

NORTH HARDIN HIGH SCHOOL
SANITARY SEWER LINE REPLACEMENT
KDE PROJECT BG NO. 14-144

MECHANICAL INDEX

SECTION NUMBER

DIVISION 22 - PLUMBING

220100	PLUMBING GENERAL PROVISIONS
220200	PIPE TRENCHING AND BACKFILLING
220500	SANITARY SEWAGE DISTRIBUTION SYSTEM
220700	GRINDER PUMP SYSTEM

SECTION 220100 - PLUMBING GENERAL PROVISIONS

1.1 GENERAL

- A. The General Conditions and Special Conditions and all other Contract Documents shall apply to this Division of the work as well as to all other Divisions.

1.2 SCOPE

- A. This branch of the work includes coordination by the Contractor with all utility companies; providing utility meters; utility tap on fees; agency review fees and all inspection fees; all labor, materials, tools, excavation and backfill and all equipment necessary for the installation of Plumbing Systems as shown on the Drawings and Specifications and/or as required for complete and operating systems. The work shall include starting and the necessary and required tests to insure the proper operation of the complete system.
- B. A complete and operating pump system shall be provided.
- C. All work for this project must comply and be in strict accordance with the Kentucky Building Code, Kentucky Plumbing Code, Kentucky Boiler Code, NFPA, ADA, NEC and all local codes and regulations.
- D. In general (as a minimum) all materials and equipment must be installed in strict accordance with manufacturer's requirements; and provided with all required controls, internal fusing, relays, piping connections, electrical connections, etc., to provide for complete and operable systems.

1.3 PERMITS, CODES, AND APPROVALS

- A. Permits and Fees
 - 1. All permits, tap on fees and agency review and inspection fees necessary for complete Plumbing systems shall be obtained by the Contractor from the authorities governing such work. The cost of all permits shall be borne by the Contractor.
- B. Codes
 - 1. The minimum standard for all plumbing work shall be the requirements of the Kentucky State Plumbing Law, Regulation and Code, Kentucky Building Code, ADA, The Division of Water Quality and local ordinances. All plumbing for this project must as a minimum comply and be in strict accordance with the Kentucky Building Code, Kentucky Plumbing Code, Kentucky Boiler Code, NFPA, ADA, NEC, The Division of Water Quality and the "Standards of Safety" of the Commonwealth of Kentucky.
- C. Approvals
 - 1. All work must be approved by the Engineer, Owner and all related Code Agencies before final payment will be made.
 - 2. Final payment will be contingent upon all Approval Certificates.

1.4 PLUMBING DRAWINGS AND SPECIFICATIONS

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- A. The Drawings and Specifications are intended to cover all work enumerated under the respective headings. The Drawings are diagrammatic only as far as final location of pipes is concerned. Any item of work not clearly included, specified and/or shown, errors or conflict between Plans (Mechanical, Architectural, Structural or Electrical), Specifications, codes and field conditions, shall be clarified by a written request to the Architect by the Bidder before bidding; otherwise, the bidder shall, at his own expense, supply the proper labor and materials to include these items of work and to make good any damages or defects in his work caused by such error, omission or conflict. Under no circumstances shall a Contractor scale the Drawings for the location of equipment and work.
- B. Piping schematics, risers and details shown on the Drawings are for the equipment specified hereinafter. All revisions, modifications or changes in piping, accessories etc., due to using equipment of a different manufacturer than specified hereinafter, shall be the responsibility of the bidder and shall be made at no additional cost to the Owner. All modifications or changes shall be submitted to the Architect in writing and meet with his approval before the equipment is released for shipment.
- C. The Contractor shall be responsible for all revisions, modifications or changes necessary in the structural, architectural or electrical drawings and/or work to accommodate the equipment to be furnished under this section of the Specifications. This shall be made at no additional cost to the Owner.
- D. Plumbing as built "Record Drawings" shall be kept up to date each day. "Record Drawings" shall be reviewed by Engineer each month with contractor's pay request review.
- E. Any deviation in work as shown on plans and specifications must be approved in writing by Architect/Engineer prior to installation.

1.5 MATERIAL AND WORKMANSHIP

- A. Material and workmanship shall comply with the General Conditions of these Specifications.
- B. All material and equipment and locations of same shall at least conform with the standards of the Underwriters' Laboratories, Inc., whenever applicable.

1.6 ACCESSIBILITY

- A. All equipment, valves traps, unions and all other items which require adjustment, maintenance, repair and observation shall be installed in such a fashion that such maintenance, repair and observation can be readily achieved without undue difficulty. Where the drawings show these items in locations not conforming to the above, the Contractor shall advise the Architect/Engineer of this conflict prior to bid Date otherwise he shall, at his own expense, relocate such items as directed by the Architect/Engineer. Where such items are installed above inaccessible ceilings or in or behind walls, this contractor shall provide approved access panels unless otherwise directed in these Specifications.

1.7 COOPERATION WITH OTHER CONTRACTORS

- A. Each Contractor shall demand and examine all Drawings and Specifications pertaining to the construction before installing the work described and shown under these Drawings and Specifications. Each Contractor shall cooperate with all other contractors in locating

piping, openings, chases and equipment in order to avoid conflict with any other contractor's work. It is the responsibility of all trades to examine all shop drawings of other trades that would require equipment to occupy the same space and plane within the building to eliminate any potential conflicts. No extra payment will be allowed for relocation of piping, ductwork, and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other contractors.

1.8 INSTALLATION OF EQUIPMENT

- A. All appliances, materials and equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. All auxiliary piping, special controls, water seals, valves, electrical connections, drains, etc., recommended by the manufacturer, required for proper operation, or required by code shall be furnished and installed complete.
- B. All equipment designed and constructed for indoor use shall not be shipped to the site until such time that the equipment is ready for permanent installation in a dry building or may be stored on site provided equipment is stored in a water and moisture tight storage building or job trailer. Covering equipment outdoors with plastic or tarp is not acceptable.

1.9 CUTTING AND PATCHING

- A. No cutting and patching of new finished work will be permitted without the approval of the Architect, and such work shall be done only under his direction. Coordinate all openings with Architectural specifications.
- B. All work improperly done or not done at all, as required in preceding article "Openings and Escutcheons", will be performed as directed by the Architect/Engineer and at the expense of the Contractor whose work is affected.

1.10 SERVICE AND GUARANTEE

- A. Contractor shall be responsible for guaranteeing all work, including equipment, materials and workmanship furnished under this section of the Specifications.
- B. The warranty created by Article 3.5 of the General Conditions remains enforceable throughout the period of the Kentucky statute of limitations. The Warranty is different from the one-year correction period defined in General Conditions Article 12.2.2. except for items of equipment requiring explicit extended warranties, refer the Bidder/Contractor to General Conditions Articles 3.5 and 12.2.2 for warranty and correction of work.
- C. Any defective work, equipment, materials and/or workmanship that develops within the guarantee period, which is not caused by ordinary wear, damage or abuse by others, shall be replaced and/or corrected without additional cost to the Owner.
- D. Make a minimum of two (2) service calls during guarantee period, free of charge, to check with Owner and to check and repair malfunctioning equipment which was installed. Service calls shall be in middle and end of guarantee period and as required to maintain systems operation. Dates shall be listed in operating and maintenance manuals, along with contractor's name and phone number.

1.11 CLEANING

- A. After the Architect/Engineer has complete examination, this Contractor shall remove all stickers, tags, etc., and shall thoroughly clean all equipment, fixtures, and materials installed under his section of the work.

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- B. Surplus material, rubbish and equipment resulting from the work shall be removed from the building and premises by the Contractor upon completion of the work in accordance with the General Conditions.
- C. All equipment shall be thoroughly cleaned to "Factory New" condition prior to turning over to owner. Touch up or completely repaint equipment as required.

1.12 EXAMINATION OF SITE

- A. Bidders shall visit the site before submitting proposals to satisfy themselves as to the nature and scope of the work and any difficulties attending to the execution.
- B. The submission of a proposal will be construed as evidence that such an examination has been made. Later claims for labor, equipment, materials, etc., required for difficulties encountered which could have been foreseen had such an examination been made, will not be recognized.

1.13 WORK AND EQUIPMENT UNDER OTHER DIVISIONS

- A. The Contractor under Division 26 will provide all power wiring and conduit and install and connect each item of electrical equipment furnished under this Division unless specified otherwise. He will also provide starting equipment for motors not specified to have starting equipment furnished under this Division.
- B. The Contractor under other Divisions will provide the following:
 - 1. Electrical work as noted in Paragraph (A) above.

1.14 WIRING DIAGRAMS

- A. Local control/side refers to any and all power and control wiring between local control panels and equipment and/or any control or power wiring between different pieces of equipment that is not explicitly or individually controlled by the building management system.
- B. The Contractor under this Division shall submit complete wiring diagrams to the Architect/Engineer for approval. Wiring diagrams shall show all electrical connections for air conditioning units, starters, switches, motors, controls, etc.
- C. Standard wiring diagrams of manufacturer's equipment will not be acceptable for this project unless they are altered to agree with the project requirements. Wiring diagrams shall include all interlocks with other equipment, whether furnished by the manufacturer or not.
- D. After review by the Architect/Engineer, a copy of the wiring diagrams shall be given to the Contractor under Division 26.
- E. Unless specified otherwise, power supply wiring to power connections on equipment will be provided by the Contractor under Division 26. The Contractors under Division 22 shall be responsible for all local control wiring and the correct sequence of operation of all plumbing equipment after all wiring has been completed. Control wiring shall include wire, conduit and miscellaneous materials required for connecting control devices on the local side unless specified otherwise under Division 27. The Control Contractor shall provide power wiring and connections to control equipment if this required power wiring is not shown on the Electrical Drawings and Specifications. The Control Contractor under Division 27 shall provide control wiring, conduit, and miscellaneous materials

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required to connect local control points to the building management system. Refer to Division 26 and Division 27.

1.15 UNDERGROUND UTILITIES TRACE TAPE

- A. Install in open trench approximately 14" above pipe, (but no more than 24" below finished grade), 4" wide trace tape to indicate location of water lines, sanitary lines and oxygen lines. Tape shall be manufactured to be traceable with pipe detector above finish grade. Tape shall be bright yellow in color and stamped with the word "WATER", "SANITARY" or "OXYGEN" at regular intervals. The tape shall be Terr Tape as manufactured by Griffolyn Co.; C. I. Thornburg, Seton Co., Bradey Co. or Craftmark.

1.16 OPERATIONAL INSTRUCTIONS

- A. Furnish services of a fully competent operational instructor for a total of two (2) one day sessions days, unless otherwise specified, as directed by Architect/Engineer to instruct operating personnel in operations and care of all equipment and systems (including control systems) and their various components.

1.17 CATALOG DATA FOR THE OWNER (MAINTENANCE, OPERATION AND INSTRUCTION MANUALS)

- A. The contractor under this Division shall prepare three (3) loose leaf, plastic bound 3 ring binders labeled on front cover, title page and binder edge "Job Title" (as indicated on the contract document) " Fire Protection and Plumbing Operations and Maintenance Data." Each manual shall be subdivided with section tabs and shall contain a title page and index. The title page shall contain the following information:
 - 1. Job Title
 - 2. Plumbing Operation and Maintenance Manual
 - 3. All Contractor Names, Address, Phone # and Contact Person
 - 4. Architect and Engineer's Name, Address and Phone #
- B. Each manual shall contain the following information:
 - 1. Name and address of Consulting Engineer, Contractor, and index of equipment, including vendor (name and address).
 - 2. Complete brochures, descriptive data, etc., on each piece of equipment, including all approved shop drawings. (The contractor must retain three (3) sets of approved shop drawings for this purpose).
 - 3. Complete maintenance and operating instructions and parts list, prepared by the manufacturer, on each major piece of equipment. This includes blow-out views with labeled parts list.
 - 4. All wiring diagrams for equipment and systems and control schematics. See paragraph on wiring diagrams listed herein before.
- C. Manuals shall be submitted to the Architect prior to final inspection of the buildings.

1.18 ACCEPTANCE OF MATERIAL AND MANUFACTURERS

- A. The Architect/Engineer reserves the right to determine if the contractor's proposed materials and equipment of any one manufacturer is acceptable in lieu of the specified material or equipment.

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- B. Where materials and equipment are listed on Drawings and specifications as acceptable or equivalent, this does not relieve the contractor and/or manufacturer from providing and proving to Architect/Engineer that their materials and equipment are equivalent to items the Architect/Engineer used as a guide specification.
- C. The contractor and manufacturer must confirm to the Architect/Engineer that their equipment and materials will meet the space requirements of the project and that the equipment is easily accessible for maintenance and operation.

1.19 CLOSEOUT DOCUMENTS

- A. Prior to this project to be considered as "Substantially Complete" the following documents must be presented and approved.
 - 1. Evidence that all guarantees and warranties have been submitted on behalf of the owner.

END OF SECTION 220100

SECTION 220200 – PIPE TRENCHING AND BACKFILLING

1.1 GENERAL

- A. The General Conditions, Special Conditions, Site Work and other Contract Documents shall apply to this Division of the work as well as to all other Divisions.
- B. The Contractor under this Division shall do all excavation, backfilling, and grading required for this part of the work. Excavation shall include all earth, rock and other materials necessary for the installation of the new work. No sub surface data available except as noted in Division 31 of the Specifications. All trenching work is unclassified except as noted in Division 31.
- C. See Site Utility Plans for utility work.
- D. Lay in all pipe in open trenches. Open the trench sufficiently ahead of pipe laying to reveal obstruction.
- E. Provide trench crossings as necessary to accommodate public travel.
- F. See the following Articles for special requirements for Plumbing work.
- G. No blasting will be allowed on this project unless approved by Architect.
- H. Contractors must use extreme care in all excavation work and protect all existing utilities.
 - 1. Contractors must comply with local utility companies requirements if more stringent than listed herein.
 - 2. Beware of existing underground fiber optic conduit and other utilities.

1.2 EXCAVATION

- A. Separate Trenches
 - 1. Unless otherwise shown or required, provide separate trenches for all services (sewers, water lines, etc.) with a minimum of three feet (3') of undisturbed earth between trenches. (All utilities installation must be coordinated with local utility companies and comply with their requirements; this includes materials and installation procedures).
- B. Width of Trench
 - 1. Excavate trenches of sufficient width for proper installation of work. When depth of backfill over sewer pipe exceeds ten feet (10') keep the trench at the level of the top of pipe as narrow as practicable.
- C. Shoring and Bracing
 - 1. Shore and brace trench as necessary to protect workmen and adjacent structures. Comply with local regulations or in the absence thereof, with the "Manual of Accident Prevention in Construction", of the associated General Contractors of America, Inc. Do not remove shoring until trench is backfilled sufficiently to protect pipe and prevent injurious caving.
- D. Water Removal
 - 1. Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell

hole to permit proper jointing of pipes. Conduct the discharge from trench dewatering to drains or natural drainage channels.

E. Disposition of Utilities

1. Local and state rules and regulations governing the utilities in this area shall be observed in executing all work under this heading. Active utilities shall be protected or relocated in accordance with instructions of the Architect, Owner, and Local Utility. Inactive and abandoned utilities encountered in trenching operations shall be removed, plugged or capped. In absence of specified requirements, plug or cap such utility lines at least three feet (3') from utility line to be installed or as required by the local regulations. Extreme care must be taken in all excavation work, since active utility lines are present throughout the area. Repair all damaged utility lines in strict accordance with the respective utility company's requirements. Coordinate with all local utility companies and the Owner prior to any excavation work.

F. Grading Trench Bottom

1. Grade the bottom of trenches evenly to insure proper slope for drainage. Perform final grading of trench bottom by hand and carry machine excavation only to such depths that soil bearing for pipes will not be disturbed. For piping to be laid on a grillage, excavate trenches to at least four inches (4") below the required bottom levels and refill to the proper grade with grillage specified hereinafter under Backfilling.

1.3 BACKFILLING

- A. The utility piping systems shall be laid on a grillage of at least 6" of No. 9 crushed stone. After the systems have been installed and tested, install at least 12" of No. 9 crushed stone over piping and firmly compacted using mechanical tamper or backhoe bucket.
- B. Backfill trenches only after piping has been inspected and locations of pipe lines and appurtenances have been recorded. (See Section 220100 for requirements of underground utilities trace tape).
- C. For grassy areas, backfill a depth of at least 12 inches above the top of the compacted crushed stone noted above with No. 9 crushed stone (free from stones, rock fragments, roots, sod, cinders, junk, refuse, scrap iron, and unused portions of welding rods). Tamp this backfill thoroughly (using mechanical tamper or backhoe bucket) in layers not exceeding 12" in thickness, taking care not to disturb the pipe or injure the pipe coating. Backfill remaining 8" to grade with earth.
- D. For paved areas, backfill to grade with dense grade aggregate compacted using a mechanical tamper or backhoe bucket in 6" lifts.
- E. Backfill under all sidewalks, concrete slabs, and pavements shall be 100% #9 crushed stone or dense grade aggregate to underside of slab or pavement. Compact solidly with mechanical tamper in layers not more than six (6) inches.

1.4 GRADING

- A. For offsite trenching or trenching beyond the normal construction limits, backfill shall be brought to existing grades.
- B. Excess earth and other excavated material shall be removed from the property, unless otherwise directed by Owner.

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1.5 RESTORATION OF SURFACES

- A. The Contractor under this Division shall restore to their original conditions all sod, paving, curbing, surfaces, drainage ditches and structures, fences, curbs, and other items damaged or removed by his operations, which are not covered under other sections of the specifications to be replaced or repaired. Replacement and repairs shall be in accordance with good construction practice and shall match material employed in the original construction of the item to be replaced.

END OF SECTION 220200

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SECTION 220500 – SANITARY SEWAGE DISTRIBUTION SYSTEM

1.1 GENERAL

- A. The General Conditions, Special Conditions, and the applicable portions of Division 1 of the Specifications are a part of this Section.

1.2 SCOPE

- A. This work includes the furnishing of all labor, materials, equipment, etc., necessary for the proper and complete sanitary sewage distribution system as shown on the Drawings and/or as herein specified in strict accordance with the Kentucky State Plumbing Code and the local utility company.
- B. Coordinate with site utility Drawings. See details on drawings.

1.3 EXTERIOR SANITARY SEWER MATERIAL

- A. Piping as a minimum shall be PVC meeting the requirements of ATM-D-3034-SDR-35 except piping under paved driveways shall be cast iron. Pipe and fittings shall have factory installed lock-in rubber rings.
- B. Provide proper fittings for the installation and connection of all lines. In general, provide a Y branch and a 1/8 curve for each branch connection. Provide exterior cleanouts as required and as noted on drawings.
- C. Provide marker tape as noted in Section 220100.

END OF SECTION 220500

SECTION 220700 – GRINDER PUMP SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following miscellaneous plumbing equipment:

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Provide Shop Drawings for each of the following plumbing miscellaneous items.
 - a. Grinder pumps
 - 2. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment 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 plumbing specialty products:
- B. Operation and Maintenance Data:
- C. Warranty: Special warranty specified in this Section.

PART 2 - PRODUCTS

2.1 GRINDER PUMPS: GP-1,2

- A. GP-1,2: Zoeller model #6840
 - 1. Two (2) Zoeller Model 7111REV; 208 volt three phase grinder pumps with automatic reversing cutter action, 2.5" flanged horizontal discharge, 5.0 hp oil filled motor (20.7 FLA), bronze vortex impeller, stainless steel cutter and plate, stainless steel shaft with tandem mechanical seals including moisture probes, thermal protection with sensors, powder coated epoxy cast iron housing, 25 foot power and sensor cords; Pump weight 245 lbs. Design point: 70 GPM at 30.5' TDH. Assumes 800 ft. of 3" PVC discharge piping with a 22 ft. elevation rise (from bottom of basin).
 - 2. Two (2) 3" NPT cast iron check valves, and two (2) 3" NPT cast iron plug valves – factory installed.
 - 3. Two (2) 2.5" flanged horizontal inlet x 3" flanged vertical outlet guide rail assemblies consisting of base elbows, removable flanges, upper support brackets and 2" stainless steel guide rails – all factory assembled.
 - 4. One (1) UL Listed 208 volt three phase duplex control panel with an electro-mechanical pump alternator, automatic reversing circuitry, H-O-A toggle switches and run indicator lights for each pump, motor protector each pump, high water alarm with light, horn and silence switch, control circuit transformer and breaker, dry alarm contacts, seal fail and thermal cutoff indicator lights; all housed in a Nema 4X enclosure.

5. Three (3) 25" weighted normally open mercury float switches and stainless steel float bracket.
6. One (1) 48" x 120" prefabricated fiberglass basin (wet well) including steel anti-flotation flange. Field calculate basin depth based on existing sanitary sewer elevations prior to ordering basin, one (1) 48" x 48" attached, prefabricated fiberglass valve box, one (1) 1/4" aluminum cover with bolt down, gas tight access hatches for each compartment, one (1) 4" vent grommet shipped loose for field installation through side of basin; one (1) 3" discharge connection; one (1) 2" NPT electrical connection and Nema 4X junction box; one (1) 4" grommet shipped loose for field installation of inlet.
7. Field cut sanitary and vent connections
8. Startup by factory representative.
9. Supplied as complete package.

PART 3 - EXECUTION

3.1 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturers written instructions.
- B. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
 1. Size same as drainage piping up to 4-inch NPS (DN100). Use 4-inch NPS (DN100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction.
- C. Install cleanouts in concrete pads flush with finish grade.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise the field assembly of components and installation of grease recovery units, including piping and electrical connections, and to report results in writing.
 1. Test and adjust plumbing specialty controls and safeties. Replace damaged and malfunctioning controls and components.

3.3 COMMISSIONING

- A. Before startup, perform the following checks:
 1. System tests are complete.
 2. Damaged and defective specialties and accessories have been replaced or repaired.
- B. Startup Procedures: Follow manufacturer's written instructions. If no procedures are prescribed by manufacturer, proceed as follows:

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1. Energize circuits for electrically operated units. Start and run units through complete sequence of operations.
 - C. Adjust operation and correct deficiencies discovered during commissioning.
- 3.4 PROTECTION
- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 220700

ELECTRICAL INDEX

SECTION NUMBER
DIVISION 26 – ELECTRICAL

260500	GENERAL REQUIREMENTS
260519	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS

SECTION 260500 – GENERAL REQUIREMENTS

1.1 GENERAL REQUIREMENTS

- A. All drawings and general provisions of the contract, including the General and Supplementary Conditions and Division 01 Specifications apply to all specifications in Divisions 26, 27 and 28. In addition, the general requirements described within this specification section, 260500 General Requirements, apply to all specifications in Division 26, 27, 28 and the Contract Drawings.
- B. The drawings and specifications constitute the Contract Documents. They complement each other. All items shown on the drawings and/or listed in the specifications shall be provided and installed by the Contractor unless specifically noted that it will be provided and/or installed by others. In the event there is a conflict within the Contract Documents, the Contractor shall notify the Engineer immediately. If a clarification is not given, the Contractor shall bid the more stringent of the two requirements.
- C. Any materials, labor, equipment or services not specifically mentioned herein which may be necessary to complete any part of the electrical systems described in the drawings and/or specifications shall be included as part of the Contract.
- D. References in the Contract Documents to any specific manufacturer and/or catalog numbers are intended to establish a standard of quality and not to limit competition. Proposed equivalent manufacturers shall be provided to the Engineer a minimum of 14 days prior to bid.
- E. All work performed in the Contract shall comply with all relevant codes adopted by the state and locality in which the project is located.
- F. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. The drawings are diagrammatic only. It is the responsibility of this Contractor to coordinate the installation of the specified components with all other trades to accomplish the following:
 - 1. Allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. Provide for ease of disconnecting the equipment with minimum interference with other installations.
 - 3. Allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays and busways will be clear of obstructions and of the working and access space of other equipment.
- H. All work shall be installed in a neat and workman like manner complying with standards in NECA1, Standard for Good Workmanship in Electrical Construction.

1.2 WARRANTY

- A. At a minimum the Contractor shall warranty all defects in material and labor for one year starting from the date of substantial completion. In the event of a multi-phased renovation, the warranties shall start on the date of substantial completion of the final

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phase. Additional warranties may be required and will be described within the associated specification section.

1.3 SHOP DRAWINGS

- A. The Contractor shall provide the Engineer with any and all product cutsheets, dimensioned drawings, wiring diagrams or any other documentation which may be required to describe the material to be provided as part of this Contract.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Provide product information for all electrical components to be included in the operation and maintenance manuals. The information shall include at a minimum cutsheets for all equipment, requirements for routine maintenance and instructions for testing and adjusting equipment.

1.5 SMOKE AND FIREPROOFING

- A. The Contractor shall provide fire and/or smoke stopping around/in any components which penetrate rated assemblies as required to maintain the rating of that assembly.
- B. Refer to the related specifications under Division 07 for additional information.

1.6 DEMOLITION

- A. All existing materials that will not be reused must be removed unless noted otherwise. All conduits shall be removed unless located in walls or slabs which do not get demolished. All conductors shall be removed.
- B. All removed materials MUST be disposed of in a lawful manner. The contractor shall familiarize themselves with all local requirements.
- C. The contractor shall keep all existing building systems functioning during construction.
- D. The contractor is responsible for patching and repairing all areas where walls, slabs and materials have been cut, removed or modified as a result of demolition. Match existing materials, ratings and finishes. This includes, but not limited to, patching holes in walls with like materials where switches, receptacles and other devices have been removed.

1.7 TRENCHING AND BACKFILLING

- A. All conduits located beyond the building perimeter must be buried a minimum of 30 inches below grade to the top of the conduit with the exception of conduits used for underground primary. Underground conduits used for primary electrical service shall be buried a minimum of 42 inches below grade unless otherwise noted.
- B. Excavate utility trenches a minimum of 6 inches below the bottom of conduit and 6 inches on each side of the outer most conduit. When multiple conduits are installed within a common trench, 3 inches shall be maintained between the edges of all conduits. Install conduit spacers as required to maintain clearances between conduits.
- C. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduits. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
- D. Place backfill on subgrades free of mud, frost, snow or ice. Install backfill as specified under Division 02.

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- E. Provide detectable warning tape above buried pipes and conduits. The warning tape shall be installed 12 inches below the top of grade except where located under pavements and slabs, and then it shall be buried 6 inches below subgrade. Install tape per manufacturers instructions.
- F. Refer to the specifications under Division 02 for additional trenching and backfilling requirements.

END OF SECTION 260500

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each conductor type.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Acceptable Manufacturers:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and SO.

2.2 CONNECTORS AND SPLICES

- A. Acceptable Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Conductors: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

- A. All locations unless otherwise noted: Conductors shall have THHN-THWN insulation and installed in raceway.

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- B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. 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. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment:

1.2 SUBMITTALS

- A. Product Data: For the grounding bus.

1.3 QUALITY ASSURANCE

- A. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor:
 - 1. No. 4 AWG minimum, soft-drawn copper.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

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2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch diameter by 10 feet length.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- C. Signal and Communication Equipment: For telephone, fire alarm, voice and data, security and other communication/low voltage equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-16-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

- D. Signal and communications pathways: Pathways include cable tray, conduits and sleeves. Any path that signal or communications cabling is routed.
 - 1. Install metal conduit sleeves entering the communication rooms with grounding bushings and connect with grounding conductor to grounding system.
 - 2. Ground cable trays according to manufacturer's written instructions.
 - 3. Conduit stub-ups and stub-outs do not need to be grounded.
 - 4. Test the pathway to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with the maximum grounding resistance. Adhere to the recommendations of the ANSI/TIA 607B standards. Install in accordance with best industry standards.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in EMT conduit, from building's main service equipment, or grounding bus, to main

metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.4 FIELD QUALITY CONTROL

- A. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- B. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- C. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
1. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 2. Perform tests by fall-of-potential method according to IEEE 81.
- D. Ground resistances shall not exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

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4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- E. If resistance to ground exceeds specified values, take appropriate measures to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Acceptable Manufacturers:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

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- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Acceptable Manufacturers:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Acceptable Manufacturers:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

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- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

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1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
- B. Rigid Galvanized Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel or aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel type.
- H. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.

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- 11. RACO; a Hubbell Company.
- 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- D. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum riser general-use installation as required by the environment.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

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- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Hubbell Incorporated; Wiring Device-Kellems Division.
 - c. Panduit Corp.
 - d. Walker Systems, Inc.; Wiremold Company (The).
 - e. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Hoffman.
 - 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 5. RACO; a Hubbell Company.
 - 6. Robroy Industries, Inc.; Enclosure Division.
 - 7. Thomas & Betts Corporation.
 - 8. Walker Systems, Inc.; Wiremold Company (The).
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron] with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- J. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

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2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
1. Color of Frame and Cover: Green.
 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC" or "TELEPHONE." as applicable each service.
 6. Retain first subparagraph below if conduit will enter enclosure through the side. Otherwise, entry will be made through an open bottom or through side openings cut in the field, as specified in Part 3. Coordinate with Drawings.
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
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:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

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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:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of fiberglass.
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:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid Galvanized Steel Conduit (RSC)
 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment):LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: RSC. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - 4. Above Ceilings: EMT.
 - 5. Concealed within concrete block and concrete walls: RNC. RNC shall transition to EMT above ceiling and all boxes shall be steel. No non-metallic boxes shall be permitted.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 7. Damp or Wet Locations: Rigid Steel Conduit.
 - 8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 - 9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 - 10. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 - 11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

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- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. Surface Raceways: Coordinate installation with architectural drawings including windows, furniture, etc.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to rigid steel conduit or EMT, as applicable, before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet .
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

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1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in architectural and/or civil engineering specifications for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in architectural and/or civil engineering specifications."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in architectural and/or civil engineering specifications."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

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- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

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- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 FLOOR MARKING TAPE

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- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

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2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.

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3. UPS.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - i) Phase A: Black.
 - ii) Phase B: Red.
 - iii) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - i) Phase A: Brown.
 - ii) Phase B: Orange.
 - iii) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- E. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-

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high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Switchboards.
- f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- g. Emergency system boxes and enclosures.
- h. Motor-control centers.
- i. Enclosed switches.
- j. Enclosed circuit breakers.
- k. Enclosed controllers.
- l. Variable-speed controllers.
- m. Push-button stations.
- n. Power transfer equipment.
- o. Contactors.
- p. Remote-controlled switches, dimmer modules, and control devices.
- q. Battery-inverter units.
- r. Battery racks.
- s. Power-generating units.
- t. Monitoring and control equipment.
- u. UPS equipment.

END OF SECTION 260553

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Molded-case circuit breakers (MCCBs).
 - 3. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Manufacturer's field service report.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

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2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Architect's and Owner's written permission.
 4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

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3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 230 or 600V ac as indicated, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
 5. Service-Rated Switches: Labeled for use as service equipment.

2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- F. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- G. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

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3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel .
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 3R.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816