

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

SPEC WRITER NOTES: Use this section only for NCA projects. Delete between //\_\_\_\_// if not applicable to the project. Also, delete any other item or paragraph not applicable to the section and renumber the paragraphs.

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below. Low-voltage electrical power conductors and cables are also referred to as conductor(s), cable(s), wire, or wiring in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 31 20 00, EARTH MOVING: Excavation and backfill for cables that are installed in conduit.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

**1.3 QUALITY ASSURANCE**

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings: Manufacturer's Literature and Data - Showing each cable type and rating.

2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):  
D2301-10.....Standard Specification for Vinyl Chloride  
Plastic Pressure Sensitive Electrical  
Insulating Tape

C. National Electrical Manufacturers Association (NEMA):  
WC 70-21.....Power Cable Rated 2000 Volts or less for the  
Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):  
70-23.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):  
44-18.....Thermoset-Insulated Wires and Cables  
83-17.....Thermoplastic-Insulated Wires and Cables  
467-22.....Safety Electrical Grounding and Bonding  
Equipment  
486A-486B-18.....Safety Wire Connectors  
486C-18.....Safety Splicing Wire Connectors  
486D-15.....Safety Sealed Wire Connector Systems  
486E-15.....Safety Equipment Wiring Terminals for Use with  
Aluminum and/or Copper Conductors  
493-18.....Safety Thermoplastic-Insulated Underground  
Feeder and Branch Circuit Cable  
514B-12.....Fittings for Cable and Conduit  
1479-15.....Safety Fire Tests of Through-Penetration Fire  
Stops

**PART 2 - PRODUCTS**

**2.1 CONDUCTORS**

A. Conductors shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.

B. Single conductor shall be:

1. Copper.
2. Stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
3. Minimum size No. 12 AWG, except where smaller sizes are specified herein or as shown on the drawings.

C. Insulation shall be:

1. THHN-THWN.
2. Direct burial: UF or USE.

D. Color Code:

1. Conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

2. No. 10 AWG and smaller: Solid color insulation or solid color coating.
3. No. 8 AWG and larger shall be color-coded using one of the following methods:
  - a. Solid color compound or solid color coating.
  - b. Stripes, bands, or hash marks of color specified above.
  - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding distinct (i.e. pink and purple) from the color coding indicated above. The distinct color codes shall be solid and in accordance with the NEC.

## 2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:

1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

D. Above Ground Splices for 250 kcmil and Larger:

1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

SPEC WRITER NOTE: Delete the paragraphs below if underground splices types are not required.

//E. Underground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:

1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.//
- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

### **2.3 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

### **2.4 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

### **2.5 CONNECTORS AND TERMINATIONS**

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be //zinc-plated//cadmium-plated// steel.

SPEC WRITER NOTE: Delete the paragraphs below if fire proofing tape does not apply.

### **//2.6 FIREPROOFING TAPE**

- A. Fireproofing tape shall be flexible, non-corrosive, self-extinguishing, arc-proof, and fireproof intumescent elastomer. Securing tape shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (0.75 inch) wide.//

**PART 3 - EXECUTION****3.1 INSTALLATION, GENERAL**

- A. Install conductors in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Install conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Conductors of different voltage systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install conductor supports for all vertically installed conductors, in accordance with the NEC. Provide split wedge type which firmly clamps each individual conductor and tightens due to conductor weight.
- F. In panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the conductors in individual circuits.
- G. Seal conductor entering a building from underground, between the conductor and conduit where the conductor exits the conduit, with a non-hardening approved compound.
- H. Conductor and Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of conductors.
  - 2. Use ropes made of nonmetallic material for pulling feeders conductors.
  - 3. Attach pulling lines for feeders conductors by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. Pull in multiple conductors and wires that share the same conduit, simultaneously.
- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.

**3.2 INSTALLATION IN MANHOLES**

- A. Install and support conductors in manholes on the steel racks with porcelain or equal insulators. Train the conductors around the manhole walls, but do not bend to a radius less than six (6) times the overall conductor diameter.

SPEC WRITER NOTE: Delete the paragraphs below if fire proofing tape does not apply.

//B. Fireproofing:

1. Install fireproofing where low voltage conductors are installed in manholes; also cover the low voltage conductors with arc proof and fireproof tape.
2. Apply fire proofing tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the conductor and extend it not less than 25 mm (one inch) into each duct.
3. Secure the tape in place by a random wrap of glass cloth tape. //

### **3.3 SPLICE INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices.

### **3.4 CONTROL AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 Volts or lower where shown on the drawings or as required by the NEC.

### **3.5 CONTROL AND SIGNAL SYSTEM IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

### 3.6 FEEDER IDENTIFICATION

- A. In each interior pullbox and junction box, install metal tags on each circuit conductor to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the conductor type and voltage rating. Attach the tags to the conductors with slip-free plastic cable lacing units.

### 3.7 DIRECT BURIAL CONDUCTOR INSTALLATION

- A. Tops of the conductors:
  - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
  - 2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
  - 3. Do not install direct burial conductors under railroad tracks.
- B. Under road and paved surfaces: Install conductors in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
- C. Work with extreme care near existing ducts, conduits, conductors and other utilities to prevent any damage.
- D. Cut the trenches neatly and uniformly:
  - 1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
  - 2. Place a 75 mm (3 inches) layer of sand in the trenches before installing the conductors.
  - 3. Place a 75 mm (3 inches) layer of sand over the installed conductors.
  - 4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inches) preservative impregnated wood planking 75 mm (3 inches) above the conductors before backfilling.
- E. Provide horizontal slack in the conductors for contraction during cold weather.
- F. Install the conductors in continuous lengths. Splices within conductor runs will not be accepted.
- G. Connections and terminations shall be submersible type designed for the conductors being installed.



H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried conductors.

**3.8 EXISTING CONDUCTORS AND CABLES**

A. Unless specifically indicated on the plans, existing conductors shall not be re-used.

**3.9 ACCEPTANCE CHECKS AND TESTS**

- A. Feeders and branch circuits conductors shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. Perform phase rotation test on all three-phase circuits. For renovation project, phase rotation shall be consistent between existing and new installations.
- E. The Contractor shall furnish the instruments, materials, and labor for these tests.

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