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ROOT ENGINEERING SERVICES

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DIVISION 22 – PLUMBING

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DIVISION 22 – PLUMBING
SECTION 22 05 00: COMMON WORK RESULTS FOR PLUMBING

1.1. GENERAL

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Summary:
1. This Section includes the following basic mechanical materials and methods to complement other Division 22 and 23 Sections.
 - a. Piping materials and installation instructions common to most piping systems.
 - b. Escutcheons
 - c. Dielectric fittings.
 - d. Flexible connectors.
 - e. Equipment nameplate data requirements.
 - f. Labeling and identifying mechanical systems
 - g. Field-fabricated metal and wood equipment supports.
 - h. Installation requirements common to equipment specification sections.
 - i. Mechanical demolition.
 - j. Cutting and patching.
 - k. Touchup painting and finishing.
 2. Pipe and pipe fitting materials are specified in Division 22 piping system Sections.
- C. Definitions:
1. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
 2. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
 3. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
 4. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
 5. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
 6. The following are industry abbreviations for plastic materials:
 - a. CPVC: Chlorinated polyvinyl chloride plastic.
 - b. NP: Nylon plastic.
 - c. PE: Polyethylene plastic.
 - d. PVC: Polyvinyl chloride plastic.
 7. The following are industry abbreviations for rubber materials:
 - a. CR: Chlorosulfonated polyethylene synthetic rubber.
 - b. EPDM: Ethylene propylene diene terpolymer rubber.

- D. Quality Assurance:
1. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
 2. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.
- E. Delivery, Storage, and Handling:
1. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
 2. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
 3. Protect flanges, fittings, and piping specialties from moisture and dirt.
- F. Sequencing and Scheduling:
1. Coordinate mechanical equipment installation with other building components.
 2. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
 3. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
 4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
 5. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
 6. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."
 7. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.2. PRODUCTS

- A. Manufacturers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Pipe and Pipe Fittings:
1. Refer to individual Division 22 piping Sections for pipe and fitting materials and joining methods.
 2. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Joining Materials:
1. Solder Filler Metals: ASTM B 32.

- a. Alloy Sn95 or Alloy Sn94: Approximately 95% tin and 5% silver, with 0.10% lead content.
 - b. Alloy E: Approximately 95% tin and 5% copper, with 0.10% maximum lead content.
 - c. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10% maximum lead content.
 - d. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10% maximum lead content.
 - e. Alloy Sb5: 95% tin and 5% antimony, with 0.20% maximum lead content.
2. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - a. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 3. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - a. Sleeve: ASTM A 126, Class B, gray iron.
 - b. Followers: Malleable iron or ASTM A 536 ductile iron.
 - c. Gaskets: Rubber.
 - d. Bolts and Nuts: AWWA C111.
 - e. Finish: Enamel paint.
- D. Dielectric Fittings:
1. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 2. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
 3. Insulating Material: Suitable for system fluid, pressure, and temperature.
 4. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180° F (82° C).
 5. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig (1035-kPa) minimum working pressure as required to suit system pressures.
 6. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150 psig (1035-kPa) minimum working pressure as required to suit system pressures.
 7. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225° F (107° C).
- E. Identifying Devices and Labels:
1. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
 2. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
 - a. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 - b. Location: Accessible and visible location.

3. Stencils: Standard stencils, prepared for required applications with letter sizes complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1¼"- (30-mm-) high letters for ductwork and not less than ¾"- (19-mm-) high letters for access door signs and similar operational instructions.
 - a. Stencil Paint: Standard exterior-type stenciling enamel; black, unless otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 - b. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
4. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
 - a. Fabricate in sizes required for message.
 - b. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 - c. Punch for mechanical fastening.
 - d. Thickness: ⅛", unless otherwise indicated.
 - e. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
5. Plastic Equipment Markers: Color-coded, laminated plastic. Comply with the following color code:
 - a. Green: Cooling equipment and components.
 - b. Yellow: Heating equipment and components.
 - c. Yellow/Green: Combination cooling and heating equipment and components.
 - d. Brown: Energy reclamation equipment and components.
 - e. Blue: Equipment and components that do not meet any criteria above.
 - f. For hazardous equipment, use colors and designs recommended by ASME A13.1.
 - g. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1) Name and plan number.
 - 2) Equipment service.
 - 3) Design capacity.
 - 4) Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
 - h. Size: Approximate 2½" by 4" (65 by 100 mm) for control devices, dampers, and valves; and 4½" by 6" (115 by 150 mm) for equipment.
6. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
 - a. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

1.3. EXECUTION

A. Piping Systems – Common Requirements:

1. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
2. Install components with pressure rating equal to or greater than system operating pressure.
3. Install piping free of sags and bends.
4. Install piping to allow application of insulation plus 1" (25-mm) clearance around insulation.
5. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
6. Install couplings according to manufacturer's written instructions.
7. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
8. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - a. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - b. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - c. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - d. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1) Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2) Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - 3) Align threads at point of assembly.
 - 4) Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - 5) Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
9. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - a. Install unions, in piping 2" NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2" NPS or smaller threaded pipe connection.
 - b. Install flanges, in piping 2½" NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - c. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - d. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

- B. Equipment Installation – Common Requirements:
1. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
 2. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
 3. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
 4. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 5. Install equipment giving right of way to piping installed at required slope.
 6. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.
- C. Labeling and Identifying:
1. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - a. Stenciled Markers: According to ASME A13.1.
 - b. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
 - c. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:
 - 1) Near each valve and control device.
 - 2) Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
 - 3) Near locations if pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
 - 4) At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5) Near major equipment items and other points of origination and termination.
 - 6) Spaced at maximum of 50' (15-m) intervals along each run. Reduce intervals to 25' (7.5 m) in congested areas of piping and equipment.
 - 7) On piping above removable acoustical ceilings, except omit intermediately spaced markers.
 2. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
 - a. Lettering Size: Minimum ¼"- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24" (610 mm), ½"h- (12.7-mm-) high lettering for distances up to 72" (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 - b. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 3. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

- D. Concrete Bases: Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
- E. Demolition:
1. Disconnect, demolish, and remove Work specified in Division 22 Sections.
 2. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
 3. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
 4. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2" beyond face of adjacent construction. Cap and patch surface to match existing finish.
 5. Removal: Remove indicated equipment from Project site.
 6. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- F. Cutting and Patching:
1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
 2. Repair cut surfaces to match adjacent surfaces.

END 22 05 00.

DIVISION 22 – PLUMBING
SECTION 22 11 119: PLUMBING SPECIALTIES

1.1 GENERAL

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Summary:
1. This Section includes the following plumbing specialties:
 - a. Backflow preventers.
 - b. Dishwasher air-gap fittings.
 - c. Thermostatic water mixing valves.
 - d. Water tempering valves.
 - e. Strainers
 - f. Outlet boxes.
 - g. Washer-supply outlets.
 - h. Wheel-handle wall hydrants.
 - i. Nondraining nonfreeze post hydrants.
 - j. Trap seal primer valves.
 - k. Drain valves.
 - l. Backwater valves.
 - m. Miscellaneous piping specialties.
 - n. Sleeve penetration systems.
 - o. Cleanouts
 - p. Floor drains.
 - q. Trench drains.
 - r. Roof drains.
- C. Definitions:
1. The following are industry abbreviations for plastic piping materials:
 - a. ABS: Acrylonitrile-butadiene-styrene plastic.
 - b. PE: Polyethylene plastic.
 - c. PUR: Polyurethane plastic.
 - d. PVC: Polyvinyl chloride plastic.
- D. Performance Requirements:
1. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - a. Domestic Water Piping: 125 psig (860 kPa)
 - b. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).
 - c. Storm Drainage Piping: 10-foot head of water (30 kPa).
 - d. Force-Main Piping: 100 psig (690 kPa)
- E. Submittals:
1. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - a. Backflow preventers and water regulators.
 - b. Balancing valves, water filters, and strainers.

- c. Thermostatic water mixing valves and water tempering valves.
 - d. Water hammer arresters, air vents, and trap seal primer valves and systems.
 - e. Drain valves, hose bibbs, hydrants, and hose stations.
 - f. Outlet boxes and washer-supply outlets.
 - g. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains.
 - h. Sleeve penetration systems.
- 2. Shop Drawings: Diagram power, signal, and control wiring.
 - 3. Field test reports.
 - 4. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
 - a. Backflow preventers and water regulators.
 - b. Water filters.
 - c. Thermostatic water mixing valves and water tempering valves.
 - d. Trap seal primer valves and systems.
 - e. Hose stations and hydrants.
- F. Quality Assurance:
- 1. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 2. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 4. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
 - 5. NSF Compliance:
 - a. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
 - b. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.2. PRODUCTS

- A. Manufacturers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- B. Backflow Preventers:
 - 1. Manufacturers:
 - a. Ames Co., Inc.
 - b. B & K Industries, Inc.
 - c. Cla-Val Co.
 - d. CMB Industries, Inc.; Febco Backflow Preventers
 - e. Conbraco Industries, Inc.

- f. FLOMATIC Corp.
 - g. IMI Cash Valve
 - h. Mueller Co.; Hersey Meters Div.
 - i. Sparco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Industries, Inc.; Wilkins Div.
2. General: ASSE standard, backflow preventers.
 - a. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - b. Interior Components: Corrosion-resistant materials.
 - c. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
 - d. Strainer: On inlet, if indicated.
 3. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
 4. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
 5. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.
 6. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
 - a. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
 7. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
 - a. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
 8. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.
 9. Back-Siphonage Backflow Vacuum Breakers: ASSE 1056, suitable for continuous pressure and backflow applications. Include shutoff valves, check valve, test cocks, and vacuum vent.
- C. Thermostatic Water Mixing Valves:
1. Manufacturers:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company
 - c. Mark Controls Corp.; Powers Process Controls
 - d. Symmons Industries, Inc.
 - e. T & S Brass and Bronze Works, Inc.

2. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
 - a. Type: Bimetal thermostat, operation and pressure rating 125 psig (860 kPa) minimum.
 - b. Type: Liquid-filled motor, operation and pressure rating 100 psig (690 kPa) minimum.
 3. Thermostatic Water Mixing Valves: Unit, with the following:
 - a. Piping, valves, and unions.
- D. Strainers:
1. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 - a. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 - b. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
 - c. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
 - d. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - 1) Drain: Pipe plug.
 - e. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
 - f. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
- E. Drain Valves:
1. Drain Valves: MSS SP-110, NPS 3/4 (DN 20) ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
 - a. Inlet: Threaded or solder joint.
 - b. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.
 2. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with NPS 3/4 (DN 20) threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.
 3. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig (1380-kPa) minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 (DN 6) side drain outlet and cap.
- F. Miscellaneous Piping Specialties:
1. Hose Bibbs: Heavy commercial, freezeproof type.
 2. Air Vents: Float type for automatic air venting.
 - a. Bolted Construction: Bronze body with replaceable, corrosion-resistant metal float and stainless-steel mechanism and seat; [NPS 1/2 (DN 15)] minimum inlet; 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C); and threaded vent outlet.

- b. Welded Construction: Stainless-steel body with corrosion-resistant metal float, stainless-steel mechanism and seat, threaded NPS 3/8 (DN 10) minimum inlet, 150-psig (1035-kPa) minimum pressure rating, and threaded vent outlet.
 - 3. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.
 - 4. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
 - 5. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
 - 6. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
 - 7. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 8. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
 - 9. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
 - 10. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.
 - 11. Conductor Nozzles: Bronze body with threaded inlet for connected conductor size, and bronze wall flange with mounting holes.
- G. Sleeve Penetration Systems:
- 1. Available Manufacturers:
 - a. Manufacturers:
 - 1) ProSet Systems, Inc.
 - b. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1) Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2) Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a) Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

- H. Cleanouts:
1. Cleanouts:
 - a. Application: Floor cleanout all cleanout or installation in exposed piping
 - b. Products:
 - 1) Josam Co.
 - 2) Josam Co., Blucher-Josam Div.
 - 3) LSP Products Group
 - 4) Sioux Chief Manufacturing Co., Inc.
 - 5) Smith, Jay R. Mfg. Co.
 - 6) Sioux Chief
 - 7) Tyler Pipe, Wade Div.
 - 8) Watts Industries, Inc., Drainage Products Div.
 - 9) Zurn Industries, Inc., Jonespec Div.
 - 10) Zurn Industries, Inc., Specification Drainage Operation
 - c. Body or Ferrule Material: Cast iron.
 - d. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - e. Frame and Cover Shape: Round
 - f. Top Loading Classification: Medium Duty.

- I. Floor Drains:
1. Floor Drains, Refer to drawing schedule:
 - a. Products:
 - 1) Josam Co.
 - 2) Josam Co., Blucher-Josam Div.
 - 3) Sioux Chief Manufacturing Co., Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe, Wade Div.
 - 6) Sioux Chief
 - 7) Watts Industries, Inc., Drainage Products Div.
 - 8) Zurn Industries, Inc., Jonespec Div.
 - 9) Zurn Industries, Inc., Specification Drainage Operation

- J. Roof Drains:
- a. Cast-Iron, Large-Sump, General-Purpose Roof Drains
 - 1) Standard: ASME A112.6.4, for general-purpose roof drains.
 - 2) Body Material: Cast iron.
 - 3) Dimension of Body: Nominal 14-inch (357-mm).
 - 4) Outlet: Bottom.
 - 5) Dome Material: Cast iron or PE
 - 6) Water Dam: when specified: 2 inches (51 mm) high.
 - b. Products:
 - 1) Josam Co.
 - 2) Sioux Chief Manufacturing Co., Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe, Wade Div.
 - 5) Watts Industries, Inc., Drainage Products Div.
 - 6) Zurn Industries, Inc.,

1.3. EXECUTION

A. Installation:

1. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
2. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - a. Locate backflow preventers in same room as connected equipment or system.
 - b. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - c. Do not install bypass piping around backflow preventers.
3. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
4. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
5. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
6. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
7. Install expansion joints on vertical risers, stacks, and conductors if indicated.
8. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - a. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - b. Locate at each change in direction of piping greater than 45 degrees.
 - c. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - d. Locate at base of each vertical soil and waste stack.
9. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
10. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
11. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
12. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
13. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
14. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - a. Position floor drains for easy access and maintenance.

- b. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - 1) Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - 2) Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - 3) Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - c. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - d. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- 15. Fasten recessed-type plumbing specialties to reinforcement built into walls.
 - 16. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
 - 17. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 22 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
 - 18. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
 - 19. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

B. Connections:

- 1. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- 2. Install piping adjacent to equipment to allow service and maintenance.
- 3. Connect plumbing specialties to piping specified in other Division 22 Sections.
- 4. Ground equipment.
- 5. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- 6. Connect plumbing specialties and devices that require power according to Division 26 Sections.

C. Protection:

- 1. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- 2. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END 22 40 00.

DIVISION 22 – PLUMBING
SECTION 22 14 00: FACILITY STORM DRAINAGE

1.1 GENERAL

A. Summary:

1. Section Includes:
 - a. Storm water piping buried within 5 feet of building.
 - b. Storm water piping above grade.
 - c. Unions and flanges.
 - d. Valves
 - e. Pipe hangers and supports.
 - f. Roof drains.
 - g. Parapet drains.
 - h. Canopy and cornice drains.
 - i. Special purpose downspout covers.
 - j. Downspout nozzles.
 - k. Area drains.
 - l. Cleanouts
 - m. Bedding and cover materials.
 - n. Section 31 20 00 - Fill: Requirements for backfill to be placed by this section.

B. References:

1. American Society of Mechanical Engineers:
 - a. ASME A112.21.1M - Floor Drains.
 - b. ASME A112.21.2M - Roof Drains.
 - c. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
 - d. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 - e. ASME B31.9 - Building Services Piping.
2. ASTM International:
 - a. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 - b. ASTM B32 - Standard Specification for Solder Metal.
 - c. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
 - d. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - e. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - f. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - g. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - h. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - i. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
 - j. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - k. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

- l. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - m. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - n. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - o. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - p. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - q. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
 - r. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - s. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - t. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - u. ASTM F679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - v. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
3. Cast Iron Soil Pipe Institute:
- a. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. 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.
4. Manufacturers Standardization Society of the Valve and Fittings Industry:
- a. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - b. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - c. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - d. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - e. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - f. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - g. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- C. Submittals:
- 1. Section 01 33 00 - Submittal Procedures: Submittal procedures.
 - 2. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump-pumps, catch basins and manholes.
 - 3. Product Data:
 - a. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - b. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

- c. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - d. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 - 4. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
 - 5. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Closeout Submittals:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
 - 2. Project Record Documents: Record actual locations of equipment and clean-outs.
- E. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
 - 2. Installer: Company specializing in performing Work of this section with minimum three years experience.
- F. Delivery, Storage, and Handling:
 - 1. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
 - 2. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- G. Environmental Requirements:
 - 1. Section 01 60 00 - Product Requirements.
 - 2. Do not install underground piping when bedding is wet or frozen.
- H. Field Measurements: Verify field measurements prior to fabrication.
- I. Warranty:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
 - 2. Furnish one year manufacturer warranty for all work.

1.2. PRODUCTS

- A. Storm Water Piping, Buried Within 5 Feet of Building:
 - 1. PVC Pipe: ASTM D2729, polyvinyl chloride (PVC) material, bell and spigot solvent sealed ends.
 - a. Fittings: PVC, ASTM D2729.
 - b. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- B. Storm Water Piping, Above Grade:
 - 1. PVC Pipe: ASTM D2665 or ASTM D3034 SDR 26, polyvinyl chloride (PVC) material.
 - a. Fittings: ASTM D2665 or ASTM D3034, PVC.
 - b. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

- C. Unions and Flanges:
1. Flanges for Pipe 2-1/2 inches and Larger:
 - a. Copper Piping: Class 150, slip-on bronze flanges.
 - b. PVC Piping: PVC flanges.
 - c. CPVC Piping: CPVC flanges.
 - d. Gaskets: 1/16 inch thick preformed neoprene gaskets.
 2. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.
- D. Pipe Hangers and Supports:
1. Manufacturers:
 - a. Carpenter & Paterson Inc. Model.
 - b. Creative Systems Inc. Model.
 - c. Flex-Weld, Inc. Model.
 - d. Glope Pipe Hanger Products Inc. Model.
 - e. Michigan Hanger Co. Model.
 - f. Superior Valve Co. Model.
 - g. Substitutions.
 2. Drain, Waste, and Vent: Conform to ASME B31.9 ASTM F708.
 3. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 4. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 7. Wall Support for Pipe Sizes 3 inches and Larger: Welded steel bracket and wrought steel clamp.
 8. Vertical Support: Steel riser clamp.
 9. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- E. Roof Drains:
1. Manufacturers:
 - a. Zurn
 - b. JR Smith
 - c. Sioux Chief
 2. Roof Drain (RD-1):
 - a. Assembly: ASME A112.21.2M.
 - b. Body: Lacquered cast iron with sump.
 - c. Strainer: Removable cast metal cast iron dome.
 - d. Accessories: Coordinate with roofing type, refer to Section:
 - 1) Membrane flange and membrane clamp with integral gravel stop.
 - 2) Adjustable under deck clamp.
 - 3) Roof sump receiver.
 - 4) Waterproofing flange.
 - 5) Controlled flow weir.
 - 6) Leveling frame.
 - 7) Adjustable extension sleeve for roof insulation.
 - 8) Perforated or slotted ballast guard extension for inverted roof.
 - 9) Perforated stainless steel ballast guard extension.

3. Roof Drain (RD-2):
 - a. Assembly: ASME A112.21.2M.
 - b. Body: Lacquered cast iron with sump.
 - c. Strainer: Removable cast metal cast iron dome.
 - d. Pipe extended to 2 inches above flood elevation.
 - e. Accessories: Coordinate with roofing type, refer to Section:
 - 1) Membrane flange and membrane clamp with integral gravel stop.
 - 2) Adjustable under deck clamp.
 - 3) Roof sump receiver.
 - 4) Waterproofing flange.
 - 5) Controlled flow weir.
 - 6) Leveling frame.
 - 7) Adjustable extension sleeve for roof insulation.
 - 8) Perforated or slotted ballast guard extension for inverted roof.
 - 9) Perforated stainless steel ballast guard extension.
 4. Lacquered cast iron body with flashing clamp collar and epoxy coated grate.
- F. Downspout Nozzles:
1. Manufacturers:
 - a. JR Smith
 - b. Zurn Model
 2. Product Description: Cast bronze body and wall flange round with straight bottom section.
- G. Cleanouts:
1. Exterior Surfaced Areas (CO-1): Round cast nickel bronze access frame and non-skid cover.
 2. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round epoxy coated cover with gasket.
 3. Interior Finished Floor Areas (CO-3): Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
 4. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.
 5. Interior Unfinished Accessible Areas (CO-5): Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

1.3. EXECUTION

- A. Examination:
1. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
 2. Verify excavations are to required grade, dry, and not over-excavated.
- B. Preparation:
1. Ream pipe and tube ends. Remove burrs.
 2. Remove scale and dirt, on inside and outside, before assembly.
 3. Prepare piping connections to equipment with flanges or unions.

4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- C. Installation – Hangers and Supports:
1. Inserts:
 - a. Provide inserts for placement in concrete forms.
 - b. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - c. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
 - d. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - e. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
 2. Pipe Hangers and Supports:
 - a. Install in accordance with ASME B31.9 ASTM F708 and MSS SP 89.
 - b. Support horizontal piping as scheduled.
 - c. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - d. Place hangers within 12 inches of each horizontal elbow.
 - e. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - f. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - g. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
 - h. Provide copper plated hangers and supports for copper piping.
 - i. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- D. Installation – Buried Piping Systems:
1. Verify connection to storm sewer size, location, and invert are as indicated on Drawings.
 2. Establish elevations of buried piping with not less than five ft of cover.
 3. Establish minimum separation of 10 from other services piping in accordance with applicable code.
 4. Excavate pipe trench in accordance with Section.
 5. Install pipe to elevation as indicated on Drawings.
 6. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches depth.
 7. Install pipe on prepared bedding.
 8. Route pipe in straight line.
 9. Install plastic ribbon tape continuous over top of pipe. above pipe line; coordinate with Section. Refer to Section. Install trace wire continuous over top of pipe. above pipe line; coordinate with Section 31 20 00. Refer to Section.
 10. Pipe Cover and Backfilling:
 - a. Backfill trench in accordance with Section 31 20 00.
 - b. Maintain optimum moisture content of fill material to attain required compaction density.
 - c. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 6

inches minimum cover over top of jacket. Compact to 95 percent maximum density.

- d. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
- e. Do not use wheeled or tracked vehicles for tamping.

11. Install Work in accordance with

E. Installation – Above Ground Piping:

1. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients.
2. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.
3. Encase exterior cleanouts in concrete flush with grade.
4. Install floor cleanouts at elevation to accommodate finished floor.
5. Install non-conducting dielectric connections wherever jointing dissimilar metals.
6. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
7. Install piping to maintain headroom. Group piping to conserve space.
8. Group piping whenever practical at common elevations.
9. Support cast iron drainage piping at every joint.
10. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
11. Provide clearance in hangers and from structure and other equipment for installation of insulation.
12. Provide access where valves and fittings are not accessible.
13. Install piping penetrating roofed areas to maintain integrity of roof assembly.
14. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
15. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
16. Install bell and spigot pipe with bell end upstream.
17. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
18. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section.

F. Field Quality Control:

1. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
2. Test storm drainage piping system in accordance with applicable code local authority having jurisdiction.

END 22 14 00.

**DIVISION 22 –PLUMBING
SECTION 22 30 00: TRENCH DRAINS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench drain systems.

1.2 RELATED SECTIONS

- A. Section 03300 – Concrete: Installation coordination of drain body and frame.

1.3 REFERENCES

- A. ASTM International (ASTM):

ASTM A 36 - Standard Specification for Carbon Structural Steel.

ASTM A 48 – Standard specification for Gray Iron Castings.

ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A 536 - Standard Specification for Ductile Iron Castings.

ASTM B 146 - Specification for Leaded Yellow Brass Sand Castings for General Purposes.

ASTM A929 – Standard specification for galvanized steel coils

ASTM A760 – Standard specification for manufacturing corrugated metal pipe

ASTM C267 – Standard for chemical resistance

ASTM C307 – Standard for tensile strength

ASTM C579 – Standard for compressive strength

ASTM C580 – Standard for flexural strength

ASTM D570 – Standard for water absorption

- B. AASHTO (American association of state highway and transportation officials)

AASHTO M306-10 – Standard specification for drainage, sewer, utility, and related castings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:

Preparation instructions and recommendations.

Storage and handling requirements and recommendations.

Installation methods.

- C. Shop Drawings:

- D. Verification Samples: For each finish product specified, two samples, minimum size 24 inches (600 mm) square representing actual product and finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.

- B. Installer Qualifications: Minimum 2 year experience installing similar products.

- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

Finish areas designated by Architect.

Do not proceed with remaining work until workmanship is approved by Architect.

Rebuild mock-up area as required to produce acceptable work.

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- C. Handle materials to avoid damage.

1.8 PROJECT CONDITIONS

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

1.9 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - a. Eric'sons Inc., 574 Industrial Way N, Dallas, GA 30132, USA. ASD. Tel: (770) 505-6575. Email: info@eric-sons.com. Web: <http://www.duratrench.com>.
 - b. JR Smith
 - c. Zurn
- B. Substitutions: Permitted with written Request
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 SYSTEM DESCRIPTION

- A. Design: Provide the following type of drain systems.
Type: Radius trench drains.

- B. Performance:

Provide a complete drain system made up of selected components that together shall make a functional trench drain system. The trench drain components provided and installed shall be the trench drain body, load bearing frame, trench drain grate, grate locking mechanism, channel joint sealing, and outlet connection.

The trench drain body shall be sized for the anticipated flow rate, application, chemical resistance, and ease of installation. The trench drain body shall have specified slope without exception to meet design

flow requirements.

The load bearing frame shall be sized based on the load rating and bearing area. The frame shall have a minimum of 2 anchors per section to properly secure the frame into the concrete surround. The material and finish shall be selected based on chemical resistance and corrosion resistance anticipated, and the aesthetic design for the Project.

The grates shall be selected based on open area and load rating required. The material and finish shall be selected based on chemical resistance and corrosion resistance anticipated, and the color, and pattern for the Project.

Grates that are small, light, in high speed traffic, or have theft potential shall be locked down to the trench frame. The locking mechanism shall be selected based on the pullout resistance, dynamic loading, and chemical loading anticipated for the system.

Where trench joints are required to be sealed water tight the system selected shall have 1.5" minimum width flange for applying sealant or the proper welding.

The outlet pipe shall be sized for the anticipated flow. Pipe material shall mate with other piping, have proper load rating at the given cover depth, and have the proper corrosion resistance.

Where the grate design is indicated as a heel proof the openings shall be less than 1/4 inch (6 mm) wide suitable for pedestrian traffic. Where the grate design is indicated as ADA compliant, the grate shall comply with the requirements of the Americans with Disabilities Act handbook section 4.5.4.

2.3 COMPONENTS

A. Trench Body Material:

DTRPF = True radius precast glass fiber reinforced polymer concrete body (Polyester resin). The trench drain body shall be cast in a true radius for a smooth, non-segmented curve. The trench drain body shall be composed of polyester fiber reinforced polymer concrete. The trench shall have a clear open throat and have a rounded or flat bottom as indicated in details. The trench body shall be gray in color to closely resemble the color of concrete and have a smooth interior for improved flow rates and reduced debris build-up. Sections shall be 96" long (typical) and have a 2" receiving flange on the upstream end for receiving and sealing the trench sections together. Each of the sections shall be labeled to indicate proper flow and placement. The trench body shall mate to the frame and form a grate seat that shall accept the specified grate. The body shall be supplied with a factory fit top for rail alignment and fastening of the channels in the field ensuring that the rails are cast in a coplanar manner. The trench body shall have the following properties: 12,600 psi minimum tensile strength per ASTM C307, 12,000 psi. minimum compressive strength per ASTM C579, 26,500 psi minimum flexural strength per ASTM C580, less than 0.35% water absorption, shall be frost proof, salt proof, and be resistant to dilute acids and alkalis per ASTM C267.

B. Slope:

As indicated on the Drawings.

C. Grate:

Ductile Iron ADA/Heel Proof Grate

D. Frame:

MDAL - Medium duty aluminum frame.

E. Grate Locking:

GLVP - Vandal resistant grate locks

F. Outlet:

Pipe Size: 6" _.

Pipe Type: PVC

Location: End

G. Joint Sealant:

SLPF - Joints shall be fully sealed with glass fiber reinforced polyester joint sealant. The joint sealant shall be applied to a lightly sanded and cleaned bell and spigot joint. The sealant shall be applied the the bell 3/8" thick minimum and be continuous from the top of the joint through the bottom and back to the top on the other side forming a water tight seal. The exterior of the joint should also be sanded, cleaned, and sealed using glass fiber reinforcing and sealant to ensure a water tight seal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Ensure ground conditions are compacted and suitable for construction. Poor soil bearing conditions or other site conditions will require engineering advise. Ensure excavation will allow for proper thickness of concrete surround before proceeding.
- B. Ensure any reinforcement is placed and firmly held in place prior to linear drain installation. All reinforcement steel shall follow concrete reinforcing steel institute standards.
- C. Prepare linear drains by ensuring they are clean and properly oriented and sequenced.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
- B. Construct expansion and control joints as indicated in construction documents. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction. The linear drain products are not to be used as a construction or control joint in the lengthwise direction. Any construction, expansion, or control joints placed traverse to the system shall be made at linear drain joints in the frame.
- C. Place concrete to completely encapsulate linear drain as shown in contract documents. The drain shall be finished 1/8" below finish grade while ensuring proper slope of adjacent areas toward the drain creating positive flow to the drain.
- D. All linear drains shall be installed to within ¼" tolerance.

3.4 PROTECTION

- A. Protect installed products until completion of project. Protective wood trench covers shall remain in place until such time that grating can be installed with no future damage to grating finishes.
- B. Clean and remove any debris from linear drains prior to Owner's acceptance.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 26 – ELECTRICAL
SECTION 26 05 00: COMMON WORK RESULTS FOR ELECTRICAL

1.1 GENERAL

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Summary: This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Electrical identification.
 - 3. Electricity-metering components.
 - 4. Concrete equipment bases.
 - 5. Electrical demolition.
 - 6. Cutting and patching for electrical construction.
 - 7. Touchup painting.
- C. Definitions:
 - 1. EMT: Electrical metallic tubing.
 - 2. FMC: Flexible metal conduit.
 - 3. IMC: Intermediate metal conduit.
 - 4. LFMC: Liquidtight flexible metal conduit.
 - 5. RNC: Rigid nonmetallic conduit.
 - 6. RGSC: Rigid, heavywall, galvanized steel conduct.
- D. Submittals:
 - 1. Product Data: For electricity-metering equipment.
 - 2. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
 - 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Quality Assurance:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Comply with NFPA 70.
- F. Coordination:
 - 1. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - a. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
 - 2. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
 - 3. Coordinate electrical service connections to components furnished by utility companies.

- a. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - b. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
4. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
 5. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
 6. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.2. PRODUCTS

A. Supporting Devices:

1. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
3. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
4. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
 - a. Channel Thickness: Selected to suit structural loading.
 - b. Fittings and Accessories: Products of the same manufacturer as channel supports.
5. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least one surface.
 - a. Fittings and Accessories: Products of the same manufacturer as channels and angles.
 - b. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
6. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
7. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
8. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
9. Expansion Anchors: Carbon-steel wedge or sleeve type.
10. Toggle Bolts: All-steel springhead type.
11. Powder-Driven Threaded Studs: Heat-treated steel.

- B. Electrical Identification:
1. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
 2. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
 - a. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
 - b. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 - c. Color: Black letters on orange background.
 - d. Legend: Indicates voltage.
 3. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
 4. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - a. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
 - b. Compounded for permanent direct-burial service.
 - c. Embedded continuous metallic strip or core.
 - d. Printed legend that indicates type of underground line.
 5. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
 6. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
 7. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.
 8. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
 9. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6-mm) grommets in corners for mounting.
 10. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- C. Equipment for Utility Company's Electricity Metering:
1. not used
- D. Equipment for Electricity Metering by Owner: Not used.
- E. Concrete Bases:

1. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
 2. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."
- F. Touch-up Paint:
1. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
 2. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

1.3. EXECUTION

- A. Electrical Equipment Installation:
1. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
 2. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
 3. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 4. Right of Way: Give to raceways and piping systems installed at a required slope.
- B. Electrical Supporting Device Application:
1. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
 2. Dry Locations: Steel materials.
 3. Support Clamps for PVC Raceways: Click-type clamp system.
 4. Selection of Supports: Comply with manufacturer's written instructions.
 5. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.
- C. Support Installation:
1. Install support devices to securely and permanently fasten and support electrical components.
 2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
 3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
 4. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
 5. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
 6. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.
 7. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

8. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
9. Simultaneously install vertical conductor supports with conductors.
10. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
11. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
12. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
13. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - a. Wood: Fasten with wood screws or screw-type nails.
 - b. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - c. New Concrete: Concrete inserts with machine screws and bolts.
 - d. Existing Concrete: Expansion bolts.
 - e. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - f. Steel: Welded threaded studs or spring-tension clamps on steel.
 - 1) Field Welding: Comply with AWS D1.1.
 - g. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - h. Light Steel: Sheet-metal screws.
 - i. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

D. Identification Materials and Devices:

1. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
2. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
3. Self-Adhesive Identification Products: Clean surfaces before applying.
4. Identify raceways and cables with color banding as follows:
 - a. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 - b. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
 - c. Colors: As follows:

- 1) Fire Alarm System: Red
 - 2) Security System: Blue and yellow.
 - 3) Telecommunication System: Green and yellow.
5. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
 6. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
 7. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Phase C: Blue
 - d. Neutral: White
 - e. Ground: Green
 8. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - a. Phase A: Yellow
 - b. Phase B: Brown
 - c. Phase C: Orange
 - d. Neutral: Grey
 - e. Ground: Green with white trace.
 9. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 10. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- E. Utility Company Electricity-Metering Equipment: not used
- F. Firestopping: Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."
- G. Concrete Bases: Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
- H. Cutting and Patching:

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
 2. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.
- I. Field Quality Control: Inspect installed components for damage and faulty work, including the following:
1. Raceways
 2. Building wire and connectors.
 3. Supporting devices for electrical components.
 4. Electrical identification.
 5. Electricity-metering components.
 6. Concrete bases.
 7. Electrical demolition.
 8. Cutting and patching for electrical construction.
 9. Touchup painting.
- J. Refinishing and Touchup Painting: Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- K. Cleaning and Protection:
1. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
 2. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END 26 05 00.

DIVISION 26 – ELECTRICAL

SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 2. Conductor not smaller than 14 AWG for control circuits.
 - 3. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire in raceway.
 - 2. Exposed Dry Interior Locations: Use only building wire in raceway.
 - 3. Above Accessible Ceilings: Use only building wire in raceway.
 - 4. Wet or Damp Interior Locations: Use only building wire in raceway.
 - 5. Exterior Locations: Use only building wire in raceway.

1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Perform Work in accordance with
- C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. AETNA
 - 2. American Insulated Wire Corp.
 - 3. Colonial Wire
 - 4. Encore Wire
 - 5. General Cable Co.
 - 6. Republic Wire
 - 7. Rome Cable
 - 8. Service Wire Co.
 - 9. Southwire Model
 - 10. Superior Essex
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 75 degrees C.
- F. Insulation Material: Thermoplastic.

2.2 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: Type.

2.3 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:

1. Protect exposed cable from damage.
 2. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 7. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- G. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- A. General:
1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:

- a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
- 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

- A. Section: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 26 05 26: GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.1 GENERAL

- A. Summary: This Section includes:
1. Rod electrodes.
 2. Mechanical connectors.
 3. Exothermic connections.
- B. References:
1. Institute of Electrical and Electronics Engineers:
 - a. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - b. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
 2. International Electrical Testing Association:
 - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 3. National Fire Protection Association:
 - a. NFPA 70 - National Electrical Code.
 - b. NFPA 99 - Standard for Health Care Facilities.
- C. System Description:
1. Grounding systems use the following elements as grounding electrodes:
 - a. Metal underground water pipe.
 - b. Concrete-encased electrode.
 - c. Rod electrode.
- D. Performance Requirements:
1. Grounding System Resistance: 5 ohms maximum.
- E. Submittals:
1. Product Data: Submit data on grounding electrodes and connections.
 2. Test Reports: Indicate overall resistance to ground.
- F. Closeout Submittals:
1. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
 2. Project Record Documents: Record actual locations of components and grounding electrodes.
- G. Quality Assurance:
1. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
 2. Perform Work in accordance with
- H. Qualifications:
1. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

2. Installer: Company specializing in performing work of this section with minimum years experience.
- I. Delivery, Storage, and Handling:
 1. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 2. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
 3. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
 4. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.
 - J. Coordination:
 1. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
 2. Complete grounding and bonding of building reinforcing steel prior concrete placement.

1.2. PRODUCTS

- A. Rod Electrodes:
 1. Manufacturers:
 - a. Erico, Inc.
 - b. O-Z Gedney Co.
 - c. Thomas & Betts, Electrical
 2. Product Description:
 - a. Material: Copper-clad steel or Copper.
 - b. Diameter: 3/4 inch.
 - c. Length: 10 feet.
 3. Connector: Connector for exothermic welded connection. or U-bolt clamp.
- B. Wire:
 1. Material: Stranded copper.
 2. Foundation Electrodes: 4 AWG.
 3. Grounding Electrode Conductor: Copper conductor bare.
 4. Bonding Conductor: Copper conductor insulated.
- C. Mechanical Connectors:
 1. Manufacturers:
 - a. Erico, Inc.
 - b. ILSCO Corporation
 - c. O-Z Gedney Co.
 - d. Thomas & Betts, Electrical
 2. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.
- D. Exothermic Connections:
 1. Manufacturers:
 - a. Copperweld, Inc.
 - b. ILSCO Corporation

- c. O-Z Gedney Co.
 - d. Thomas & Betts, Electrical
2. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

1.3. EXECUTION

- A. Examination:
- 1. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
 - 2. Verify final backfill and compaction has been completed before driving rod electrodes.
- B. Preparation: Remove paint, rust, mill oils, surface contaminants at connection points.
- C. Existing Work:
- 1. Modify existing grounding system to maintain continuity to accommodate renovations.
 - 2. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.
- D. Installation:
- 1. Install in accordance with IEEE 142
 - 2. Install rod electrodes at indicated
 - 3. Install grounding and bonding conductors concealed from view.
 - 4. Install grounding well pipe with cover at. Install well pipe top flush with finished grade.
 - 5. Install 4 AWG bare copper wire in foundation footing.
 - 6. Bond together metal siding not attached to grounded structure; bond to ground.
 - 7. Bond together reinforcing steel and metal accessories in structures.
 - 8. Bond together each metallic raceway, pipe, duct and other metal object entering. Install AWG bare copper bonding conductor.
 - 9. Install isolated grounding conductor for circuits supplying in accordance with IEEE 1100.
 - 10. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
 - 11. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
 - 12. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
 - 13. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
 - 14. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles,

lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

15. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
 16. Permanently attach equipment and grounding conductors prior to energizing equipment.
- E. Field Quality Control:
1. Inspect and test in accordance with NETA ATS, except Section 4.
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
 3. Perform ground resistance testing in accordance with IEEE 142.
 4. Perform leakage current tests in accordance with NFPA 99.
 5. Perform continuity testing in accordance with IEEE 142.
 6. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END 26 05 26.

DIVISION 26 – ELECTRICAL
SECTION 26 05 33: RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

1.1 GENERAL

- A. Summary: Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. References:
1. American National Standards Institute:
 - a. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - b. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - c. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
 2. National Electrical Manufacturers Association:
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - c. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - d. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - e. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - f. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - g. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. System Description:
1. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
 2. Underground More than 5 feet outside Foundation Wall: Provide rigid steel conduit or non-metallic conduit. Provide cast metal boxes or nonmetallic handhole.
 3. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit, or nonmetallic conduit. Provide cast metal or nonmetallic boxes.
 4. In or Under Slab on Grade: Provide rigid steel conduit, thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.
 5. Outdoor Locations, Above Grade: Provide, intermediate metal conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
 6. In Slab Above Grade: Provide, intermediate metal conduit, or electrical metallic tubing. Provide cast boxes.
 7. Wet and Damp Locations: Provide rigid steel conduit, or thickwall nonmetallic conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
 8. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
 9. Exposed Dry Locations: Provide, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- D. Design Requirements:
 - 1. Minimum Raceway Size: 1/2 inch unless otherwise specified.

- E. Submittals:
 - 1. Section 01 33 00 - Submittal Procedures: Submittal procedures.
 - 2. Product Data: Submit for the following:
 - a. Flexible metal conduit.
 - b. Liquidtight flexible metal conduit.
 - c. Nonmetallic conduit.
 - d. Flexible nonmetallic conduit.
 - e. Nonmetallic tubing.
 - f. Raceway fittings.
 - g. Conduit bodies.
 - h. Surface raceway.
 - i. Wireway
 - j. Pull and junction boxes.
 - k. Handholes

 - 3. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

- F. Closeout Submittals:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
 - 2. Project Record Documents:
 - a. Record actual routing of conduits larger than 2 inch.
 - b. Record actual locations and mounting heights of outlet, pull, and junction boxes.

- G. Delivery, Storage, and Handling:
 - 1. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
 - 2. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
 - 3. Protect PVC conduit from sunlight.

- H. Coordination:
 - 1. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
 - 2. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.2. PRODUCTS

- A. Metal Conduit:
 - 1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.

2. Rigid Steel Conduit: ANSI C80.1,
 3. Rigid Aluminum Conduit: ANSI C80.5.
 4. Intermediate Metal Conduit (IMC): Rigid steel.
 5. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.
- B. Flexible Metal Conduit
1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
 - f. Substitutions
 2. Product Description: Interlocked steel construction.
 3. Fittings: NEMA FB 1.
- C. Liquidtight Flexible Metal Conduit:
1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co. Product Description: Interlocked steel construction with PVC jacket.
 2. Fittings: NEMA FB 1.
- D. Electrical Metallic Tubing (EMT):
1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
 2. Product Description: ANSI C80.3; galvanized tubing.
 3. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.
- E. Nonmetallic Conduit:
1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
 2. Product Description: NEMA TC 2; Schedule 40 PVC.
 3. Fittings and Conduit Bodies: NEMA TC 3.
- F. Surface Metal Raceway:
1. Manufacturers:

- a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
- 2. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
 - 3. Finish: Gray enamel.
 - 4. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.
- G. Surface Nonmetal Raceway:
- 1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co. M
 - 2. Product Description: Plastic channel with fitted cover, suitable for use as surface raceway.
 - 3. Finish: Gray.
 - 4. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories, finish to match raceway.
- H. Wireway:
- 1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
 - 2. Product Description: General purpose type wireway.
 - 3. Knockouts: Manufacturer's standard.
 - 4. Size: 6 x 6 inch 8 x 8 inch; length as indicated on Drawings.
 - 5. Cover: Screw cover
 - 6. Connector: Slip-in.
 - 7. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
 - 8. Finish: Rust inhibiting primer coating with gray enamel finish.
- I. Outlet Boxes:
- 1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co.
 - 2. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - a. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.

- b. Concrete Ceiling Boxes: Concrete type.
- 3. Nonmetallic Outlet Boxes: NEMA OS 2.
- 4. Cast Boxes: NEMA FB 1, Type FD. Furnish gasketed cover by box manufacturer.
- 5. Wall Plates for Unfinished Areas: Furnish gasketed cover.

- J. Pull and Junction Boxes:
 - 1. Manufacturers:
 - a. Carlon Electrical Products
 - b. Hubbell Wiring Devices
 - c. Thomas & Betts Corp.
 - d. Walker Systems Inc.
 - e. The Wiremold Co. Model

 - 2. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
 - 3. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

- K. Adjusting:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
 - 2. Adjust flush-mounting outlets to make front flush with finished wall material.
 - 3. Install knockout closures in unused openings in boxes.

- L. Cleaning:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
 - 2. Clean interior of boxes to remove dust, debris, and other material.
 - 3. Clean exposed surfaces and restore finish.

END 26 05 33.

DIVISION 26 – ELECTRICAL
SECTION 26 09 23: LIGHTING CONTROL DEVICES

1.1 GENERAL

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Summary: Section includes photoelectric sensors, and occupancy sensors.
- C. Submittals:
 - 1. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices.
 - 2. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 1.
- D. Quality Assurance:
 - 1. Source Limitations: Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Section.
 - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
 - 3. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
 - 4. Comply with NFPA 70.
- E. Coordination: Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

1.2 PRODUCTS

- A. Manufacturers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Photoelectric Sensors:
 - 1) Allen-Bradley/Rockwell Automation
 - 2) Area Lighting Research, Inc.
 - 3) Fisher Pierce
 - 4) Grasslin Controls, Corp.
 - 5) Intermatic, Inc.
 - 6) Paragon Electric Co., Inc.
 - 7) Rhodes: M H Rhodes, Inc.
 - 8) SSAC, Inc.
 - 9) Tork, Inc.
 - b. Occupancy Sensors:
 - 1) Arrow Hart Wiring Devices
 - 2) BRK Electronics

- 3) Bryant Electric
- 4) Honeywell, Inc.; Home and Building Controls
- 5) Hubbell Lighting, Inc.
- 6) Lightolier
- 7) Lithonia Control Systems
- 8) MyTech Corporation
- 9) Novitas, Inc.
- 10) RAB Electric Manufacturing Co., Inc.
- 11) SenTec, Inc.
- 12) Sterner Lighting Systems, Inc.
- 13) Tork, Inc.
- 14) Touchplate
- 15) Unenco Electronics (A Hubbell Co.)
- 16) Watt Stopper, Inc. (The)

B. General Lighting Control Device Requirements:

1. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

C. Photoelectric Sensors:

1. Description: Solid state, complying with UL 773A.
2. Light-Level Monitoring Range: 0 to 3500 fc (0 to 37 673 lx).
3. Indoor Ceiling- or Wall-Mounting Units: Semiflush, calibrated to detect adequacy of daylighting in perimeter locations, and arranged to turn artificial illumination on and off to suit varying intensities of available daylighting.
4. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

D. Occupancy Sensors:

1. Ceiling-Mounting Units: Unit receives 24-V dc power from a remote source and, on sensing occupancy, closes contacts that provide signal input to a remote microprocessor-based lighting control system.
2. Switch-Box-Mounting Units: Unit receives power directly from switch leg of the 120- or 277-V ac circuit it controls and operates integral power switching contacts rated 800 W at 120-V ac, and 1000 W at 277-V ac, minimum.
3. Operation: Refer to lighting control scope of work on drawings.
4. Dual-Technology Type: Uses a combination of passive-infrared and ultrasonic detection methods to distinguish between occupied and unoccupied conditions for area covered. Particular technology or combination of technologies that controls each function (on or off) is selectable in the field by operating controls on unit.

1.3. EXECUTION

A. Installation:

1. Install equipment level and plumb and according to manufacturer's written instructions.
2. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section "Common Work Results for Electrical."
3. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

- B. Control Wiring Installation:
1. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 26 Section "Conductors and Cables" for low-voltage connections and Division 26 Section "Voice and Data Systems" for digital circuits.
 2. Wiring Method: Install all wiring in raceway as specified in Division 26 Section "Raceways and Boxes."
 3. Wiring Method: Install all wiring in raceway as specified in Division 26 Section "Raceways and Boxes," unless run in accessible ceiling space and gypsum board partitions.
 4. Bundle, train, and support wiring in enclosures.
 5. Ground equipment.
 6. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- C. Identification:
1. Identify components and power and control wiring according to Division 26 Section "Common Work Results for Electrical."
 2. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- D. Field Quality Control:
1. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
 2. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
 3. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
 4. Verify settings of photoelectric devices with photometer calibrated within previous six months.
 5. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - a. Continuity tests of circuits.
 - b. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - 1) Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
 6. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
 7. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
 8. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- E. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

- F. Demonstration: Train Owner's maintenance personnel as specified below:
1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of three hours' training.
 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END 26 09 23.

**DIVISION 26 – ELECTRICAL
SECTION 26 14 10: WIRING DEVICES**

1.1 GENERAL

- A. Work Includes:
 - 1. Base Bid:
 - a. Electrical Contractor:
 - 1) Receptacles, connectors, switches, and finish plates.
- B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- C. Definitions:
 - 1. GFCI: Ground-fault circuit interrupter.
 - 2. TVSS: Transient voltage surge suppressor.
- D. Submittals:
 - 1. See Section 01 33 00 – Shop Drawings, Product Data and Samples, for submittal procedures.
 - 2. Product Data: For each product specified.
 - 3. Shop Drawings: Legends for receptacles and switch plates.
 - 4. Samples: For devices and device plates for color selection and evaluation of technical features.
 - 5. Maintenance Data: For materials and products to include in maintenance manuals specified in Section 01 73 00.
- E. Quality Assurance:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
 - 2. Comply with NEMA WD 1.
 - 3. Comply with NFPA 70.
- F. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - a. Cord and Plug Sets: Match equipment requirements.

1.2. PRODUCTS

- A. Manufacturers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wiring Devices:
 - 1) Bryant Electric, Inc.
 - 2) Eagle Electric Manufacturing Co., Inc.
 - 3) GE Company; GE Wiring Devices
 - 4) Hubbell, Inc.; Wiring Devices Div.
 - 5) Killark Electric Manufacturing Co.
 - 6) Pass & Seymour/Legrand; Wiring Devices Div.

- b. Wiring Devices for Hazardous (Classified) Locations:
 - 1) Crouse-Hinds Electrical Co.; Distribution Equipment Div.
 - 2) Killark Electric Manufacturing Co.
 - 3) Pyle-National, Inc.; an Amphenol Co.
 - 4) Appleton Electric
 - c. Multi-outlet Assemblies:
 - 1) Airey-Thompson Co.
 - 2) Wiremold
- B. Receptacles:
- 1. Straight-Blade and Locking Receptacles: Specification grade.
 - 2. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
 - 3. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.
 - a. Devices: Listed and labeled as isolated-ground receptacles.
 - b. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
 - 4. TVSS Receptacles: Duplex type, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 - a. TVSS Components: Multiple metal-oxide varistors; rated a nominal clamp level of 500 transient-suppression voltage and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
 - b. Active TVSS Indication: Light visible in face of device to indicate device as "active" or "no longer active."
 - c. Identification: Distinctive marking on face of device denotes TVSS-type unit.
 - 5. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.
 - 6. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.
- C. Cord and Plug Sets:
- 1. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - a. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - b. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.
- D. Switches:
- 1. Snap Switches: Specification grade, quiet type.
 - 2. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - a. Switch: 20 A, 120/277-V ac.
 - b. Receptacle: NEMA WD 6, Configuration 5-20R.

3. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
 - a. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
 - b. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle, or slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads.
 - c. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

- E. Wall Plates: Single and combination types match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Heavy plastic, specification grade, ivory finish.
 3. Material for Unfinished Spaces: Galvanized steel.

- F. Floor Service Fittings:
 1. Type: Modular, flush-type, dual-service units suitable for wiring method used.
 2. Type: Modular, above-floor, dual-service units suitable for wiring method used.
 3. Compartmentation: Barrier separates power and signal compartments.
 4. Housing Material: Die-cast aluminum, satin finished.
 5. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
 6. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

- G. Multioutlet Assemblies:
 1. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
 2. Raceway Material: Metal, with manufacturer's standard finish.
 3. Wire: as indicated by drawings. Refer to drawings for additional specification

- H. Telephone/Power Service Poles:
 1. Poles: Nominal 2.5-inch- (65-mm-) square cross section with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and separate channels for power and signal wiring.
 2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports, and pole foot with carpet pad attachment.
 3. Finishes: One of manufacturers standard finish and trim combinations, including painted and satin anodized-aluminum finishes and wood-grain-type trim.
 4. Wiring: as indicated by drawings.

1.3. EXECUTION

- A. Installation:
 1. Install devices and assemblies plumb and secure.
 2. Install wall plates when painting is complete.
 3. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
 4. Do not share neutral conductor on load side of dimmers.

5. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
 6. Protect devices and assemblies during painting.
 7. Adjust locations at which floor service outlets are installed to suit arrangement of partitions and furnishings.
- B. Identification:
1. Comply with Section 26 05 00 - "Common Work Results for Electrical."
 - a. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - b. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.
- C. Connections:
1. Connect wiring device grounding terminal to outlet box with bonding jumper.
 2. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
 3. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Field Quality Control:
1. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
 2. Check TVSS receptacle indicating lights for normal indication.
 3. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
 4. Replace damaged or defective components.
- E. Cleaning: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END 26 14 10.

DIVISION 26 – ELECTRICAL
SECTION 26 22 00: DRY TYPE TRANSFORMERS (1000V AND LESS)

1.1 GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. This Section includes e distribution and specialty transformers rated 1000 V and less.

C. SUBMITTALS

1. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
2. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.
3. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
4. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
5. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.
6. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable to equipment for this Project.
7. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.
8. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 1.

D. QUALITY ASSURANCE

1. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.
 - a. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - b. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
2. Comply with IEEE C2.
3. Comply with NFPA 70.
4. Comply with DOE 2016 (10 CFR 431)

1.2 PRODUCTS

A. MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:
 - a. Acme Electric Corp.; Transformer Division.
 - b. Cutler-Hammer/Eaton Corp.
 - c. GE Electrical Distribution & Control.
 - d. MagneTek Inc.
 - e. Siemens Energy & Automation, Inc.
 - f. Square D; Groupe Schneider.

B. TRANSFORMERS, GENERAL

1. Description: Factory-assembled and -tested units of types specified, designed for 60-Hz service.
2. Cores: Grain-oriented, nonaging silicon steel.
3. Coils: Continuous windings without splices, except for taps.
4. Internal Coil Connections: Brazed or pressure type.
5. Enclosure: Class complies with NEMA 250 for the environment in which installed.
6. Low-Sound-Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

C. GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

1. Comply with NEMA ST 20 and list and label as complying with UL 1561.
2. Cores: One leg per phase.
3. Windings: One coil per phase in primary and secondary.
4. Enclosure: Outdoor, ventilated, raintight, NEMA 250, Type 3R.
5. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
 - a. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
 - b. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
 - c. Taps, 750 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
6. K-Factor Rating: Transformers indicated to be K-factor rated are listed to comply with UL 1561 requirements for nonsinusoidal load current handling capability to the degree defined by the designated K-factor.
7. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor.
8. Nameplate states the designated K-factor of the transformer.
9. Refer to drawings for other requirements

D. FINISHES

1. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.
2. Outdoor Units: Comply with ANSI C57.12.28.

E. SOURCE QUALITY CONTROL

1. Factory Tests: Design and routine tests comply with referenced standards.
2. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project if specified sound levels are below standard ratings.

1.3 EXECUTION

A. INSTALLATION

1. Comply with safety requirements of IEEE C2.
2. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.
3. Identify transformers and install warning signs according to Division 16 Section "Electrical Identification."
4. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. GROUNDING

1. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

2. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping as indicated and to comply with NFPA 70.
3. Comply with Division 26 Section "Grounding" for materials and installation requirements.

C. FIELD QUALITY CONTROL – NOT USED

D. CLEANING

1. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

E. ADJUSTING

1. After installing and cleaning, touch up scratches and mars on finish to match original finish.
2. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.
3. Adjust buck-boost transformer connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility.
4. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to 2 visits to Project site for this purpose without additional cost.
 - a. Voltage Recordings: Contractor performed. Provide up to 48 hours of recording on the low-voltage system of each medium-voltage transformer.
 - b. Point of Measurement: Make voltage recordings at load outlets selected by Owner.

**DIVISION 26 – ELECTRICAL
SECTION 26 24 16: PANELBOARDS**

1.1 GENERAL

- A. Summary:
1. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards.
 2. Related Sections:
 - a. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - b. Section 26 05 53 - Identification for Electrical Systems.
- B. References:
1. Institute of Electrical and Electronics Engineers:
 - a. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 2. National Electrical Manufacturers Association:
 - a. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - b. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - c. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - d. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - e. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - f. NEMA PB 1 - Panelboards.
 - g. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
 3. International Electrical Testing Association:
 - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 4. National Fire Protection Association:
 - a. NFPA 70 - National Electrical Code.
 5. Underwriters Laboratories Inc.:
 - a. UL 67 - Safety for Panelboards.
 - b. UL 1283 - Electromagnetic Interference Filters.
 - c. UL 1449 - Transient Voltage Surge Suppressors.
- C. Submittals:
1. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
 2. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
 3. Product Data: Submit catalog data showing specified features of standard products.

- D. Closeout Submittals:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
 - 2. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
 - 3. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- E. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- F. Maintenance Materials: Furnish two of each panelboard key. Panelboards keyed alike.

1.2. PRODUCTS

- A. Distribution Panelboards:
 - 1. Manufacturers:
 - a. Appleton Electric Co.
 - b. GE Electrical
 - c. Siemens
 - d. Square D.
 - e. Cutler Hammer
 - f. Eaton
 - 2. Product Description: NEMA PB 1, circuit breaker type panelboard.
 - 3. Panelboard Bus: Aluminum, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
 - 4. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 240 208 volt panelboards; 65,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
 - 5. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 6. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
 - 7. Enclosure: NEMA PB 1, Type 1
 - 8. Cabinet Front: Surface type, fastened with screws, finished in manufacturer's standard gray enamel.
- B. Branch Circuit Panelboards:
 - 1. Manufacturers:
 - a. Appleton Electric Co.
 - b. GE Electrical
 - c. Siemens
 - d. Square D
 - e. Cutler Hammer
 - f. Eaton
 - 2. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

3. Panelboard Bus: Aluminum, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.
4. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
5. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
6. Enclosure: NEMA PB 1, Type 1.
7. Cabinet Box: 6 inches deep, 20 inches wide.
8. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

1.3. EXECUTION

- A. Installation:
 1. Install panelboards in accordance with NEMA PB 1.1.
 2. Install panelboards plumb.
 3. Install recessed panelboards flush with wall finishes.
 4. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
 5. Install filler plates for unused spaces in panelboards.
 6. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
 7. Install engraved plastic nameplates in accordance with Section 26 05 53.
 8. Install spare conduits out of each recessed panelboard to accessible location. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
 9. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.
- B. Field Quality Control:
 1. Section: Field inspecting, testing, adjusting, and balancing.
 2. Inspect and test in accordance with NETA ATS, except Section 4.
 3. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
 4. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
 5. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.
- C. Adjusting:
 1. Section: Requirements for starting and adjusting.
 2. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END 26 24 16.

DIVISION 26 – ELECTRICAL
SECTION 26 28 19: ENCLOSED SWITCHES

1.1 GENERAL

A. Summary:

1. Section includes fusible and non-fusible switches.

B. References:

1. National Electrical Manufacturers Association:
 - a. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - b. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
2. International Electrical Testing Association:
 - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Submittals:

1. Section 01 33 00 - Submittal Procedures: Submittal procedures.
2. Product Data: Submit switch ratings and enclosure dimensions.

D. Closeout Submittals:

1. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
2. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

E. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.2 PRODUCTS

A. Fusible Switch Assemblies:

1. Manufacturers:
 - a. GE Electrical Model
 - b. Hubbell Inc. Model
 - c. Westinghouse Electric Corp.
 - d. Square D
2. Product Description: NEMA KS 1, Type GD, enclosed load interrupter knife switch. Handle lockable in OFF position.
3. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
4. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - a. Interior Dry Locations: Type 1.
 - b. Exterior Locations: Type 3R.

- c. Industrial Locations: Type.
 - d. Locations: Type.
 - 5. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
 - 6. Furnish switches with entirely copper current carrying parts.
- B. Non-Fusible Switch Assemblies:
- 1. Manufacturers:
 - a. GE Electrical
 - b. Hubbell Inc.
 - c. Westinghouse Electric Corp.
 - d. Square D
 - 2. Product Description: NEMA KS 1, Type GD enclosed load interrupter knife switch. Handle lockable in OFF position.
 - 3. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - a. Interior Dry Locations: Type 1.
 - b. Exterior Locations: Type 3R.
 - c. Industrial Locations: Type.
 - d. Locations: Type.
 - 4. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
 - 5. Furnish switches with entirely copper current carrying parts.
- C. Switch Ratings:
- 1. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
 - 2. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).

1.3 EXECUTION

- A. Existing Work:
 - 1. Disconnect and remove abandoned enclosed switches.
 - 2. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
 - 3. Clean and repair existing enclosed switches to remain or to be reinstalled.
- B. Installation:
 - 1. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 00.
 - 2. Height: 5 feet to operating handle.
 - 3. Install fuses for fusible disconnect switches.
 - 4. Install engraved plastic nameplates in accordance with Section 26 05 00.

5. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- C. Field Quality Control:
1. Section: Field inspecting, testing, adjusting, and balancing.
 2. Inspect and test in accordance with NETA ATS, except Section 4.
 3. Perform inspections and tests listed in NETA ATS, Section 7.5.

END 26 28 19.

DIVISION 26 – ELECTRICAL
SECTION 26 56 00: EXTERIOR LIGHTING

1.1 GENERAL

- A. Summary: Section includes exterior luminaires, poles, and accessories.
- B. References:
 - 1. American National Standards Institute:
 - a. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - b. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - c. ANSI O5.1 - Wood Poles, Specifications and Dimensions.
- C. Submittals:
 - 1. Section 01 33 00 - Submittal Procedures: Submittal procedures.
 - 2. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
 - 3. Product Data: Submit dimensions, ratings, and performance data.
 - 4. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.
- D. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- E. Delivery, Storage, and Handling:
 - 1. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
 - 2. Store and handle solid wood poles in accordance with ANSI O5.1.
- F. Coordination:
 - 1. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
 - 2. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.2 PRODUCTS

- A. Luminaries:
 - 1. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.
 - 2. Refer to Section 01 60 00 - Product Requirements for product options.
- B. Fluorescent Ballasts:
 - 1. Manufacturers:
 - a. Cooper Industries Inc.
 - b. Duro-Test Corp.
 - c. General Electric Co.
 - d. Hubbell Lighting

- e. Magnetek Inc.
 - f. Pass & Seymour
2. Product Description: Suitable for lamps and environmental conditions specified, with voltage to match luminaire voltage.
- C. High Intensity Discharge (HID) Ballasts:
1. Manufacturers:
 - a. Duro-Test Corp.
 - b. General Electric Co.
 - c. Philips Electronics North America
 - d. Radiant Lamp Co.
 - e. Siemens Corp.
 2. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp and environmental conditions specified, with voltage to match luminaire voltage.
- D. Fluorescent Lamps:
1. Manufacturers:
 - a. Duro-Test Corp.
 - b. General Electric Co.
 - c. Hubbell Inc.
 - d. Philips Electronics
 - e. Siemens Corp.
- E. HID Lamps:
1. Manufacturers:
 - a. Duro-Test Corp.
 - b. General Electric Co.
 - c. Philips Electronic North America
 - d. RCS Industries North America
 - e. Siemens Corp.

1.3. EXECUTION

- A. Examination:
1. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
 2. Verify foundations are ready to receive fixtures.
- B. Existing Work:
1. Disconnect and remove exterior luminaries directed by drawings.
 2. Clean and repair existing exterior luminaries to remain or to be reinstalled.
- C. Installation:
1. Install concrete bases for lighting poles at locations as indicated on Drawings, in accordance with Section 03 30 00.
 2. Install poles plumb. Install shims to adjust plumb. Grout around each base.
 3. Install lamps in each luminaire.
 4. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26. Install supplementary grounding electrode at each pole.

- D. Field Quality Control:
 - 1. Section: Field inspecting, testing, adjusting, and balancing.
 - 2. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

- E. Adjusting:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
 - 2. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings.

- F. Cleaning:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
 - 2. Clean photometric control surfaces as recommended by manufacturer.
 - 3. Clean finishes and touch up damage.

- G. Protection of Finished Work:
 - 1. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
 - 2. Relamp luminaries having failed lamps at Substantial Completion.

END 26 56 00.