

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Type EMT-S raceways and elbows.
2. Type LFMC raceways.
3. Type PVC raceways and fittings.
4. Fittings for conduit, tubing, and cable.
5. Threaded metal joint compound.
6. Solvent cements.
7. Surface metal raceways and fittings.
8. Metallic outlet boxes, device boxes, rings, and covers.
9. Cabinets, cutout boxes, junction boxes, and pull boxes.
10. Cover plates for device boxes.
11. Hoods for outlet boxes.

PART 2 - PRODUCTS**2.1 TYPE EMT-S RACEWAYS AND ELBOWS****A. Performance Criteria:**

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
2. Material: Steel.
3. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc.
 - c. Minimum Trade Size: 1/2".
 - d. Colors: As indicated on Drawings.

2.2 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
2. Material: Steel.
3. Options:
 - a. Minimum Trade Size: 1/2".
 - b. Colors: As indicated on Drawings.

2.3 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Panduit Corporation.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Enduro Systems, Inc.; Composite Products Division.
 - e. Butler Manufacturing Company; Walker Division.
 - f. Wiremold Company (The); Electrical Sales Division.
 - g. Walker Systems, Inc; Wiremold Company (The).
2. Dimensional Specifications: Schedule 40.
3. Options:
 - a. Minimum Trade Size: 1/2".
 - b. Markings: For use with maximum 90 deg C wire.

C. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

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

- a. Panduit Corporation.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Enduro Systems, Inc.; Composite Products Division.
 - e. Butler Manufacturing Company; Walker Division.
 - f. Wiremold Company (The); Electrical Sales Division.
 - g. Walker Systems, Inc; Wiremold Company (The).
- 2. Dimensional Specifications: Schedule 80.
 - 3. Options:
 - a. Minimum Trade Size: 1/2".
 - b. Markings: For use with maximum 90 deg C wire.

D. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Panduit Corporation.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Enduro Systems, Inc.; Composite Products Division.
 - e. Butler Manufacturing Company; Walker Division.
 - f. Wiremold Company (The); Electrical Sales Division.
 - g. Walker Systems, Inc; Wiremold Company (The).
- 2. Dimensional Specifications: Type EB.
- 3. Options:
 - a. Minimum Trade Size: 2".

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type EMT Raceways:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Wiremold Company (The); Electrical Sales Division.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Thomas & Betts Corporation.
- 2. General Characteristics: UL 514B and UL Category Control Number FKAV.
- 3. Options:
 - a. Material: Steel.
 - b. Coupling Method: Setscrew coupling for conduits 2" and larger. Setscrew couplings with only single screw per conduit are unacceptable.

- c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type FMC Raceways:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Wiremold Company (The); Electrical Sales Division.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Thomas & Betts Corporation.
- 2. General Characteristics: UL 514B and UL Category Control Number ILNR.

D. Fittings for Type LFMC Raceways:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Wiremold Company (The); Electrical Sales Division.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Thomas & Betts Corporation.
- 2. General Characteristics: UL 514B and UL Category Control Number DXAS.

2.5 SURFACE METAL RACEWAYS AND FITTINGS

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. General Characteristics: UL 5 and UL Category Control Number RJBT.

B. Surface Metal Raceways and Fittings with Metal Covers:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Wiremold Company (The); Electrical Sales Division.
 - b. Walker Systems, Inc; Wiremold Company (The).
 - c. Thomas & Betts Corporation.
- 2. Options:
 - a. Galvanized steel base with snap-on covers.
 - b. Manufacturer's standard enamel finish in color selected by Architect.
 - c. Wiring Channels: Per detail on drawings.

2.6 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Pass & Seymour; Legrand North America, LLC.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Wiremold; Legrand North America, LLC.
3. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: Minimum 2 inch.
 - c. Cast-Metal Depth: Minimum 2.4 inch.
 - d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
 - e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - b. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - d. Pass & Seymour; Legrand North America, LLC.
 - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
3. Options:
- a. Material: Sheet steel.
 - b. Sheet Metal Depth: minimum 2 inch.
 - c. Cast-Metal Depth: minimum 2.4 inch.

E. Metallic Floor Boxes and Floor Box Covers:

- 1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. FSR Inc.
 - b. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - d. Leviton Manufacturing Co., Inc.
 - e. Pass & Seymour; Legrand North America, LLC.
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Wiremold; Legrand North America, LLC.

2.7 CABINETS, CUTOOT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. General Characteristics:
 - a. Non-Environmental Characteristics: UL 50.
 - b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Junction and Pull Boxes:

- 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. FSR Inc.
 - c. Hoffman; brand of nVent Electrical plc.
 - d. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Milbank Manufacturing Co.
 - g. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - h. Square D; Schneider Electric USA.
- 3. Additional Characteristics: UL Category Control Number BGUZ.
- 4. Options:

- a. Degree of Protection: Type 1.
- C. Indoor Cast-Metal Junction and Pull Boxes:
 - 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adalet.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - 3. Additional Characteristics: UL Category Control Number BGUZ.
 - 4. Options:
 - a. Degree of Protection: Type 1.

2.8 COVER PLATES FOR DEVICES BOXES

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics:
 - a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.
- B. Metallic Cover Plates for Device Boxes:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Intermatic, Inc.
 - g. Leviton Manufacturing Co., Inc.
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - i. Panduit Corp.
 - j. Pass & Seymour; Legrand North America, LLC.
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - l. Wiremold; Legrand North America, LLC.
 - 2. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Wallplate Material: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.
- C. Nonmetallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Leviton Manufacturing Co., Inc.
 - g. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - h. Panduit Corp.
 - i. Pass & Seymour; Legrand North America, LLC.
 - j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - k. Wiremold; Legrand North America, LLC.
2. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish.
 - c. Color: Selected by Architect.

2.9 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. Reference Standards:
 - 1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
3. Mounts to box using fasteners different from wiring device.

B. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - c. Leviton Manufacturing Co., Inc.
 - d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:
 - a. Provides clear, weatherproof, "while-in-use" cover.
 - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION**3.1 SELECTION OF RACEWAYS**

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 - 1. Exposed and Subject to Physical Damage: ERM. C.
 - 2. Exposed and Not Subject to Physical Damage: ERM. C and PVC-80.
 - 3. Concealed Aboveground: ERM. C.
 - 4. Direct Buried: PVC-80.
 - 5. Concrete Encased in Trench: PVC-EB.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFM. C.
- C. Indoors:
 - 1. Exposed and Subject to Severe Physical Damage: ERM. C. Subject to severe physical damage includes the following locations:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - e. Shop Spaces.
 - 2. Exposed and Subject to Physical Damage: ERM. C. Subject to physical damage includes the following locations:
 - a. Locations less than 2.5 m above finished floor.
 - b. Stub-ups to above suspended ceilings.
 - 3. Exposed and Not Subject to Physical Damage: EMT.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Damp or Wet Locations: ERM C.
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.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM C and IMC: Provide threaded type fittings unless otherwise indicated.
2. EMT: Set screw.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
 - a. Type 3R unless otherwise indicated.
2. Indoors:
 - a. Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 2.5 m Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
6. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.
7. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
4. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
5. Support conduit within 12 inch of enclosures to which attached.
6. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
7. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
8. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
9. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
10. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
11. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERM and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Types FMC and LFMC:
 - a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
3. Type PVC:
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.

- b. Comply with manufacturer's written instructions for solvent welding and fittings.
- D. Stub-ups to Above Recessed Ceilings:
 - 1. Provide EMT, IMC, or ERM for raceways.
 - 2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. EMT: Provide steel, setscrew for conduits 2" and larger, otherwise compression fittings. Comply with NEMA FB 2.10.
 - 2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- F. Expansion-Joint Fittings:
 - 1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.
- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- C. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.7 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY****A. Section includes:**

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

1.2 PERFORMANCE REQUIREMENTS**A. Seismic-Restraint Loading:**

1. Building Occupancy Category as Defined in ASCE 7: III.
2. Site Class as Defined in IBC: D.
3. Seismic Design Category as Defined in IBC: D.
4. Design Spectral Response Acceleration at Short Periods (0.2 Second): 41.7%.
5. Design Spectral Response Acceleration at 1-Second Period: 24.0%.

1.3 SUBMITTALS**A. Product Data: For the following:**

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. The professional engineer must be licensed/registered for the state that the project is located.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

- a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
- 3. Field-fabricated supports.
- 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Qualification Data: For professional engineer. The professional engineer must be licensed/registered for the state that the project is located.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the 2007 Kentucky Building Code and ASCE Standard 7, unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. The professional engineer must be licensed/registered for the state that the project is located.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.

2. Kinetics Noise Control.
3. Mason Industries.
4. Approved equal.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

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

1. Amber/Booth Company, Inc.
2. Cooper B-Line, Inc.; a division of Cooper Industries.
3. Hilti Inc.
4. Mason Industries.
5. Unistrut; Tyco International, Ltd.
6. Approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 3. Test to 90 percent of rated proof load of device.
 4. Measure isolator restraint clearance.
 5. Measure isolator deflection.
 6. Verify snubber minimum clearances.
 7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

EQUIPMENT/SYSTEM TYPE	ISOLATOR TYPE	BASE TYPE	COMPONENT IMPORTANCE FACTOR (I_p)	COMPONENT AMPLIFICATION FACTOR	COMPONENT RESPONSE MODIFICATION FACTOR	SEISMIC RESTRAINT SYSTEM REQUIRED (Y/N)
Switchgear and Panelboards	NR	NA	1.0	2.5	6.0	Y. See Exemptions
Communication Equipment	NR	NA	1.0	1.0	2.5	Y. See Exemptions
Lighting Fixtures	NR	NA	1.0	1.0	1.5	Y. See Exemptions
Life-Safety Distribution Systems	NR	NA	1.5	1.0	2.5	Y
Conduit and Bus Ducts	NR	NA	1.0	1.0	2.5	Y. See Exemptions
Suspended Cable Trays	NR	NA	1.0	2.5	6.0	Y. See Exemptions
Other Electrical Components	NR	NA	1.0	1.0	1.5	Y. See Exemptions

LEGEND:

- NA = Not Applicable
- NR = Not Required
- Y = Yes
- N = No

A. Electrical Seismic-Restraint Exemptions:

1. Electrical components in Seismic Design Category B.
2. Electrical components in Seismic Design Category C provided that $I_p = 1.0$.
3. Electrical components in Seismic Design Categories D, E, and F where $I_p = 1.0$ and either:

- a. Flexible connections between the components and associated conduit are provided.
 - b. Components are mounted at 4 ft or less above a floor level and weigh 400 lb or less.
4. Electrical components in Seismic Design Categories D, E, and F where $I_p = 1.0$ and:
- a. Flexible connections between the components and associated conduit are provided.
 - b. The components weigh 20 lb or less or, for distribution systems, weighing 5 lb/ft or less.
5. Electrical conduit in any Seismic Design Category where $I_p = 1.5$ and:
- a. Conduit is 2 ½ inch trade size or less.
6. Electrical trapeze assemblies (supporting conduit, bus duct, or cable tray) in any Seismic Design Category where $I_p = 1.5$ and:
- a. Total weight of trapeze assembly weighs 10 lb/ft or less.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Labels.
 - 2. Tapes and stencils.
 - 3. Signs.
 - 4. Miscellaneous identification products.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
 - 1. Safety Colors: NEMA Z535.1.
 - 2. Facility Safety Signs: NEMA Z535.2.
 - 3. Safety Symbols: NEMA Z535.3.
 - 4. Product Safety Signs and Labels: NEMA Z535.4.
 - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field.
 2. Legend: Indicate voltage.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color must be factory applied.
 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Color for Neutral: White.
 4. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
1. Identify system voltage with black letters on orange background.
- D. Warning labels and signs must include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- E. Equipment Identification Labels:
1. Black letters on white field.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. Disconnect switches.
 - e. Enclosed circuit breakers.
 - f. Motor starters.
 - g. Push-button stations.
 - h. Contactors.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch for raceway and conductors.
 - b. 3-1/2 by 5 inch for equipment.
 - c. Minimum letter height shall be 3/8".
 - d. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
 1. Tape:
 - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.
 - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 2. Color and Printing:
 - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - c. Inscriptions for Orange Tapes: "CAUTION BURIED CATV LINE BELOW", "CAUTION BURIED TELEPHONE LINE BELOW", "CAUTION BURIED FIBER OPTIC LINE BELOW", "CAUTION BURIED COMMUNICATION LINE BELOW".
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.5 SIGNS

- A. Baked-Enamel 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 inch.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inch.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Indoor Equipment: Self-adhesive.
 - e. Outdoor Equipment: Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting
 - f. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
 - g. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- I. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- J. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- K. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- L. Self-Adhesive Labels:
 - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.
- M. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

S. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.

T. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

U. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels, self-adhesive wraparound labels, or self-adhesive vinyl tape to identify phase.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.
- F. Conductors to Be Extended in Future: Attach write-on tags, marker tape to conductors, and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels, Baked-enamel warning signs, or Metal-backed, butyrate warning signs.
 1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- K. Arc Flash Warning Labeling: Self-adhesive labels.
- L. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs, or Laminated acrylic or melamine plastic signs.
- M. Equipment Identification Labels:
 1. Indoor Equipment: Self-adhesive label, Baked-enamel signs, Metal-backed butyrate signs, Laminated acrylic, or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Outdoor photoelectric switches, solid state, flexible mounting.
2. Indoor occupancy and vacancy sensors.
3. Lighting contactors.
4. Conductors and cables.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.**1.3 WARRANTY****A. Special Extended Warranty:** Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
2. Extended Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Novitas, Inc.
 6. Paragon Electric Co.; Invensys Climate Controls.
 7. Ripley
 8. Square D; Schneider Electric.
 9. TORK.
 10. Touch-Plate, Inc.
 11. Watt Stopper.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Fifteen-second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 6. Failure Mode: Luminaire stays ON.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. Novitas, Inc.
 5. RAB Lighting.
 6. Sensor Switch, Inc.
 7. TORK.
 8. WattStopper; Legrand North America, LLC.
- B. General Requirements for Sensors:
1. Wall or ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Integrated or Separate power pack.
 4. Hardwired connection to switch with auxiliary dry contacts to interface BAS.

5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack/relay unit.
 8. Power: Line voltage.
 9. Power Pack: Dry contacts rated for 20 A ballast or LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
 10. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
 - b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.
 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Wall and Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. when mounted 48 inch above finished floor.
 5. Auxiliary dry contacts to interface BAS.

2.3 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies.
 3. Eaton.
 4. GE Industrial Systems; Total Lighting Control.

5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 6. Hubbell Lighting.
 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 8. MicroLite Lighting Control Systems.
 9. Square D; Schneider Electric USA.
 10. TORK.
 11. Touch-Plate, Inc.
 12. Watt Stopper.
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SENSORS

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.2 INSTALLATION OF CONTACTORS

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by the Construction Manager.
- B. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. For each type of product.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS**A. Manufacturers' Published Instructions:** Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Transformer working clearances, anchoring, torque values, and insulation-resistance testing.

B. Source quality-control reports.**PART 2 - PRODUCTS****2.1 MANUFACTURERS****A. Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Acme Electric; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Controlled Power Company; an Emerson company.

4. Eaton.
5. Federal Pacific.
6. General Electric Company.
7. Hammond Power Solutions Inc.
8. Magnetek Power Electronics Group.
9. Micron Industries Corporation.
10. Myers Power Products, Inc.
11. Siemens Industry, Inc., Energy Management Division.
12. SolaHD; Emerson Electric Co., Automation Solutions.
13. Square D; Schneider Electric USA.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger:
 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
 1. One leg per phase.
- C. Coils: Continuous windings without splices except for taps.
 1. Coil Material: Copper.
 2. Internal Coil Connections: Brazed or pressure type.
 3. Terminal Connections: Welded.
- D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.
- E. Enclosure: Ventilated.
 1. Core and coil must be encapsulated within resin compound to seal out moisture and air.
 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 3. Wiring Compartment: Sized for conduit entry and wiring installation.
 4. Environmental Protection:
 - a. Indoor: UL 50E, Type 2.
- F. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.

- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 150 deg C rise above 40 deg C ambient temperature.
- K. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.
- L. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION

- A. Nameplates:
 - 1. Engraved, laminated-acrylic or melamine plastic signs for distribution transformers, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.
- E. Environment: Enclosures must be rated for environment in which they are located. Covers for UL 50E, Type 4X enclosures may not cause accessibility problems.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

2. Brace wall-mounted transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
 3. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions, seismic requirements applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 4. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Secure transformer to concrete base in accordance with manufacturer's published instructions.
 - C. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.
 - D. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

3.4 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:
 - a. Visual and Mechanical Inspection.
 - 1) Inspect physical and mechanical condition.
 - 2) Inspect anchorage, alignment, and grounding.
 - 3) Verify that resilient mounts are free and that shipping brackets have been removed.
 - 4) Verify that unit is clean.
 - 5) Perform specific inspections and mechanical tests recommended by manufacturer.
 - 6) Verify that as-left tap connections are as specified.
 - 7) Verify presence of surge arresters and that their ratings are as specified.
 - b. Electrical Tests:
 - 1) Measure resistance at windings, taps, and bolted connections.

- 2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
 - 3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
 - 4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Test Labeling: On completion of satisfactory testing of units, attach dated and signed "Satisfactory Test" label to tested components.
- D. Nonconforming Work:
1. Transformer will be considered defective if it does not pass tests and inspections.
 2. Remove and replace units that do not pass tests or inspections and retest as specified above.
- E. Assemble and submit test and inspection reports.
- 3.5 CLEANING
- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
 2. Surge protection devices.
 3. Disconnecting and overcurrent protective devices.
 4. Instrumentation
 5. Identification.

1.2 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
- B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.
 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Detail utility company's metering provisions with indication of approval by utility company.
 6. Include evidence of NRTL listing for series rating of installed devices.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
 9. Include schematic and wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1.7 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 SWITCHBOARDS

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

1. Eaton.
 2. General Electric.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- H. Nominal System Voltage: 208Y/120 V.
- I. Main-Bus Continuous: As indicated on Construction Drawings.
- J. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- K. Indoor Enclosures: Steel, NEMA 250, Type 1.
- L. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- N. Pull Box on Top of Switchboard:
1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 2. Set back from front to clear circuit-breaker removal mechanism.
 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

- O. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 3. Tin-plated aluminum feeder circuit-breaker line connections.
 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 5. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 7. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- P. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.3 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. Siemens Industry, Inc., Energy Management Division.
 3. Square D; Schneider Electric USA.
- B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
- C. Features and Accessories:
1. Integral disconnect switch.
 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 3. Indicator light display for protection status.
 4. Surge counter.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 250kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 100 kA.

G. Nominal Rating: 20 kA.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

1. 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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.5 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.

- c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Frequency: Plus or minus 0.1 percent.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- B. Watt-Hour Meters and Wattmeters:
- 1. Comply with ANSI C12.1.
 - 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
 - 3. Suitable for connection to three- and four-wire circuits.
 - 4. Potential indicating lamps.
 - 5. Adjustments for light and full load, phase balance, and power factor.
 - 6. Four-dial clock register.
 - 7. Ratchets to prevent reverse rotation.
 - 8. Removable meter with drawout test plug.
 - 9. Semiflush mounted case with matching cover.
 - 10. Appropriate multiplier tag.

2.6 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Install switchboards and accessories according to NEMA PB 2.1.
- C. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 - 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- E. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- G. Install filler plates in unused spaces of panel-mounted sections.
- H. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
 - 2. Manufacturer shall provide all necessary settings for breaker.
- I. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Switchboard will be considered defective if it does not pass tests and inspections.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Key interlock scheme drawing and sequence of operations.
 - 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 2. Height: 84 inches maximum.
 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Top and Bottom.
- G. Phase, Neutral, and Ground Buses: Tin-plated aluminum.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Tin-plated aluminum.

2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
 - J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 - L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As indicated on Construction Drawings.

- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers, and Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only as indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.

- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. Subfeed Circuit Breakers: Vertically mounted.
- 7. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.

- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Manufacturer shall provide all necessary settings required for circuit breakers.
- H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- I. Install filler plates in unused spaces.
- J. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Receptacles with ground-fault protective devices.
5. Locking receptacles.
6. Connectors, cords, and plugs.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Toggle switches.
2. Single straight-blade receptacles
3. Duplex straight-blade receptacles.
4. Receptacles with GFCI device.
5. Locking receptacles.
6. Spring-driven commercial/industrial-use cord reels.

PART 2 - PRODUCTS**2.1 GENERAL-USE SWITCHES****A. Toggle Switch:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:

- a. Reference Standards: UL CCN WMUZ and UL 20.
- 4. Options:
 - a. Device Color: Selected by Architect.
 - b. Configuration:
 - 1) Extra-heavy-duty, 120-277 V, 15 A, single pole, double pole, three way, four way.
 - 2) Extra-heavy-duty, 120-277 V, 20 A, single pole, double pole, three way, four way.
 - 3) Extra-heavy-duty, 120-277 V, 30 A, single pole, double pole, three way.
- 5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
- 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
- 4. Options:
 - a. Device Color: Selected by Architect.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.
- 5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Tamper-Resistant Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
 - a. Device Color: Selected by Architect.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.
5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:
 - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
 - a. Device Color: Selected by Architect.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
 - a. Device Color: Selected by Architect.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.5 LOCKING RECEPTACLES

A. NEMA, 125 V, Locking Receptacle:

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

- a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
 - 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
 - 4. Options:
 - a. Device Color: Black with yellow voltage indication on face.
 - b. Configuration: As noted on Drawings.
- B. NEMA, 250 V, Locking Receptacle:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
 - 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
 - 4. Options:
 - a. Device Color: Black with blue voltage indication on face.
 - b. Configuration:
 - 1) As noted on Drawings.

2.6 SPECIAL-PURPOSE POWER OUTLET ASSEMBLIES

- A. Spring-Driven Commercial/Industrial-Use Cord Reel, No. 12 AWG Conductors:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Appleton; Emerson Electric Co., Automation Solutions.
 - b. Ericson Manufacturing Company.

- c. Gleason Reel; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - d. Reelcraft; Madison Industries.
- 2. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
 - a. Reference Standards: UL CCN SBCV and UL 355.
 - b. Spring take-up retraction mechanism.
- 4. Options:
 - a. Electrical Rating with Cable: 600 V, 20 A.
 - b. Color: Black.
 - c. Enclosure Degree of Protection: Type 4.
 - d. Ball stop.
 - e. Pivot base.
 - f. Spool Capacity:
 - 1) No. 12 AWG, two wires and equipment ground, 30 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

- 1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

- 1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
- 2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
- 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

- 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
- 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
- 3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

3.4 INSTALLATION OF LOCKING RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.5 INSTALLATION OF CORD REELS AND FITTINGS

- A. Comply with manufacturer's instructions.

3.6 FIELD QUALITY CONTROL OF SWITCHES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
1. Perform tests and inspections in accordance with manufacturers' instructions.
- C. Nonconforming Work:
1. Unit will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

3.7 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
1. Insert and remove test plug to verify that device is securely mounted.
 2. Verify polarity of hot and neutral pins.
 3. Measure line voltage.
 4. Measure percent voltage drop.
 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 6. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
 7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:
1. Device will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

3.8 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
 - 1. Insert and remove test plug to verify that device is securely mounted.
 - 2. Verify polarity of hot and neutral pins.
 - 3. Measure line voltage.
 - 4. Measure percent voltage drop.
 - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 - 6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

3.9 FIELD QUALITY CONTROL OF CORD REELS AND FITTINGS

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
 - 1. Perform tests and inspections indicated in manufacturer's instructions.
- C. Nonconforming Work:
 - 1. Components and assemblies will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

3.10 ADJUSTING

- A. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.

3.11 PROTECTION

- A. Devices:
 - 1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.

2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Cord Reels and Fittings:

1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262416 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Nonfusible switches.
 - 2. Enclosures.

1.2 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.3 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, 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. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

- D. Comply with NFPA 70.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, 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.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12), a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel), copper-free cast aluminum alloy (NEMA 250 Types 7, 9).
- C. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R), externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. As indicated on the drawings.