SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install low-voltage conductors and cabling.
   2. Types of cabling required include:
      a. Insulated cable for installation in raceways.
      b. Cable for installation in cable trays.

B. Related Sections:
   1. Section 26 05 53, Identification for Electrical Systems.
   2. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   2. ASTM B3, Specification for Soft or Annealed Copper Wire.
   3. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
   4. ASTM D3485, Specification for Smooth-Wall Coilable Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable.
   5. ASTM F2160, Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD).
   6. NEMA TC 7, Smooth Wall Coilable Electrical Polyethylene Conduit.
   7. UL 44, Thermoset-Insulated Wires and Cables.
   8. UL 1277, Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 300, Wiring Methods.
   2. NEC Article 310, Conductors for General Wiring.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
    a. Manufacturer's literature, specifications, and engineering data for low volt insulated cable proposed for use.

B. Informational Submittals: Submit the following:
1. Field Quality Control Submittals:
    a. Written results of field insulation resistance tests.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Insulated Cable In Raceways:
1. Application: Use for circuits located indoors and outdoors.
2. Manufacturers: Provide products of one of the following:
    a. Southwire.
    b. The Okonite Company.
    c. American Insulated Wire
    d. General Cable
    e. Approved equivalent.
3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 or RHW-2 complying with UL 44.
4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.

B. Fire-Rated Cable:
1. Application:
    a. Use as required to comply with NEC Article 708 and as shown or indicated on the Drawings.
2. Manufacturers: Provide products of one of the following:
    a. Tyco/Thermal Control VITALink 2000 Fire Rated Cable.
    b. Or equal.
3. Material: Single nickel-clad copper conductor with proprietary thermoset ceramifiable layer and thermoset low-smoke zero halogen covering insulation. Cable shall be rated for 90 degrees C in dry locations and 75 degrees C in wet locations. Cable shall comply with UL1709 and shall be suitable for continuous exposure temperature of 670 degrees C and maximum exposure temperature of 1,065 degrees C for at least 60 minutes. Cable shall be UL-labeled.
4. Thermal Barrier: Inorganic layer.
5. Binder Tape: Helically-applied.
6. Jacket: Black low-smoke zero halogen polyolefin.

7. Splicing: Manufacturer's recommended method.
8. Wire Sizes: Not smaller than No. 12 AWG and not larger than 500 KCMIL.
9. Stranding: 600-volt cable shall be stranded.

C. VFD Cable
   1. Provide where specified on the Drawings
   2. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. Belden.
      c. Anixter.
      d. Houston Wire.
      e. Approved equivalent.
   3. Bare copper conductors with XLPE insulation and an XHHW-2 rating, spirally applied dual copper tapes, three symmetrical bare ground wires, 600V rated, Class B Stranding per ASTM, 90°C Wet/Dry, Class I & II; Division 2 Hazardous Locations.

D. Cable for Installation in Trays:
   1. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. The Okonite Company.
      c. Prysmian Cables & Systems.
      d. General Cable.
      e. Approved equivalent.
   2. Material: Factory-assembled single- or multi-conductor control, signal, or power cable that bears UL label Type TC and are specifically approved for installation in cable trays. Overall jacket shall be sunlight-resistant PVC. Cable shall be rated for 90 degrees C wet or dry, complying with UL 44 and UL 1277.

E. Cable Connectors, Solderless Type:
   1. Products and Manufacturers: Provide products of one of the following:
      a. T&B Sta-Kon.
      b. Burndy Hylug.
      c. Approved equivalent.
   2. For wire sizes No. 4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
   3. For wire sizes up to and including No. 6 AWG, use compression type. Alarm and control wire shall be terminated using forked type connectors at terminal boards.
   4. For wire sizes No. 250 KCMIL and larger, use connectors with at least two cable clamping elements or compression indents and provision for at least two bolts for joining to apparatus terminal.
   5. Properly size connectors to fit fastening device and wire size. Connectors shall be rated for 90 degree C, 600 volts.

F. Cable Splices:

1. Products and Manufacturers:
    a. Compression-Type Splices: Provide one of the following:
        1) Burndy Hylink.
        2) T&B Color-Keyed Compression Connectors.
        3) Approved equivalent.
    b. Spring Connectors: Provide one of the following:
        1) Buchanan B-Cap.
        2) T&B Wire Connector.
        3) Approved equivalent.
2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.

G. Wire and Cable Markers:
1. Provide wire and cable markers in accordance with Section 26 05 53, Identification for Electrical Systems.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests:
1. Factory-test wire and cable in accordance with UL standards

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.

B. Pulling:
1. Use insulating types of pulling compounds containing no mineral oil.
2. Pulling tension shall be within limits recommended by wire and cable manufacturer.
3. Use dynamometer where mechanical means are used.
4. Cut off section subject to mechanical means.

C. Bending Radius: Limit to minimum of six times cable overall diameter.

D. Slack: Provide maximum slack at all terminal points.

E. Splices:
   1. Where possible, install cable continuous, without splice, from termination to termination.
   2. Where required, splice as shown and also where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.
   3. Splices are not allowed in conduits.

F. Identification:
   1. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
   2. Identify power conductors by circuit number and phase at each terminal or splice location.
   3. Identify control and status wiring using numeral tagging system.

G. Color-code power cables as follows:
   1. No. 8 AWG and Smaller: Provide colored conductors.
   2. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
   3. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

System	**Conductor**	**Color**
All Systems	Equipment Grounding	Green
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
480Y/277 Volts Three-Phase, Four-Wire	rounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow

3.2 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test each electrical circuit after permanent cables are in place, to demonstrate that circuit and equipment are connected properly and will perform satisfactorily, free from improper grounds and short circuits.
   2. Individually test 600-volt cable mechanical connections after installation and before they are put in service, with calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
   3. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are

put in service, with Megger type tester for one minute at voltage rating recommended by cable manufacturer or in accordance with ANSI/NETA ATS recommendations.

4. Insulation resistance for each conductor shall not be less than value recommended by cable manufacturer. Cables not meeting recommended value or that fail when tested under full load conditions shall be replaced with a new cable for full length.

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