituminous setting materials.
c. Mortar and grout materials.
d. Edge restraints.

B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.

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

D. Samples for Verification: For full-size units of each type of unit paver indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

C. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified unit paving installer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, Samples of flooring materials that will contact or affect mortar and grout that contain latex additives.

1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimal adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.8 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Bituminous Setting Bed:

1. Install bituminous setting bed only when ambient temperature is above 40 deg F and when base is dry.
2. Apply asphalt adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when setting bed is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

    a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 BRICK PAVERS

A. Brick Pavers, Light-Traffic Paving Brick: ASTM C902, Class SX, Type I, Application PS. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.

1. Thickness: 2-1/4 inches.
2. Face Size: 3-5/8 by 7-5/8 inches.
3. Color: Full-range red.

B. Efflorescence: Brick to be rated "not effloresced" when tested according to ASTM C67.

C. Temporary Protective Coating: Precoat exposed surfaces of brick pavers with a continuous film of a temporary protective coating that is compatible with brick, mortar, and grout products and can be removed without damaging grout or brick. Do not coat unexposed brick surfaces; handle brick to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

2.3 STONE PAVERS

A. Limestone Pavers: Rectangular paving slabs made from limestone complying with ASTM C568/C568M.

1. Classification: II Medium-Density.
2. Stone Abrasion Resistance: Minimum value of 10, based on testing according to ASTM C241/C241M or ASTM C1353.
3. Ohio Limestone Grade and Color: Blue Vein, according to grade and color classification established by ILI.
4. Finish: Smooth.
5. Thickness: As shown on Drawings.
6. Face Size: Random as shown on Drawings .

2.4 CURBS AND EDGE RESTRAINTS

A. Steel Edge Restraints: Manufacturer's standard painted steel edging 3/16 inch thick by 4 inches high with loops pressed from or welded to face to receive stakes at 36 inches o.c. and steel stakes 15 inches long for each loop.

1. Color: As selected by Architect from manufacturer's full range.

2.5 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D448 for Size No. 57.

B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D448 for Size No. 8.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33/C33M for fine aggregate.

D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D448 for Size No. 10.

E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

1. Provide sand of color needed to produce required joint color.

F. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.6 BITUMINOUS SETTING-BED MATERIALS

A. Primer for Base: ASTM D2028/D2028M, cutback asphalt, grade as recommended by unit paver manufacturer.

B. Fine Aggregate for Setting Bed: ASTM D1073, No. 2 or No. 3.

C. Asphalt Cement: ASTM D3381/D3381M, Viscosity Grade AC-10 or Grade AC-20.

D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.

E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

1. Provide sand of color needed to produce required joint color.

2.7 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II.

B. Hydrated Lime: ASTM C207, Type S.

C. Sand: ASTM C144.

D. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

E. Thin-Set Mortar for Bond Coat: Latex-portland cement mortar complying with ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.

F. Water: Potable.

G. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062 inch in diameter; comply with ASTM A1064/A1064M except for minimum wire size.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, made of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6, sanded.

C. Water: Potable.

2.9 BITUMINOUS SETTING-BED MIX

A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to 300 deg F.

2.10 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.

C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C270, Proportion Specification.

D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.

F. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.

G. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.

H. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

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

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: As indicated and Match and continue existing unit paver joint pattern.

F. Tolerances:

1. Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints:

1. Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."

H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.
3. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
4. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

I. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.

1. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.

D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

F. Treat leveling course with herbicide to inhibit growth of grass and weeds.

G. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

I. Do not allow traffic on installed pavers until sand has been vibrated into joints.

J. Repeat joint-filling process 30 days later.

3.5 BITUMINOUS SETTING-BED APPLICATIONS

A. Apply primer to concrete slab or binder course immediately before placing setting bed.

B. Prepare for setting-bed placement by locating 3/4-inch-deep control bars approximately 11 feet apart and parallel to one another, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.

C. Place bituminous setting bed where indicated, in panels, by spreading bituminous material between control bars. Spread mix at a minimum temperature of 250 deg F. Strike setting bed smooth, firm, even, and not less than 3/4 inch thick. Add fresh bituminous material to low, porous spots after each pass of striking board. After each panel is completed, advance first control bar to next position in readiness for striking adjacent panels. Carefully fill depressions that remain after removing depth-control bars.

1. Roll setting bed with power roller to a nominal depth of 3/4 inch. Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated. Complete rolling before mix temperature cools to 185 deg F.

D. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers. If additional leveling of paving is required, and before treating joints, roll paving with power roller after sufficient heat has built up in the surface from several days of hot weather.

E. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

3.6 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately 1/2 inch.

E. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

F. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

G. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

H. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch-thick bond coat to mortar bed or to back of each paver with a flat trowel.

I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

J. Grouted Joints: Grout paver joints complying with ANSI A108.10.

K. Grout joints as soon as possible after initial set of setting bed.

1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

L. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.7 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400

MP Rotator® Nozzle Written Specifications

Part 1 – General

1.1 The MP Rotator is a high-efficiency, multi-stream, multi-trajectory rotary nozzle designed with a viscous drive for rotation. The multiple streams allow for a slow application of water without misting at a high distribution uniformity. Standard MP Rotator nozzles, designated by a black canister, have a matched precipitation rate of approximately 0.4 in/hr (10 mm/hr) across any arc and radius to better match soil intake rates and prevent runoff. MP800 nozzles, designated by a gray canister, have a matched precipitation rate of approximately 0.8 in/hr (20 mm/hr). MP Rotator nozzles have female threads for installation on male-threaded pop-up sprinklers. Select models have a male-threaded option for installation on female-threaded pop-up sprinklers. Each MP Rotator nozzle shall have a filter screen to prevent internal system debris from entering the nozzle and the patented double-pop feature to prevent external debris from falling into the nozzle. Each MP Rotator nozzle shall be color-coded for easy field identification.

Part 2 – Parts and Material

2.1 MP Rotator nozzles shall be available in the following options:

- Standard MP Rotator nozzles: approximately 0.4 in/hr (10 mm/hr) precipitation rate
    - MP-1000-90, MP-1000-210, MP-1000-360 for an 8–15' (2.5–4.5 m) radius when operating at 30–55 PSI (2.1–3.8 bar; 210–380 kPa)
    - MP-2000-90, MP-2000-210, MP-2000-360 for a 13–21' (4.0–6.4 m) radius when operating at 25–55 PSI (1.7–3.8 bar; 170–380 kPa)
    - MP-3000-90, MP-3000-210, MP-3000-360 for a 22–30' (6.7–9.1 m) radius when operating at 25–55 PSI (1.7–3.8 bar; 170–380 kPa)
    - MP-3500-90 for a 31–35' (9.4–10.7 m) radius when operating at 25–55 PSI (1.7–3.8 bar; 170–380 kPa)
    - MP-CORNER for an 8-15' (2.5–4.5 m) radius when operating at 25–55 PSI (1.7–3.8 bar; 170–380 kPa)
- MP Rotator Strip nozzles: precipitation rate dependent on layout
    - MP-LCS-515, MP-RCS-515, MP-SS-530 for 5' (1.5 m) wide strip models
- MP800 nozzles: approximately 0.8 in/hr (20 mm/hr) precipitation rate
    - MP-800SR-90, MP-800SR-360 for 6–12' (1.8–3.5 m) radius when operating at 30–55 PSI (2.1–3.8 bar; 210–380 kPa)
    - MP-815-90, MP-815-210, MP-815-360 for 8–15' (2.5–4.9 m) radius when operating at 30–55 PSI (2.1–3.8 bar; 210–380 kPa)

A. Plastic material description
    1. The adjustable orifice shall be manufactured from polyurethane and acetal plastic materials for durability and adjustability.
    2. The acetal material shall have UV stabilizers for outdoor applications.

B. Metal component materials
    1. The radius adjustment screw, arc ring, spring, and internal collar shall be made of stainless steel.

2. The stator that drives the speed of rotation inside the silicone chamber shall be made of brass.

C. Filter screen description
   1. Each MP Rotator shall come with a detachable filter screen.
   2. The filter screens shall be made of polypropylene.
   3. The screen mesh size shall be dependent on the MP Rotator model.
      a. 60 mesh: MP800SR90
      b. 40 mesh: MP1000, MP2000, MP Corner, MP Strips, MP800SR360, MP815
      c. 20 mesh: MP3000, MP3500

D. Color description
   1. Each MP Rotator model shall have its own designated color scheme.
   2. Standard MP Rotator nozzles have a black canister and black top retainer.
      a. MP-1000-90 (maroon), MP-1000-210 (light blue), MP-1000-360 (olive)
      b. MP-2000-90 (black), MP-2000-210 (green), MP-2000-360 (red)
      c. MP-3000-90 (blue), MP-3000-210 (yellow), MP-3000-360 (gray)
      d. MP-3500-90 (tan)
      e. MP-Corner (turquoise)
      f. MP-LCS-515 (ivory), MP-RCS-515 (copper), MP-SS-530 (brown)
   3. The MP800 family has a gray canister and gray top retainer.
      a. MP-800SR-90 (orange), MP-800SR-360 (lime green)
      b. MP-815-90 (maroon), MP-815-210 (light blue), MP-815-360 (olive)

E. Nozzle threads
   1. Models MP1000, MP2000, MP3000, MP3500, MP Corner, MP Strips, MP800SR, and MP815 shall be fit for installation in pop-up bodies having a 5/8-27 UNS male-threaded stem at all common pop-up heights.
   2. Models MP1000HT, MP2000HT, MP3000HT, MP Corner HT, and MP Strip HT shall be fit for installation in pop-up bodies having a 5/8-28 UNS female-threaded stem at all common pop-up heights.

F. Viscous drive
   1. The viscous fluid used to maintain the rotation speed of the MP Rotator shall be made of a silicone material.
   2. The silicone chamber shall be sealed with EPDM rubber seals.
   3. The brass stator inside the silicone chamber shall control the rotation speed.

2.2 Warranty

A. MP Rotator nozzles shall have a warranty period of three years.

Part 3 – Function and Operation

3.1 Operating pressure

A. MP Rotator nozzles shall operate between 25–55 PSI (1.7–3.8 bar; 170–380 kPa).
B. The recommended operating pressure is 40 PSI (2.8 bar; 280 kPa).

3.2 Flow rates

A. Flow rates shall depend on the specific MP Rotator model.
B. As the arc and radius are adjusted, the flow rate shall change to maintain matched precipitation.

3.3 Radius description

A. The radius of throw shall depend on the specific MP Rotator model.
B. At the recommended 40 PSI (2.8 bar; 280 kPa) operating pressure, full- or part-circle sprinklers shall be capable of radius reduction up to 25% using a stainless steel radius adjustment screw.
C. The radius reduction screw shall have a slip clutch mechanism to prevent internal damage if turned past the minimum or maximum radius settings.
D. The radius reduction screw shall reduce the pressure and flow upstream of the adjustable orifice thereby maintaining stream integrity.

3.4 Arc adjustment

A. Depending on the model selected, the part-circle sprinkler shall have an infinitely adjustable arc from 45° to 105°, 90° to 210°, or 210° to 270° using the stainless steel arc ring.
B. The full-circle sprinkler shall irrigate a full 360°.
C. The 45° to 105° model shall not require coverage from adjacent sprinklers closer than 3' (1 m) from the head.
D. Arc adjustment shall be effective only while the sprinkler is popped up and shall be ineffective when the sprinkler is popped down.
E. The adjustment mechanism shall have a ratcheting action to prevent internal damage when turned past the minimum or maximum arc limits.

3.5 Application rate

A. Models MP1000, MP2000, MP3000, MP3500, MP Corner, and MP Strips shall produce and maintain a matched precipitation rate no greater than 0.6 in/hr (15 mm/hr) throughout the arc adjustment range and radius adjustment range, with a radius reduction up to 25%, when spaced at 50% of irrigated diameter.
B. Models MP800SR and MP815 shall produce and maintain a matched precipitation rate no greater than 1.0 in/hr (25 mm/hr) throughout the arc adjustment range and radius adjustment range, with a radius reduction up to 25%, when spaced at 50% of irrigated diameter.

3.5 Double-pop feature

A. When installed in a pop-up sprinkler body, the MP Rotator rotor shall pop up after the body stem is fully extended; upon decreasing pressure, the MP Rotator rotor shall retract before the retraction of the sprinkler body stem.
B. MP Rotator nozzles shall pop up at approximately 15 PSI (1.0 bar; 100 kPa).

EZ Decoder System (EZDS) Written Specifications

Part 1 – General

1.1 The irrigation control system shall feature a two-wire output module for two-wire decoder control of standard 24 VAC solenoid valves. The two-wire output module shall fit into a pre-existing module slot in the controller backplane and may coexist with "conventional" output modules. The field decoders are programmable and maximum wiring distances shall adhere to manufacturer specifications. An optional handheld, battery-powered diagnostic tool shall also provide wireless field diagnostic capabilities.

Part 2 – Two-Wire Output Modules

2.1 The two-wire output module shall be manufactured by the same manufacturer as the controller and shall carry all the same necessary approvals and compliance as the host controller.

A. Output Module Characteristics - EZDM
   i. The two-wire output module is compatible with Hunter model HCC and ICC2 controllers.
   ii. The maximum station count of the control system is 54, in any combination of conventional and decoder outputs.
   iii. The two-wire output module shall not exceed 29 VAC (nominal 24 VAC) at 50 or 60 Hz, suitable for direct-burial wiring in landscape irrigation applications.
   iv. The two-wire output module shall include two separate two-wire path screw terminals for wiring in different directions.
   v. The two-wire output module shall also permit operation of a Pump/Master Valve output via decoder in the two-wire path, if desired.
   vi. The two-wire output module shall include a programming port and button for programming station addresses into the field decoders. The two-wire output module shall also include an LED light for programming and diagnostic purposes.
   vii. The two-wire output module shall operate dedicated, programmable field decoders (EZ-1), manufactured by the same manufacturer as the controller and the two-wire output module, and specifically designed to operate as a complete system.
   viii. The two-wire output module must be capable of operating two field decoders, plus a decoder-operated Pump/Master Valve output, simultaneously.

B. Output Module Characteristics - PCDM
   i. The two-wire output module is compatible with Hunter model HPC and Pro-C controllers.
   ii. The maximum station count of the control system is 28 decoders (if two-wire only), or 32 stations in a combination of conventional and decoder outputs.
   iii. The two-wire output module shall not exceed 29VAC (nominal 24VAC) at 50 or 60 Hz, suitable for direct-burial wiring in landscape irrigation applications.

iv. The two-wire output module shall include one two-wire path terminal block for wiring in any direction.
v. The two-wire output module shall also permit operation of a Pump/Master Valve output via decoder in the two-wire path, if desired.
vi. The two-wire output module shall include a programming port and button for programming station addresses into the field decoders. The two-wire output module shall also include an LED light for programming and diagnostic purposes.
vii. The two-wire output module shall operate dedicated, programmable field decoders (EZ-1), manufactured by the same manufacturer as the controller and the two-wire output module, and specifically designed to operate as a complete system.
viii. The two-wire output module must be capable of operating one field decoder, plus a decoder-operated Pump/Master Valve output, simultaneously.

Part 3 – Field Decoders

3.1 Decoder Characteristics – EZ-1

A. The field decoders shall be completely waterproof, rated at IP68 for total immersion.
    i. Each field decoder shall be programmable with the desired station address and shall not require separate serial numbers of any kind.
    ii. Each field decoder must include a waterproof status LED light to confirm programming and operations and serve as a field diagnostic aid.
B. The programmable field decoders shall receive their station addresses from a programming port built into the two-wire output module or via handheld programmer.
C. The field decoder output to the solenoid shall be 24 VAC, 50/60 Hz, and the output of an active station shall be measurable on a standard voltmeter or handheld programmer (EZDT).
    i. The wiring distance from the decoder to the solenoid shall be limited only by the total distance from the controller to the solenoid and the wire diameter, as indicated in the manufacturer's wiring table.

Part 4 – Wireless Diagnostic Tool

4.1 An optional handheld, battery-powered diagnostic tool shall also be provided for wireless system diagnostics and troubleshooting.

A. Diagnostic Tool Characteristics – EZDT
    i. The handheld diagnostic tool shall be capable of wireless communication with EZ-1 decoders without needing to remove decoders from the two-wire path.
    ii. The diagnostic tool shall be capable of reading any individual decoder's: station address, status, voltage on the two-wire path, and active current draw.
    iii. The diagnostic tool shall provide wired station addressing and reprogramming of field decoders via the red and blue wires from an individual decoder.
    iv. The diagnostic tool display shall be viewable in 12 different languages.
    v. The diagnostic tool shall be powered by 4 x AAA batteries.

vi. The diagnostic tool shall be provided with a MicroSD card reader for updating firmware versions of various EZ Decoder System components.

Part 5 – Field Wiring

5.1 The field decoders shall have color-coded wires to facilitate proper connection to the two-wire path and to the valve solenoid. There shall be no polarity on the two-wire path, which means it does not matter which path wire is connected to which incoming lead, and there shall be no polarity on the output wires to the 24VAC solenoid.

A. All field decoder connections shall be made with gel-filled or similar waterproof splice connectors designed for standard in-ground landscape irrigation purposes.
B. Wiring between the two-wire output module and the field decoders shall consist of direct-burial-rated standard irrigation wiring of an appropriate diameter for the maximum distances per the manufacturer's specifications.
    i. Generally, American 14 AWG or international 2.5 mm^2 are the preferred minimum sizes in professional installations, for tensile strength and longevity.
    ii. Shorter runs may be achieved with smaller wires as indicated by the manufacturer's recommendations.
C. It is permissible, but not required, to run field wiring in plastic or metal conduit for resistance to pests.

Part 6 – Earth Grounding

6.1 The host controller shall be thoroughly earth grounded in accordance with the manufacturer's specifications, ideally to a resistance of 10 ohms or less.

A. The two-wire path does not require earth grounding or surge suppressors of any kind for typical installations.
B. Compatible in-line surge arresting modules from the controller manufacturer may be added and grounded if specified.
    i. Compatible surge arresting modules shall be connected to 8' (2.5 m) copper-clad rods, or 100 mm x 1 m copper ground plates, and installed at least 8' (2.5 m) away from and at right angles to the two-wire path.
    ii. Surge-arresting modules shall be connected to the two-wire path either in-line or at the far end of the two-wire path from the controller as specified.

Part 7 – Models

7.1 All components of the system shall have a three-year manufacturer's warranty.

A. The two-wire output modules shall be Hunter Industries Model EZ-DM (for HCC and ICC2 controllers) and PC-DM (for HPC and Pro-C controllers).
B. The field decoders shall be Hunter Industries Model EZ-1.
C. The wireless diagnostic tool shall be Hunter Industries Model EZ-DT
D. Compatible surge arrestors shall be Hunter Industries Model DUAL-S.

DBRY-6

Waterproof Wire Connectors

KEY BENEFITS

- UL Listed for 600 Volts direct burial.
- Improved red-and-yellow wire nut, eliminating the need for two different sizes.
- A snap-lock feature that secures the wire nut in the bottom of the light blue waterproof tube.
- 3 wire exit cutouts in the strain relief cap, to ease wire routing.
- Meets Directive 2006/95/EC and IEC standards EN61984:2009, EN60998- 1:2004, and EN60998-2-4:2005.

https://www.hunterindustries.com/en-metric/irrigation-product/accessories/dbry-6
101123

Engineering Specification

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series 825Y

Reduced Pressure Zone Assemblies

¾" – 2"

⚠ WARNING

It is illegal to use this product in any plumbing system providing water for human consumption, such as drinking or dishwashing, in the United States. Before installing standard material product, consult your local water authority, building and plumbing codes.

825Y-FS

FEBCO Series 825Y Reduced Pressure Zone assemblies are used to protect against high hazard (toxic) fluids in water services to industrial plants, hospitals, morgues, mortuaries, and chemical plants. They are also used in irrigation systems, boiler feed, water lines and other installations requiring maximum protection.

The series includes a flood sensor to detect excessive water discharges from the relief valve. The sensor is installed on the assembly exterior and does not alter assembly functions or certifications. The sensor relays a signal that triggers notification to facility personnel for corrective action, thus limiting flooding and costly damage.

NOTICE

An add-on connection kit is required to activate the flood sensor. Without the connection kit, the sensor is a passive component that has no communication with any other device. (For more information download RP/IS-F-825Y.)

Features

- Ultimate mechanical protection of potable water, against hazards of cross-connection contamination
- Meets all specifications of AWWA, ASSE, and CSA
- Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California
- Modular relief valve for ease of maintenance
- Simple service procedures
- All internal parts serviceable in line
- Low head loss
- Spring loaded "Y" type check valves
- Internal relief valve pressure sensing passages
- Replaceable seat rings on all sizes
- End connection – NPT ANSI / ASME B1.20.1
- Sensor on the relief valve for flood detection
- Flood alerts feature activated with add-on sensor connection kit, compatible with BMS and cellular communication

Operation

In a flow condition the check valves are open with the pressure between the checks, called the zone, being maintained at least 5 psi lower than the inlet pressure and the relief valve is maintained closed.

Should abnormal conditions arise under no flow or reversal of flow, the differential relief valve opens and discharges to maintain the zone at least 2 psi lower than the supply.

When normal flow resumes, the differential pressure in the zone resumes and the relief valve closes.

NOTICE

Use of the flood sensor does not replace the need to comply with all required instructions, codes, and regulations related to installation, operation, and maintenance of this product, including the need to provide proper drainage in the event of a discharge.

Watts® is not responsible for the failure of alerts due to connectivity or power issues.

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

Inquire with governing authorities for local installation requirements.

FEBCO®

A WATTS Brand

Specification

The reduced pressure zone assembly shall consist of two independently operating, spring loaded, "Y" pattern check valves and one hydraulically dependent differential relief valve. The assembly shall automatically reduce the pressure in the "zone" between the check valves to at least 5 psi lower than inlet pressure. Should the differential between the upstream and the zone of the unit drop to 2 psi, the differential relief valve shall open and maintain the proper differential.

Mainline valve body and caps including relief valve body and cover shall be bronze. Check valve moving member shall be center stem guided. All hydraulic sensing passages shall be internally located within the mainline and relief valve bodies and relief valve cover. Diaphragm to seat area ratio shall be 10:1 minimum. Relief valve shall have a removable seat ring. Check valve and relief valve components shall be constructed so they may be serviced without removing the valve body from the line. All seat discs shall be reversible. Shutoff valves and test cocks shall be full ported ball valves.

The assembly shall be rated to 175 psi (12.1 bar) working pressure and water temperature range from 32°F to 140°F (0ºC to 60ºC).

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511; CSA Standard B64.4; and approved by the Foundation for Cross-Connection Control and Hydraulic Hydraulic Research at the University of Southern California.

The assembly shall be FEBCO Series 825Y, and shall include a sensor on the relief valve for flood detection.

Dimensions – Weights

Call customer service if you need assistance with technical details.

SIZE	DIMENSIONS										WEIGHT	
	A		B*		C		D		E			
in.	*in.*	*mm*	*In.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lb*	*kg*
¾	12	305	7¾	197	3¼	83	3¼	83	4⅛	105	11.5	5.2
1	12¾	324	7¾	197	3¼	83	3¼	83	4⅛	105	12.5	5.7
1½	17	432	10½	267	4⅞	124	5¼	134	5⁷⁄₁₆	138	26.7	12.1
2	17¾	451	10½	267	4⅞	124	5¼	134	5⁷⁄₁₆	138	29.2	13.2

* B dimensions are less shutoffs.

NOTICE

Weights shown are approximate. Dimensions shown are nominal, allowance must be made for normal manufacturing tolerances.

Temperature – Pressure

Maximum working pressure	175 psi (12.1 bar)
Hydrostatic test pressure	350 psi (24.1 bar)
Temperature range	32ºF to 140ºF (0ºC to 60ºC)

Materials

Main valve body	Bronze
Relief valve body	Bronze
Elastomers	Nitrile seat discs
Diaphragms	Nitrile, fabric reinforced
Springs	Stainless steel

Model/Option

FS	Flood detection sensor

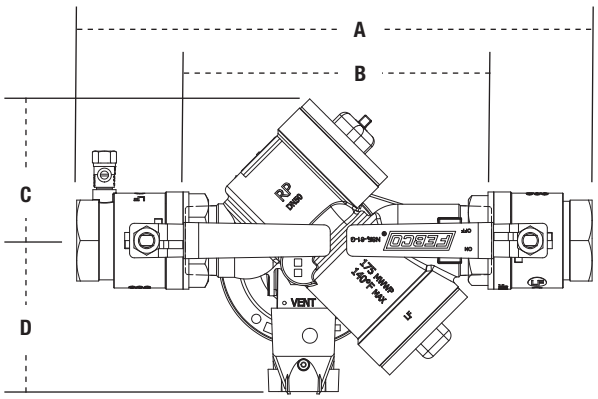
Approvals – Standards

Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California

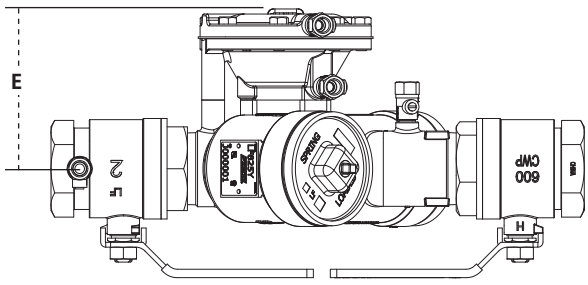
AWWA C511 Conformance

1013 B64.4

Side View



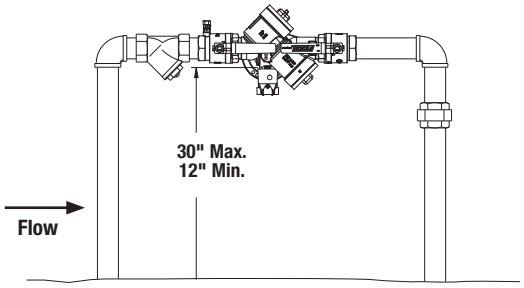
Top View



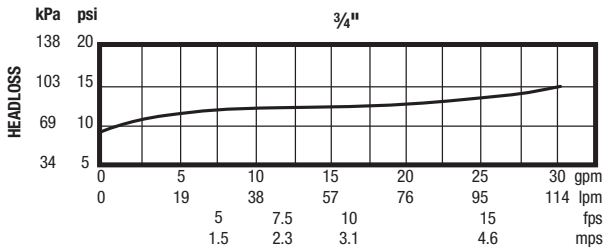
Typical Installation

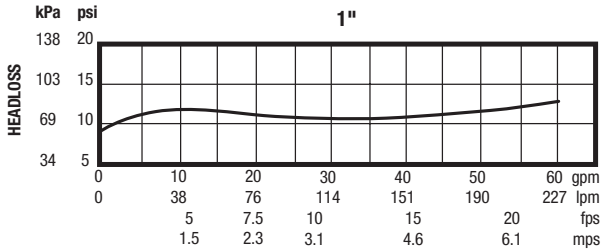
Reduced pressure zone assemblies should be installed with minimum clearance of 12" between relief valve discharge port and floor or grade. They must be installed where discharge is not objectionable and can be positively drained away. They should be installed where easily accessible for testing and maintenance and must be protected from freezing. Thermal water expansion and/or water hammer downstream of the backflow preventer can cause excessive pressure. Excessive pressure situations should be eliminated to avoid possible damage to the system and assembly.

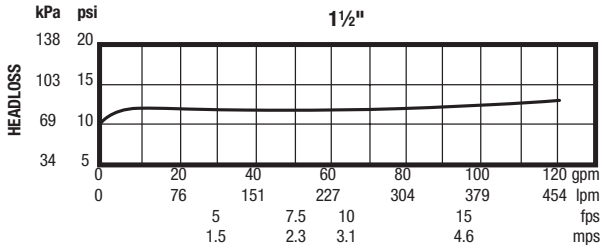
Refer to local codes for specific installation requirements. Some codes may prohibit vertical installation.

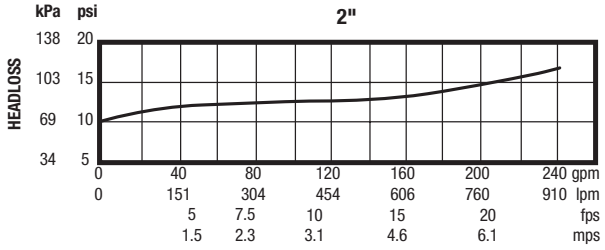


Capacity









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HC-200-FLOW

Brand: Residential & Commercial Irrigation

Product Line: Controllers Hydrawise

Product Model: HC Flow Meter

SKU: HC200FLOW

Description: HC Flow Meter with 2" (50 mm) male NPT thread, U.S. gallons

UPC-A: 0611698416907

Qty. / Bag: 2

Master Carton: 2

Land Pallet: 64

Ocean Pallet: 64

Flow: With Flow

https://www.hunterindustries.com/en-metric/irrigation-product/hc-flow-meter/hc-200-flow
101123

HCC Irrigation Controller Written Specifications

Part 1 – General

1.1 The controller shall be a full-featured, commercial-industrial product for the purpose of irrigation operation, management, and monitoring of control valves and sensors. The controller shall be fully integrated with Wi-Fi connectivity to the internet and Hydrawise® software. The controller shall be of a modular design that is provided with a standard 8-station output module. The controller shall be expandable with 4-, 8-, or 22-station conventional modules or one 54-station decoder output module.

Part 2 – Controller Enclosures

2.1 Controller shall be available in following the options:

A. Plastic wall-mount enclosure

1. The controller shall be Hunter Industries model HCC-800-PL.
2. Pre-assembled controller shall have a height of 12" (30.5 cm), width of 13¾" (35 cm), and a depth of 5" (12.7 cm).
3. The controller shall be furnished in an outdoor, weather-resistant, wall-mount plastic enclosure, pre-wired for remote control, with a key lock.
4. The controller shall provide modular expansion up to 38 stations conventionally wired, or 54 stations via two-wire decoders.
5. All station outputs shall have MOV and copper induction coil surge suppression.
6. The enclosure shall be IP44, NEMA 3R rated.
7. A 751CH key shall be mounted in the enclosure door for security.
    a. Two (2) keys shall be provided per each controller.

B. Plastic pedestal-mount enclosure

1. The controller shall be Hunter Industries model HCC-800-PP.
2. Pre-assembled controller shall have a height of 39" (99 cm), width of 24" (61 cm), and a depth of 17" (43 cm).
3. The controller shall be furnished in an outdoor, weather-resistant, pedestal-mount plastic enclosure, pre-wired for remote control, with a key lock.
4. The controller shall provide modular expansion up to 54 stations conventionally wired, or 54 stations via two-wire decoders.
5. All station outputs shall have MOV and copper induction coil surge suppression.
6. The enclosure shall be IP34, NEMA 3R rated.
7. A 751CH key shall be mounted in the enclosure door for security.

a. Two (2) keys shall be provided per each controller.

C. Powder-coated metal wall-mount enclosure / Powder-coated metal pedestal

1. The controller shall be Hunter Industries model HCC-800-M. The metal wall mount may also be mounted on a matching gray powder-coated metal pedestal. The pedestal shall be Hunter Industries model ICC-PED.
2. Pre-assembled wall-mount controller shall have a height of 16" (40.6 cm), width of 13" (33 cm), and depth of 5" (12.7 cm).
3. Pre-assembled pedestal mount shall have a height of 36" (91.4 cm), width of 11½" (29.2 cm), and depth of 5" (12.7 cm).
4. The controller shall be furnished in an outdoor, weather-resistant, pedestal-mount gray metal enclosure, pre-wired for remote control, with a key lock.
5. The controller shall provide modular expansion up to 54 stations conventionally wired, or 54 stations via two-wire decoders.
6. All station outputs shall have MOV and copper induction coil surge suppression.
7. The enclosure shall be IP44, NEMA 3R rated.
8. A 751CH key shall be mounted in the enclosure door for security.
    a. Two (2) keys shall be provided per each controller.

D. Stainless steel wall-mount enclosure / Stainless steel pedestal

1. The controller shall be Hunter Industries model HCC-800-SS. The stainless wall-mount may also be mounted on a matching type 316 stainless steel pedestal. The pedestal shall be Hunter Industries model ICC-PED-SS.
2. Pre-assembled wall-mount controller shall have a height of 16" (40.6 cm), width of 13" (33 cm), and depth of 5" (12.7 cm).
3. Pre-assembled pedestal mount shall have a height of 36" (91.4 cm), width of 11½" (29.2 cm), and depth of 5" (12.7 cm).
4. The controller shall be furnished in an outdoor, weather-resistant, type 316 stainless pedestal-mount metal enclosure, pre-wired for remote control, with a key lock.
5. The controller shall provide modular expansion up to 54 stations conventionally wired, or 54 stations via two-wire decoders.
6. The enclosure shall be IP44, NEMA 3R rated.
7. All station outputs shall have MOV and copper induction coil surge suppression.
8. A 751CH key shall be mounted in the enclosure door for security.
    a. Two (2) keys shall be provided per each controller.

2.2 Warranty

A. The controller shall be installed in accordance with the manufacturer's published instructions. The controller shall carry a conditional 5-year exchange warranty. The automatic controller(s) shall be the HCC series controller as manufactured for Hunter Industries Incorporated, San Marcos, California.

Part 3 – Controller Hardware

3.1 Control display

A. Display shall be 3.2" (8.1 cm), full graphical touchscreen interface allowing for programming and manual operation.

B. All programming shall be accomplished by use of the touch screen interface or with a smartphone, tablet, or PC.

3.2 Control panel

A. Operation from the control panel shall be via touchscreen only, with no available buttons or dials.

B. Control panel door shall fully close and protect the wiring and internal components from moisture and dust.

3.3 Controller power

A. Depending on requirements, transformer input shall be 120 VAC, 60 Hz or 230 VAC, 50 Hz.

B. Transformer output shall be 24 VAC, 1.4 A. Maximum output per station shall be 24 VAC, up to 0.56 A. Maximum output per P/MV terminal shall be 24 VAC, up to 0.56 A.

3.4 Controller surge protection

A. The controller transformer shall be equipped with an internal, self-resetting thermal circuit breaker to protect against overheating.

B. The controller transformer shall also be equipped with a ground lug for connecting to proper earth-ground hardware.

3.5 Station Modules

A. Controller shall provide 4 (plastic enclosure) or 6 (metal and pedestal enclosures) separate station output module slots.

1. Controller shall use 4-, 8-, or 22-station conventional output modules, or one 54-station decoder output module.

2. Station modules shall be secured against field wiring tension by locking levers.

3. Using conventional wire only, the controller shall be expandable from 8 to 38 stations (plastic) and 8 to 54 stations (metal and pedestals).
4. Using conventional station modules in conjunction with one decoder output module (model: EZ-DM), all controller configurations (plastic, metal, pedestal) shall expand up to 54 stations.
5. Using only one decoder output module (model: EZ-DM) all controller configurations (plastic, metal, pedestal) shall expand up to 54 stations.

B. The controller shall have a base model capacity of 8 stations, consisting of one 8-station output module.

C. Each station output shall supply 24 VAC, up to 0.56 A current for solenoid activation.

D. The controller shall have self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station via alert/notification to the user's smartphone, tablet, or computer. The built-in milliamp sensor shall constantly be measuring the current draw of each individual station.

E. Module hardware

1. The controller output modules shall have metal oxide varistors (MOVs) and copper induction coils on each station output circuit to help protect the micro-circuitry from power surges.

3.6 Sensor inputs

A. The controller shall be equipped with two dedicated general-purpose sensor ports.

1. The sensor inputs shall be compatible with any standard normally closed or normally open "Clik-type" sensors for automatic shutdown during rain, freeze, soil moisture, and/or wind events.
2. The sensor inputs shall also be compatible with the Hunter HC Flow Meter for flow monitoring, alerts, and reporting.

3.7 P/MV outputs

A. The controller shall have one built-in P/MV (24 VAC) output with a capacity of up to 0.56 A.

B. The P/MV output shall be selectable as active or disabled per each individual station.

3.8 Common wire

A. A common wire terminal is provided on the controller's power module, and additional commons are provided on each station output module.

3.9 SmartPort®

A. The controller shall be pre-wired with a SmartPort connector for easy connection of optional wireless remote controls.

B. For international or short-range uses, the wireless remote control shall be the Hunter model ROAM with a useful range of up to 1,000' (330 m).

C. For use in the United States or long-range uses, where permitted, the wireless remote shall be Hunter model ROAM-XL with a useful range of up to 2 mi. (3.2 km).

3.10 Wi-Fi information

A. The controller shall be equipped with built-in Wi-Fi.

B. Wi-Fi operation shall be 802.11 b/g/n.

C. Wi-Fi frequency is 2.4 GHz.

D. Security shall have the ability to auto detect and offer the following security settings: WPA2, WPA Personal, and WPA Auto.

Part 4 – Programming and Operational Software

4.1 General

A. The control panel shall be available in an English-language display. The display shall include selectable settings for date, time, and units of measurement.

B. The Hydrawise software shall be fully translated and available in Czech, English, French, German, Greek, Hungarian, Italian, Polish, Portuguese, Russian, Spanish, Thai, and Turkish.

4.2 Programming

A. The controller shall be programmed via station-based programming, up to 54 total zones available.

B. The controller shall have 54 total Start Times available.

C. The controller shall be capable of running any two stations (+P/MV) simultaneously.

D. The controller programs shall have 5 weekly schedule options to choose from:

1. 7-day calendar
2. Up to 31-day interval calendar
3. Odd-day/even-day programming
4. Odd-week/even-week programming
5. 365-day calendar clock to accommodate true odd-even watering

E. Each station shall be programmable in minutes of run time, from 1 minute to 24 hours.

F. The controller shall be equipped with programmable Non-Water Days to prevent watering on selected days of the week.

G. Each zone may be assigned a programmable Delay Between Stations, to allow for slow-closing valves or pressure recharging.

1. Delays between stations shall be programmable in 1-second increments from 0 to 3,600 seconds (60 minutes).
2. A P/MV delay shall be programmable in 1-second increments from 0 to 60 seconds (1 minute).

4.3 Software

A. The controller shall be connected to Hydrawise software.
    1. Hydrawise software is available via web login, and as a mobile application that is downloadable via the Apple® App Store and Google Play™ Store.
B. The controller shall utilize Predictive Watering® adjustments to automatically modify irrigation scheduling based on local weather data and forecast information.
C. The controller shall also have manual Seasonal Adjust settings from 0% to 300% for offline programming.

PGP® Ultra PRB Written Specifications

Part 1 – General

1.1 The PGP Ultra PRB is a pressure-regulated rotary gear-driven sprinkler for residential and light commercial applications. It features a non-strippable drive, automatic arc return, water-efficient nozzles that can be easily changed, and simple arc adjustment.

Part 2 – Parts and Material

2.1 The PGP Ultra PRB shall be available in the following versions: Shrub, 4" (10 cm) pop-up.

A. The sprinkler shall be constructed from corrosion- and impact-resistant ABS plastic.
B. The sprinkler shall be equipped with a durable, stainless steel riser spring.
C. The sprinkler shall be available with 30 nozzle choices in flow rates from 0.36 to 9.8 GPM (0.07 to 2.22 m^3/hr; 1.2 to 36.0 l/min).
D. The sprinkler shall be equipped with a non-strippable gear drive.
E. The sprinkler shall be equipped with automatic arc return.
F. The arc of the sprinkler shall be adjustable from 50° to 360°.
G. The sprinkler shall be equipped with through-the-top arc adjustment.
H. The sprinkler shall be equipped with a QuickCheck™ arc mechanism.
I. The sprinkler shall be equipped with a factory-installed rubber cover.
J. The sprinkler may be equipped with an optional drain check valve to hold back up to 10' (3 m) of elevation.
K. The sprinkler shall be available in a reclaimed water ID version.
L. The sprinkler shall be equipped with a 45 PSI (3.1 bar; 310 kPa) regulator in the body.

2.2. Rotor dimensions

A. PGP-00

- Overall height: 8¾" (22 cm)
- Exposed diameter: 1¾" (4.5 cm)
- Inlet size: ¾" NPT

B. PGP-04

- Pop-up height: 4" (10 cm)
- Overall height: 8¼" (22 cm)
- Exposed diameter: 1¾" (4.5 cm)
- Inlet size: ¾" NPT

2.3 Warranty

A. The sprinkler shall carry a five-year exchange warranty.

Part 3 – Function and Operation

3.1 Operating pressure range: 55 to 100 PSI (1.7 to 4.5 bar; 170 to 450 kPa)

3.2 Radius: 17' to 46' (4.9 to 14.0 m)

3.3 Flow rate: 0.36 to 9.8 GPM (0.07 to 2.22 m^3/hr; 1.2 to 36.0 l/min)

3.4 Precipitation rate: 0.4 in/hr (10 mm/hr) approximately

3.5 Nozzle trajectory: Standard = 25° approximately, Low-angle = 13° approximately

Hydrawise® Software

Hydrawise is an intuitive water management software designed to help users manage their irrigation controllers, conduct water management, monitor piping and electrical systems, and save up to 50 percent in water savings through Predictive Watering Adjustments. This cloud-based software is suitable for both professionals and homeowners, offering an easy-to-use solution for efficient water management. Hydrawise is available as a mobile device App (Apple & Android) for remote functionality and a web interface for easier reporting.

KEY BENEFITS

- The Hydrawise Customer Manager is a tool within the Hydrawise platform designed for irrigation contractors and professionals who manage multiple irrigation systems for their clients.
- Hydrawise usesaward-winning Predictive Watering™ to adjust your garden's irrigation based on highly accurate local weather data
- Transparency at Your Fingertips: Get detailed insights into your irrigation system's behavior with updates that explain why watering did or didn't occur.
- Notifications That Matter: No more sifting through irrelevant alerts! Stay in the know about critical updates that affect your system's performance with clear, concise notifications.
- Zone Data: Access more information about your lawn and garden zones, and enjoy increased visibility with bigger pictures, prominently displayed zone numbers, and user-friendly zone names right on your home screen.
- Local Weather Insights: Dive into weather data with enhanced icons and descriptors that make it easier to understand the forecast's impact on your irrigation schedule.

https://www.hunterindustries.com/en-metric/irrigation-product/software/hydrawiser-software
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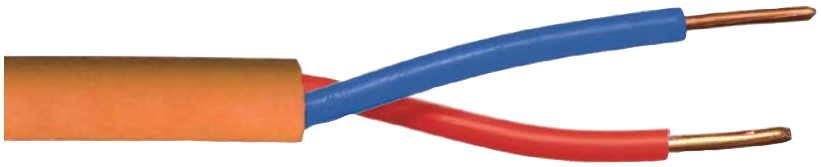
P.O. Box 368. Union, NJ 07083-0368, 908-687-7810, 800-327-2443, Fax: 908-687-2722

Paige® irrigation spec **P7354D - Rev 4**



HUNTER JACKETED DECODER CABLES DIRECT BURIAL

SIZES: 14 & 12 AWG, SOLID COPPER, 2-CONDUCTOR

1.0 SCOPE:

1.1 This specification covers jacketed cables containing two listed Golf Course Sprinkler wires, single conductor, suitable for direct burial, for operation up to 600 volts, and temperatures up to 60°C.

2.0 CONSTRUCTION:

2.1 ***Inner Conductors:***
Soft drawn bare copper meeting the requirements of ASTM specification B-3 or B-8. Insulation shall be low density high molecular weight polyethylene and a thickness of 0.045", per Paige Electric specification P7079D. The two conductors (blue and red) shall be twisted with a minimum lay of 4".

2.2 An optional Mylar tape may be used over the conductors.

2.3 A rip cord shall be placed directly below the outer jacket.

2.4 ***Overall jacket:***
High density polyethylene with a thickness of 0.035". Available with different color jackets as listed in the table below. The jacket shall be sufficiently round, and loose, to facilitate its removal when being stripped. Minimum inner diameters of the outer jacket:

CONSTRUCTION	INCHES	mm
14 AWG/2c	0.358	9.1
12 AWG/2c	0.386	9.8

A "T" drill bit, whose diameter is 0.358", shall be used to measure the minimum inner diameter of 14 AWG/2c cables.

A "W" drill bit, whose diameter is 0.386", shall be used to measure the minimum inner diameter of 12 AWG/2c cables.

2.5 ***Surface Print:***

2.51 Inner Conductors – "Paige Electric P7079D 14 AWG PE Listing file Number 600V Sprinkler System Direct Burial"

2.52 Outer Jacket – "Paige Electric, P7354D, 14 or 12 AWG PE 600V Sprinkler System Wire Direct Burial Only for Hunter Decoder Systems RoHS"

3.0 TEMPERATURE RATING

3.1 ***Color Code:***
-55°C to +60°C

4.0 PUT-UPS

4.1 1000' (328m), 2500' (762m) and some odd lengths.

5.0 SPLICING RECOMMENDATIONS:

Wire splices are the weak link of any electrical circuit. It is especially important to make proper joints in irrigation systems because the joints are exposed to wet and damp environments that can cause corrosion of the copper conductor, and premature failure. Paige Electric recommends the strict use of Model DBR/Y-6, as manufactured by the 3M Company (Paige specification P7364D) for 14 AWG 2 or 3 conductors. For 12 AWG and splices of 4 to 6 conductors, Paige Electric recommends its Re-enterable connectors (Paige Specification P7408D).

PAIGE PART NO.	SIZE		JACKET COLOR	SHIPPING WEIGHT	
	AWG	mm^2		Lbs/1000'	Kg/328m
170801BU	14	2,08	Blue	65	30
170801GY			Gray		
170801PR			Purple		
170801YL			Yellow		
170801OG			Orange		
170801TN			Tan		
170801RD			Red		
170802BU	12	3,32	Blue	80	36
170802GY			Gray		
170802PR			Purple		
170802YL			Yellow		
170802OG			Orange		
170802TN			Tan		
170802RD			Red		

Pro-Spray® Sprinkler Body Written Specifications

Part 1 – General

1.1 General Description of Product and Function

The pop-up Hunter Pro-Spray Sprinkler Body is designed for residential and commercial applications in both pressure-regulated and non-pressure-regulated models. Standard Pro-Spray models shall be available with a 2", 3", 4", 6", and 12" (5, 7.5, 10, 15, and 30 cm) pop-up stroke as well as an above-ground shrub head. Pressure-regulated PRS30 and PRS40 models shall be available in a shrub model and a 3", 4", 6", and 12" (7.5, 10, 15, and 30 cm) pop-up stroke. Standard, PRS30, and PRS40 models in 6" and 12" (15 and 30 cm) shall have a side inlet option. Pop-up models shall have the option of a factory- or field-installed drain check valve and a purple body cap for reclaimed water applications. Pressure-regulated models shall have the option of the drain check valve and FloGuard™ Technology to reduce the flow through the riser in the event of a missing nozzle. Factory-installed features shall be designated on the top of the Pro-Spray cap for easy identification.

Part 2 – Parts and Material

2.1 The Hunter Pro-Spray Sprinkler Body shall be available in the following options:

Pro-Spray	Pro-Spray PRS30	Pro-Spray PRS40
PROS-00	PROS-00-PRS30	PROS-00-PRS40
PROS-00-R	PROS-00-PRS30-R	PROS-00-PRS40-R
PROS-02	PROS-03-PRS30	PROS-03-PRS40
PROS-03	PROS-04-PRS30	PROS-04-PRS40
PROS-04	PROS-04-PRS30-CV	PROS-04-PRS40-CV
PROS-04-CV	PROS-04-PRS30-CV-R	PROS-04-PRS40-CV-R
PROS-04-CV-R	PROS-04-PRS30-CV-F	PROS-04-PRS40-CV-F
PROS-06	PROS-04-PRS30-CV-F-R	PROS-04-PRS40-CV-F-R
PROS-06-CV	PROS-06-PRS30	PROS-06-PRS40
PROS-06-CV-R	PROS-06-PRS30-CV	PROS-06-PRS40-CV
PROS-12	PROS-06-PRS30-CV-R	PROS-06-PRS40-CV-R
PROS-12-CV	PROS-06-PRS30-CV-F	PROS-06-PRS40-CV-F
PROS-12-CV-R	PROS-06-PRS30-CV-F-R	PROS-06-PRS40-CV-F-R
PROS-06-SI	PROS-12-PRS30	PROS-12-PRS40
PROS-12-SI	PROS-12-PRS30-CV	PROS-12-PRS40-CV
	PROS-12-PRS30-CV-R	PROS-12-PRS40-CV-R
	PROS-12-PRS30-CV-F	PROS-12-PRS40-CV-F
	PROS-12-PRS30-CV-F-R	PROS-12-PRS40-CV-F-R
	PROS-06-SI-PRS30	PROS-06-SI-PRS40
	PROS-12-SI-PRS30	PROS-12-SI-PRS40

A. Specification Descriptions
    i. PROS-00 = Shrub
    ii. PROS-02 = 2" (5 cm) pop-up
    iii. PROS-03 = 3" (7.5 cm) pop-up
    iv. PROS-04 = 4" (10 cm) pop-up
    v. PROS-06 = 6" (15 cm) pop-up
    vi. PROS-12 = 12" (30 cm) pop-up
    vii. -SI = side inlet model for 6" and 12" (15 cm and 30 cm)
    viii. -CV = includes factory-installed drain check valve, “CHECK VALVE” designated on body cap
    ix. -PRS30 = pressure-regulated to 30 PSI (2.1 bar; 210 kPa), brown body cap
    x. -PRS40 = pressure-regulated to 40 PSI (2.8 bar; 280 kPa), gray body cap
    xi. -F = includes factory-installed FloGuard technology, “FLOGUARD” designated on body cap
    xii. -R = includes factory-installed reclaimed water purple cap
B. Cap Description
    i. The Pro-Spray cap shall be made of a non-corrosive, impact-resistant, UV-resistant, heavy-duty ABS material.
    ii. Standard and pressure-regulated models shall be color-coded for field identification.
        a. The standard Pro-Spray model shall have a black cap.
        b. The Pro-Spray PRS30 model shall have a brown cap with “PRS30” marked on the top.
        c. The Pro-Spray PRS40 model shall have a gray cap with “PRS40” marked on the top.
    iii. When specified for reclaimed water applications, the cap will be molded in purple.
    iv. An optional snap-on cap molded in UV-resistant purple acetal shall be available to indicate the use of reclaimed water.
    v. When specified as factory-installed drain check valve, the cap shall have “CHECK VALVE” marked on the top.
    vi. When specified with the FloGuard feature, the cap shall have “FLOGUARD” marked on the top.
C. Seal Description
    i. The Pro-Spray shall have a pressure-activated, chemical- and chlorine-resistant, UV-stable wiper seal that cleans debris from the riser while it retracts.
    ii. The seal shall be molded around a rigid plastic ring to prevent seal deformation.
    iii. The seal shall prevent the pop-up from sticking in the up position.
    iv. The seal shall seal the riser stem to the cap under normal operating pressures.
    v. The seal shall be removable from the cap for easy service and be replaceable.
D. Body
    i. The body of the Pro-Spray shall be constructed of a non-corrosive, impact-resistant, UV-resistant, heavy-duty ABS material.
    ii. Standard Pro-Spray and PRS30 models in 6" and 12" (15 and 30 cm) shall be available with a ½" FNPT side inlet option.

iii. The inlet size shall be ½" thread.

E. Riser Description
   i. The riser of the sprinkler shall be constructed of abrasion- and UV-resistant ABS.
   ii. The riser shall be adjustable for pattern alignment using a two-piece ratchet mechanism.
   iii. The riser shall be compatible with female-threaded nozzles.
   iv. A stainless steel spring shall be assembled with the riser for positive retraction when the irrigation cycle is complete.

F. Flush Plug Description
   i. The Pro-Spray shall have a factory-installed, removable flush plug with a pull-up tab that shall prevent debris from entering the sprinkler during installation.
   ii. The flush plug shall be made of polyethylene.

G. Drain Check Valve Description
   i. The Pro-Spray shall have the option of including either a factory- or field-installed drain check valve.
   ii. The standard Pro-Spray models with drain check valve shall check up to 10' (3 m) in elevation change.
   iii. The pressure-regulated Pro-Spray models with drain check valve shall check up to 14' (4.3 m) in elevation change except for the 3" (7.5 cm) PRS models for field-installed check valve.
      a. PROS-03-PRS30 and PROS-03-PRS40 models will hold up to 10' (3 m) of elevation with a field-installed check valve.
   iv. When specified with the drain check valve, the cap shall have “CHECK VALVE” marked on the top.

H. FloGuard Technology Description
   i. Pressure-regulated Pro-Spray models with drain check valve shall include the option of a factory-installed FloGuard Technology feature installed in the riser to reduce flow in the event of a missing nozzle.

2.2 Pro-Spray Dimensions

A. Shrub models
   i. PROS-00
   ii. Height = 1½" (4 cm)
   iii. Inlet size = ½"

B. PROS-00-PRS30 and PROS-00-PRS40
   i. Height = 4½" (11 cm)
   ii. Inlet size = ½"

C. PROS-02
   i. Retracted height = 4" (10 cm)
   ii. Pop-up height = 2" (5 cm)
   iii. Exposed diameter = 2¼" (5.7 cm)
   iv. Inlet size = ½"

D. PROS-03
   i. Retracted height = 5" (12.5 cm)
   ii. Pop-up height = 3" (7.5 cm)

iii. Exposed diameter = 2¼" (5.7 cm)
iv. Inlet size = ½"

E. PROS-04 models
i. Retracted height = 5⅞" (15.5 cm)
ii. Pop-up height = 4" (10 cm)
iii. Exposed diameter = 2¼" (5.7 cm)
iv. Inlet size = ½"

F. PROS-06 models
i. Retracted height = 8¾" (22.5 cm)
ii. Pop-up height = 6" (15 cm)
iii. Exposed diameter = 2¼" (5.7 cm)
iv. Inlet size = ½"

G. PROS-12 models
i. Retracted height = 16⅛" (41 cm)
ii. Pop-up height = 12" (30 cm)
iii. Exposed diameter = 2¼" (5.7 cm)
iv. Inlet size = ½"

2.3 Warranty

A. The Pro-Spray Sprinkler Body shall carry a 5-year exchange warranty.

Part 3 – Function and Operation

3.1 Operating Pressure

A. The Pro-Spray Sprinkler Body shall operate from 15 to 100 PSI (1.0 to 7.0 bar; 100 to 700 kPa).
B. To activate the pressure regulator in PRS30 and PRS40 models, a minimum of 10 PSI (0.7 bar; 70 kPa) differential is required to achieve the desired output pressure.

3.2 Pressure Regulation

A. When specified as PRS30 or PRS40, the sprinkler body shall have a pressure-regulating device as an integral part of the pop-up riser.
B. The PRS30 models will prevent fogging or misting of the nozzle spray pattern by maintaining a constant outlet pressure of 30 PSI (2.1 bar; 210 kPa) with inlet pressures of up to 100 PSI (7.0 bar; 700 kPa), regardless of the nozzle installed.
C. The PRS40 models will provide optimal distribution uniformity of the Hunter MP Rotator® Nozzle by maintaining a constant outlet pressure of 40 PSI (2.8 bar; 280 kPa) with inlet pressures of up to 100 PSI (7.0 bar; 700 kPa), regardless of the specific MP Rotator Nozzle installed.

3.3 System Flushing

A. The flush plug shall allow the system to be flushed before installing the nozzle.
B. The flush plug shall open as the stem extends and close when the stem is in the retracted position, preventing debris from entering the riser.
C. The flush plug shall have directional flushing action that allows the water to escape in only one direction.
D. When specified with FloGuard Technology, the flush plug shall include a spacer to keep the FloGuard feature deactivated for a complete system flush.

3.4 Drain Check Valve

A. For standard Pro-Spray models, the drain check valve will hold up to 10' (3 m) of elevation.
B. For pressure-regulated models, the drain check valve will hold up to 14' (4.3 m) of elevation except for the 3" (7.5 cm) PRS models for field-installed check valve.
    a. PROS-03-PRS30 and PROS-03-PRS40 models will hold up to 10' (3 m) of elevation with a field-installed check valve.
C. The drain check valve can be factory- or field-installed in pop-up models.

3.5 FloGuard Technology

A. In the event of a missing nozzle, the FloGuard feature shall reduce the flow from the riser to a low-flow 10' (3 m) tall stream indicating the need for maintenance.

Hunter Product Written Specification Template – ICV Valves

Part 1 – General

1.1 ICV valve is normally closed, electronically-actuated, diaphragm-operated, remote-control valve for operation of residential and commercial irrigation systems with flow control and bleeder pin. Includes internal filter with self-cleaning metering rod and both AC and DC power solenoids. Add on products include solenoid conduit cover, internal filter (Filter Sentry) and pressure regulation (ACCU-SYNC).

Part 2 – Parts and Material

2.1 ICV Valves shall be available in the following options:

A. Model Specification / Dimensions:

1. 1" (ICV-101G) Height: 5 ½", Length: 4 ¾", Width: 4", globe body style
2. 1 ½" (ICV-151G) Height: 7 1/8", 6 7/8", Width: 5 1/2", globe body style
3. 1 ½" (ICV-151G-FS-R) Height: 7 1/8", Length: 6 7/8", Width: 5 ½", globe body style
4. 2" (ICV-201G) 7 1/8", Length: 6 7/8", Width: 5 ½", globe body style
5. 2" (ICV-201G-FS-R) Height: 7 1/8", Length: 6 7/8", Width: 5 ½", globe body style
6. 3" (ICV-301) Height: 10 ¾", Length: 9", Width: 7 3/8", globe and angle body style

B. Threads

1. Valve inlet and outlet to be Female National Pipe Theards (FNPT)
2. British Standard Pipe Threads available when specified

C. Materials

1. Body / Bonnet
    a. Shall be molded of non-corrodible, glass-reinforced nylon rated to 220 PSI (15 bars, 1500 kPa)
    b. Body shall have brass inserts, with through-holes, to accept bonnet bolts
    c. Bonnet bolts shall be held captive in bonnet
2. Diaphragm
    a. Diaphragm assembly shall be molded construction, reinforced nylon fabric and thermoplastic elastomer seating material

b. ICV-R: Diaphragm constructed of a higher grade of EPDM rubber with greater chlorine resistance

3. Solenoid

a. Shall be an encapsulated, one-piece unit with captive plunger

4. Filter and Metering Rod

a. Shall be manufactured from corrosion-resistant stainless steel

2.2 Warranty

A. Hunter Industries Incorporated warrants the following products to be free of defects in the materials or workmanship under normal use in landscape irrigation applications for the specified period of time from the original date of manufacture

1. Warranty Period: 5 years

Part 3 – Function and Operation

3.1 Pressure

A. Valve shall be capable of operating between 20 and 220 PSI (1.5 to 15.0 bar; 150 to 1500 kPa)

3.2 Flow

A. Valve shall be capable of operating with a flow range between 0.1 to 300 GPM (0.06 to 68 m3/hr;0.4 to 1135l/m)

3.3 Pressure Loss

A. Pressure loss shall be 10.1 PSI (0.6 bars; 60 kPa) maximum at 300 GPM (68 m3/hr; 1135 l/m)

3.4 Solenoid

A. Solenoid shall be 24 VAC unit with a 350 mA inrush current and 190 mA holding current at 60 cycles and a 370 mA inrush current and 210 mA holding current at 50 cycles

B. DC latching solenoid available

3.5 Pressure Regulation

A. Valve shall be available with optional adjustable pressure regulating device with calibrated dial for setting of the outlet pressure

1. Regulator shall be capable of adjusting the outlet pressure from between 20 and 100 PSI (1.4 to 7.0 bars; 138 to 689 kPa) when inlet pressure is 15 PSI (1.0 bars; 103 kPa) or greater than regulated outlet pressure

B. Regulator shall be capable of regulating upstream pressures from 35 psi to 220 psi.

3.6 Serviceability

A. Valve shall be serviceable through captive bolts held in the bonnet

SECTION 329300 - PLANTS

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. Section Includes:

1. Furnish and Installation of Plants.

2. Furnish and installation of Decorative Gravel at locations shown on drawings.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for turf (lawn), hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

E. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

F. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure the main body of tree or shrub for height and spread; do not measure branches or roots tip to tip.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

G. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 – June 15
2. Fall Planting: September 15 – November 15
3. Perennials in Spring Planting ONLY,

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

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

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods: As listed on the Drawing.

3. Include the following remedial actions as a minimum:

    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
    d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List indicated on Drawing and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch diameter; or with stem girdling roots are unacceptable.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Project Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:

1. Type; Shredded Hardwood Mulch.

2. Color: Natural.

2.3 DECORATIVE GRAVEL

1. Level course – washed #57 gravel.
2. Decorative Stone – 'Riverjack' Rock
3. Accent boulders – approximately 24" to 36" in diameter, granite and limestone.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable, or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Project Architect and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Project Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

3.3 EXCAVATION FOR TREES

A. Planting Pits and Trenches: Refer to Installation Details on the Drawing.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Project Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

3.4 TREE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting them cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil- use excavated soil for backfill.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When the planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Continue backfilling process. Water again after placing and tamping the final layer of soil.

3.5 TREE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Project Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

3.6 TREE MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply 3" depth mulch ring at a 48" diameter around trunks or stems. Do not place mulch within 3" of trunks or stems.

3.7 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

3.8 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before **Substantial Completion**, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and the Project site.

3.9 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 30 days from date of **Substantial Completion**

END OF SECTION 329300

SECTION 329119.13 - LANDSCAPE FINE GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Final grade topsoil for finish landscaping.

1.02 RELATED SECTIONS

A. Section 329200 – TURF AND GRASSES

B. Section 329300 - PLANTS

PART 2 - PRODUCTS

2.01 MATERIAL

A. Topsoil: Provide Topsoil as specified.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that building and trench backfilling have been inspected.

B. Verify that substrate base has been contoured and compacted.

3.02 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of ½ inch in size.

C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.03 PLACING TOPSOIL

A. Place topsoil in areas where seeding and planting is required to thickness as scheduled.

B. Place topsoil during dry weather.

C. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

D. Remove roots, weeds, rocks, and foreign material while spreading.

E. Manually spread topsoil close to existing plant life and building to prevent damage. After topsoil has been spread.

F. Lightly compact placed topsoil.

G. Surplus imported subsoil and topsoil shall be removed from the Property.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.04 TOLERANCES

A. Top of Topsoil: Plus or minus ½ inch.

3.05 PROTECTION

A. Protect landscaping and other features remaining as final work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.06 SCHEDULES

A. Compacted topsoil thickness at the following areas:

1. Lawn: 4 inches.
2. Landscape Beds: 4 inches.

END OF SECTION

SECTION 329200 – TURF and GRASSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seeding, optional Hydroseeding, mulching, and fertilizing.
B. Sodding,
B. Maintenance.

1.02 RELATED SECTIONS

A. Section 329119.13 – LANDSCAPE FINE GRADING

1.03 REFERENCES

A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.04 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.05 SUBMITTALS

A. Maintenance Data: Submit maintenance instructions, recommended cutting methods and maximum grass height, types, application frequency, and recommended coverage of fertilizer.

B. Product Data: Submit seed vendors' certified statement for grass seed mixture required, stating botanical and common names, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

C. Certificate of Compliance: See Regulatory requirements.

1.06 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.07 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from Contracting Officer indicating approval of seed mixture.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Deliver grass seed mixture in sealed containers. Seed that is wet or moldy or that has been otherwise damaged in transit or storage will not be acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 - PRODUCTS

2.01 SEED MIXTURE

A. Seed Mixture: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

B. Turf Lawn Seed mix required as follows:

85% Elite Turf Type Tall Fescue, 15% Annual Ryegrass

2.02 SOD

A. Sod shall be the best quality, nursery grown, Turf-type Tall Fescue complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, and mowed height, and free or weeds and undesirable native grasses. Provide viable sod of uniform density, color and texture, strongly rooted and capable of vigorous growth and development when planted.

2.02 ACCESSORIES

A. Mulching Material: Wood cellulose fiber, free of growth or germination inhibiting ingredients.

B. Fertilizer: FS O-F-241, recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis to the following proportions: Nitrogen 12 percent, phosphoric acid 12 percent, soluble potash 12 percent.

C. Water: Clean, fresh, potable, and free of substances or matter which could inhibit vigorous growth of grass.

1. Water will be provided to the Landscape Contractor at the building hose bibbs.

2. The Landscape Contractor shall furnish all equipment and hose as required to properly water the seeded areas.

D. Herbicide: Teflan or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that the prepared topsoil base is ready to receive the work of this Specification Section.

3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil as per Specification Section 329119.13 LANDSCAPE FINE GRADING.

3.03 PLACING TOPSOIL

A. Place topsoil as per Specification Section 329119.13 LANDSCAPE FINE GRADING.

3.04 FERTILIZING

A. Apply fertilizer at a rate of 30 pounds per 1,000 square feet.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 SEEDING

A. Apply *Turf Lawn* seed at a rate of: 8-10 lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season: As established by the Contracting Officer.

D. Do not sow immediately following rain, when ground is too dry, or during windy periods.

E. Roll seeded area with roller not exceeding 112 lbs.

F. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches . Maintain mulch clear of shrubs and trees.

G. Apply water with a fine spray immediately after each area has been mulched. Saturate the depth of the topsoil.

3.06 OPTIONAL HYDROSEEDING

A. Apply seeded slurry with a hydraulic seeder at a rate of**:** 8-10 lbs per 1000 sq ft evenly in two intersecting directions.

B. Do not hydroseed areas in excess of that which can be mulched on the same day.

C. Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain mulch clear of shrubs and trees.

C. Apply water with a fine spray immediately after each area has been mulched. Saturate to the depth of the topsoil.

3.07 SODDING

A. Place all sod with staggered joints, tightly butted, with no inequalities in grade. All damaged sod will be rejected. No sodding shall take place when the ground is frozen or muddy, nor when soil or weather conditions would prevent the proper soil preparation and subsequent operations as specified.

3.08 MAINTENANCE AND REPAIR

A. Begin maintenance of lawns immediately after each area is planted and continues for the periods required to establish acceptable lawns, but no less than the following:

1. New Lawn areas, **at least 30 days**, after date of substantial completion. If seeded in fall and not given full 30 days of maintenance, or if not considered acceptable then, continue maintenance during following spring until acceptable lawn is established. Areas repaired as a result of damage occurring through no fault of the Contractor will be maintained only until the end of the original established period.

B. Maintain lawns by watering, fertilizing, mowing, trimming, and other operations such as rolling, regrading, replanting as required to establish a smooth, acceptable lawn, free of eroded or bare a areas.

1. Replant bare areas with same materials specified for lawns.

2. Mow lawns when there is enough top growth to cut with a mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height. Remove no more than 40 percent of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when the grass is wet. Time initial and subsequent mowings to maintain following grass height: Mow grass from 1-1/2 inches to 2 inches high. Do not mow to less than 1-1/2 inches.

3.09 ACCEPTANCE

A. When work is substantially completed, including maintenance, Project Architect will, upon request, make an inspection to determine acceptability. Lawn work may be inspected for acceptance in parts agreeable to Project Architect, provided work offered for inspection is complete, including maintenance.

B. Replant rejected work and continue specified maintenance until reinspected by Project Architect and found acceptable.

D. Lawns will be acceptable provided requirements, including maintenance, have been met and a healthy, uniform close stand of specified grass is established, free of weeds, bare areas, and surface irregularities.

3.10 SCHEDULE

A. All project disturbed areas not scheduled to receive impervious materials, or plant bed areas, as shown on drawings, shall receive sod or grass seed as designated on the drawings in accordance with this Specification Section. Verify extend of work with Architect's Representative.

END OF SECTION