SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

07.28.23

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical Identification
2. Hangers and Supports
3. Conduit Sleeves
4. Grounding and Bonding

B. Related Sections
1. Section 09900 - Paints and Coatings: Field painting of hangers and supports.
2. Section 16100 – Wiring Methods
3. Section 16500 – Lighting

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. National Fire Protection Association (NFPA).
1. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 QUALITY ASSURANCE

A. Owner's Independent Power Systems Study Consultant: The Power Systems Study Consultant (PSSC) is a consultant hired by and contracted by the Owner for the purpose of performing an arc flash risk assessment and ensuring compliance of equipment in accordance with NFPA 70E. Testing and inspection by the PSSC is specified in Appendix B (Section 16050). The PSSC shall be the following:
1. Brown and Caldwell, Inc., Nashville, TN. Contact Tommy Woodroof, Director, (615) 250-1260 or (615) 335-5736, twoodroof@brwncald.com

1.4 SEQUENCING AND SCHEDULING

A. PSSC will schedule with Contractor and perform site visits at no cost to the Contractor as specified in Appendix B (Section 16050).

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION

A. Nameplates: Provide laminated plastic nameplates with 3/4 inch minimum contrasting-color engraved letters.

2.2 HANGERS AND SUPPORTS

A. Manufacturers:
1. Atkore (formerly Unistrut), Harvey, IL, (800) 882-5543 or (708) 339-1610.
2. Nvent (corporate owner of Erico/Caddy brands), (800) 753-9221.
3. Minerallac Company, Hampshire, IL, (800) 927-3293.

B Conduit and Equipment Supports: Hangers shall be Series P3000 or P3300 channels by Atkore/Unistrut depending on load and span involved. Use Pipe Hangers by Minerallac, or Caddy Clips by Erico only where impractical to install Atkore/Unistrut Hangers.

C. Attach hangers and supports to structure overhead by methods approved at job site. Do not use fasteners which penetrate the roof deck.

2.3 CONDUIT SLEEVES

A. Sleeves:
1. Below Grade: Galvanized, black steel or schedule 40 PVC pipe.
2. Above Grade: Electrical Metallic Tubing (EMT).

2.4 GROUNDING AND BONDING

A. Insulated Grounding Bushing: Steel with feed-thru lugs.

B. Insulated Equipment Ground Wire: Copper.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install specified materials in accordance with manufacturer's recommendations and as indicated on Drawings.

B. Cutting and Patching: Where cutting is required through walls, floors, or ceilings, make openings no larger than required and repair affected surfaces to match adjacent surfaces.

C. Nameplates: Bolt or pop-rivet nameplates to equipment. Clearly identify equipment or equipment served, such as "BALER", "COMPACTOR," etc. Install nameplates for each safety switch, contactor, time switch, pushbutton and other similar equipment.

D. Electrical Equipment Supports: Support electrical equipment with hangers and supports specified above or in another approved manner where details are not indicated.

E. Sleeves:
1. Below Grade: Install where conduits pass through concrete floors as shown on drawings.
2. Above Grade: Install where conduits pass through outside walls as shown on drawings. Caulk sleeves with sealant as specified in Section 07900.

F. Fastening and Anchoring: Fasten conduit straps, disconnect switches, panelboards, and other equipment secured to walls and slabs with cadmium plated screws or bolts and lead cinch anchors or expansion bolts and install in holes drilled with proper size masonry drill. Properly size anchors in accordance with manufacturer's recommendations for load to be supported.

G. Torque all conductor connection terminations to manufacturer's recommended values. Inspect panelboards for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.2 GROUNDING

A, General: Ground all metallic conduits, supports, cabinets, equipment, system neutrals, metal building structures, and other items required to be grounded in accordance with the NEC and other applicable codes and as indicated on drawings.

B. Equipment Grounding:
1. Make conduits electrically continuous using proper fittings, connections, grounding bushings, etc.
2. Install insulating grounding bushings on all conduit connections 1 1/4 inch and larger and where indicated on Drawings.
3. Install insulated equipment ground wires in all raceways.

C. Concrete Encased Electrodes: Where indicated on the Drawings, furnish and install electrodes, jumpers, and approved fittings in accordance with Grounding Electrode Detail.

D. Ground Rods: If ground rods are required, install two 5/8 inch minimum diameter Copperweld rods driven vertically not less than 12 feet apart and each with 8 feet of length in contact with the soil.

3.3 TESTING

A. Upon completion of installation, perform continuity tests on power and equipment branch circuit conductors. Inspect wire and cable for physical damage. Verify proper phasing connections.

END OF SECTION

SECTION 16100 - WIRING METHODS

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SECTION 16100 - WIRING METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wire and Cable.
2. Conduit
3. Outlet boxes and Conduit Fittings.
4. Wiring Devices.
5. Wire Connectors.

B. Related Requirements:
1. Section 16050 - Basic Electrical Materials and Methods: Hangers and Supports
2. Section 16410 – Enclosed Switches

1.2 REFERENCES
A. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code (NEC).
B. American Society for Testing Material (ASTM)
1. ASTM D698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft
2. ASTM D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-bf/ft3)
C. National Electrical Manufacturers Association (NEMA):
1. NEMA VE 1 – Metal Cable Tray Systems
D. Underwriters Laboratories (UL)
1. UL 1569 - Metal Clad Cables

1.3 DELIVERY, STORAGE AND HANDLING

A. Receive, store and handle products in accordance with the requirements of Appendix A – Products and Work by Owner or Separate Contractor.
B. Arrange with Owner for delivery of Owner furnished materials at such stage of construction as will expedite the work. Products will be supplied to the job site complete and ready for installation. Allow minimum of four weeks for delivery.
C. Provide proper facilities for handling and storage of Owner furnished materials to prevent damage. Keep materials dry and fully protected from weather.
D. Upon receipt of shipment of Owner furnished materials, check contents of shipment against bill of material furnished by vendor. Report any shortages or damage to the vendor immediately so that replacements can be ordered and/or freight claims can be filed. Note damage on Bill of Lading in order to substantiate freight claims.]
E. All deliveries shall be staged and scheduled to correspond to construction schedule and to minimize on-site storage.
F. Provide proper facilities for handling and storage of all materials to prevent damage. Keep materials dry and fully protected from weather

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by a nationally recognized testing agency and marked for use.
B. Wire and cable shall bear UL label and shall conform to standards established for such materials by nationally recognized agencies.
C. Provide code gauge, soft annealed copper wire, not less than 98 percent conductivity and of 600 volt class.
D. Conductors:
1. Insulation type shall be one of the following:
a. THHN
b. THWN
c. XHHW
d. XHHW-2
2. Type:
a. #10 and smaller – stranded or solid.
b. #8 and larger - stranded
E. Wire smaller than #12 AWG not permitted unless otherwise noted. #14 AWG, type MTW or TFF permitted for signal and pilot control circuits unless otherwise noted.
F. Color code:

SYSTEM VOLTAGE	NEUTRAL COLOR	PHASE	GROUND	ISOLATED GROUND
208V/120V	WHITE	A-BLACK, B-RED, C-BLUE	GREEN	GREEN W/ YELLOW TRACER
480V/277V	WHITE	A-BROWN, B-ORANGE, C-YELLOW	GREEN	GREEN W/ YELLOW TRACER

G. Color code #6 AWG and smaller phase and neutral conductors by continuous outer covering. Conductors #4 AWG and larger may be color coded by tape. Tape shall have minimum of two complete wraps around conductor at 6 inches from terminations, splices, and junction points.
H. Identify circuit numbers with synthetic cloth or plastic labels at splice and junction points.

2.2 CONDUIT

A. Conduit types shall be as follows and shall bear UL or ETL label:
1. Galvanized Rigid Metal Conduit (GRC): Hot-dip galvanized.
2. Intermediate Metal Conduit (IMC): Hot-dip galvanized.
3. Electrical Metallic Tubing (EMT): Hot-dip galvanized.
4. Schedule 40 heavy-wall PVC for all underground conduit runs.
5. Flexible Metal Conduit: Zinc-coated steel or Aluminum.
6. Liquid Tight Flexible Steel Conduit with PVC jacket.

B. Conduit Sizes: Size conduit in accordance with NEC unless noted otherwise on Drawings, but not less than the following:
1. Alarm and Data Systems: 3/4 inch.
2. Flexible Metal Conduit: For connection of recessed light fixtures in suspended ceilings, 3/8 inch. For connection of other equipment subject to vibration: 1/2 inch.
3. Underground Conduit in Parking Lot: 1 inch.
4. Other Uses: 1/2 inch.

C. Contact Information:
1. Prime Conduit MWE Inc. 816-842-9283 or 800-678-3075
2. Vikimatic 800-345-8454
3. Innerduct 800-332-8114

2.3 OUTLET BOXES AND CONDUIT FITTINGS

A. Outlet boxes and conduit fittings shall bear the label of a nationally recognized testing laboratory and be rated for environmental conditions where installed.
B. Boxes: Comply with NEC in regard to maximum allowable number of conductors .
1. Interior Boxes: Hot-dip galvanized, 4 inches minimum octagon or square, unless otherwise noted. Provide single or multiple gang outlet boxes as required for flush installation in drywall construction. Provide masonry boxes for outlets installed flush in concrete unit masonry. Provide single surface-mounted outlet boxes for utility type boxes.
2. Exterior Wall Boxes: Provide masonry boxes for outlets installed flush in concrete unit masonry
3. Exterior In-Grade Pull Boxes:
a. PVC with UV-stabilized PVC cover, sealed and gasketed watertight.
b. Cast iron with cast iron cover, sealed and gasketed watertight, in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
c. Install buried boxes with box covers flush with grade unless indicated otherwise.
4. Outlet Boxes: Suitable for supporting lighting fixtures if intended for that purpose.
5. Ceiling Fan Boxes: Rated and listed for mounting ceiling fans.

C. Conduit Fittings:
1. EMT Fittings for Dry Locations: Diecast or steel set screw type.
2. EMT Fittings For Wet or Damp Locations: Steel Compression type.
3. GRC, IMC, or EMT Box Connectors For Wet or Damp Locations: Weather-tight hubs.
4. Threadless GRC or IMC Fittings: Not permitted.
5. GRC or IMC connectors for dry locations.
6. PVC Fittings: Solvent weld type for PVC conduit.

2.4 WIRE CONNECTORS

A. Splices:
1. #8 AWG and Smaller: Ideal Wingnut, 3M Scotchlok, or equal connectors of proper size. 3M No. 567 in-line self-stripping connectors will be permitted only at ballast lead connections in fluorescent light rows.
2. #6 AWG and Larger: Solderless lugs and connectors.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install specified materials in accordance with manufacturer's recommendations.

B. Where switches are ganged, provide permanently installed steel barriers between switches. Where or provide separate boxes and separate coverplates for each circuit.

3.2 HANGERS AND SUPPORTS

A. Hangers and Supports are specified in Section 16050.

3.3 WIRE

A. Tie wrap groups of conductors in switchboards and panel boards.

3.4 CONDUIT

A. Installation:
1. Install conduit concealed, except in unfinished areas and where indicated on Drawings.
2. Support conduit by means of specified hangers.
3. Clean PVC conduit per manufacturer's recommendations before application of solvent cement.
4. Coordinate flashings where conduit penetrates roof membrane.
5. Paint metallic conduit under concrete slab or where installed in contact with earth. Apply two 6 mil coats of PVC or Asphalt paint continuously along entire length of conduit prior to installation below grade. Do not run conduit in concrete slab.
6. Install flexible metal conduit or liquid tight flexible metal conduit for final connections to dry-type transformers, baler, air compressors, HVAC equipment, motors and other vibrating equipment.
7. Coordinate installation of conduit in masonry work.
8. Do not install conduit under slab unless indicated on Drawings. Conduit installed below slab shall be galvanized rigid metal (GRC), intermediate metal conduit (IMC), or Schedule 40 PVC. Provide exterior coated GRC bends and elbows for all underground conduit.
9. Route above grade conduit parallel or perpendicular to building lines.
10. Maintain minimum of 6 inches clearance at flues and heat sources.
11. Install GRC conduit when penetrating from below grade outdoors or penetrating concrete slabs, Including elbow.
12. Install GRC elbow on all conduit runs below grade that have 45º bends or greater.
13. Install double locknut and bushings when terminating GRC or IMC conduit, except where conduit terminates in threaded hub.
14. Install insulated throat bushings on all PVC conduit runs.

B. Location:
1. Galvanized Rigid Metal Conduit (GRC): Permitted for general exposed or concealed work above or below grade.
2. Intermediate Metal Conduit (IMC): Permitted for general exposed or concealed work above or below grade.
3. Electrical Metallic Tubing (EMT): Permitted for general exposed or concealed work above grade.
4. Polyvinyl Chloride rigid Nonmetallic Conduit (PVC) unless noted otherwise on drawings: Permitted for below-grade use when permitted by local governing codes..
5. Flexible Metal Conduit: Permitted in attic spaces and exposed in lengths of 6 feet or less for connections to equipment in dry areas. Not permitted for general exposed or concealed work. For connection of recessed light fixtures in suspended ceilings and connection of other equipment subject to vibration.
6. Liquid tight Flexible Metal Conduit: Permitted exposed in lengths of 6 feet or less for connections to food service equipment, refrigeration equipment and other v ibrating equipment in damp locations where rigid connections are not suitable.

3.5 WIRE CONNECTIONS

A. Make final connection of motors, starters, disconnects, and other items furnished under other Sections.

3.6 PROTECTION

A. Protect installed products from damage until completion of construction operations.

END OF SECTION

SECTION 16410 - ENCLOSED SWITCHES

04.24.20

SECTION 16410 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Safety disconnect switches and enclosed circuit breakers.

B. Related Requirements:
1. 16100 - Wiring Methods.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA).
1. NEMA 250 – Enclosures for Electrical Equipment (1000 volts maximum).

PART 2 - PRODUCTS

2.1 SAFETY DISCONNECT SWITCHES

A. Requirements:
1. Furnish and install all disconnect switches required for full code compliance except where switches are furnished with equipment specified in other DIVISIONS of the specifications in which case, install only.
2. Fusible Switch Assemblies: Shall be NEMA KS 1, Type HD (Heavy Duty) horsepower rated, load interrupter switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips shall accommodate Class R unless indicated otherwise. Fusible switches shall be UL rated 200,000 AIC with Class R,J or L fuses.
3. Nonfusible Switch Assemblies: Shall be NEMA KS 1, Type HD (Heavy Duty) load interrupter switch with externally operable handle interlocked to prevent opening
front cover with switch in ON position. Handle lockable in OFF position.
4. Switches controlling or disconnecting motor loads shall be horsepower rated and approved for motor control service except where NEC 430-109 exceptions apply.
5. Line and load terminals of disconnect switches rated 100 amperes or less shall be rated for 75 degrees C.
6. Provide electrical interlock to de-energize control wiring as required.
7. All disconnect switches shall be capable of being locked open.
8. Controller disconnect switches shall be within sight of the controller. If the disconnect switch of any controller is out of site of, or more than 50 feet from, its related motor, then a disconnecting switch shall be added within sight of the motor. The switch at the motor may be deleted only where allowed by the NEC and where approved by the Engineer.
9. Install fuses specified in SECTION 16402 – LOW VOLTAGE SERVICE AND DISTRIBUTION in all fusible switches.
10. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
11. Switches used for service entrance shall have a UL Service Entrance Label.

B. Enclosures:
1. NEMA Type 1 general purpose enclosures shall be used for interior dry locations unless otherwise indicated.
2. NEMA Type 3R raintight enclosures shall be used for exterior locations unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor and circuit disconnects in accordance with manufacturer's recommendations. Applicable Codes shall take precedence over drawing details.

B. Provide properly sized grounding lug and terminations for all disconnect switches.

END OF SECTION

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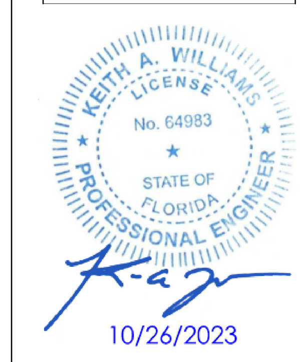

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