Section 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

1. GENERAL
   * + 1. DESCRIPTION
          1. This Section describes wires, cables, and connectors.
       2. REFERENCES
          1. ASTM: American Society for Testing and Materials:

ASTM B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM B33: Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

ASTM B172: Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors

ASTM B189: Standard Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes

* + - * 1. ICEA: Insulated Cable Engineers Association

ICEA 566-524: Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electrical Energy

ICEA S-95-658: Non-shielded 0-2 kV Cable

ICEA S-75-381: Portable and Power Feeder Cables for Use in Mines and Similar Applications

* + - * 1. NEC: National Electric Code

NEC Article 336: Power and Control Tray Cable, Type TC

* + - * 1. NEMA: National Electrical Manufacturers Association

NEMA WC 58: Portable and Power Feeder Cables for Use in Mines and Similar Applications

NEMA WC 70: Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy

* + - * 1. UL: Underwriters Laboratories:

UL 44: Thermoset-Insulated Wires and Cable

UL 83: Thermoplastic-Insulated Wires and Cables

UL 1277: Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members

UL 1581: Reference Standard for Electrical Wires, Cables, and Flexible Cords

* + - 1. SUBMITTALS
         1. Submit the following materials:

Lighting and receptacle circuit conductors.

Single conductor 600-volt power and control conductors.

Multi-conductor 600-volt power cable.

Multi-conductor 600-volt control cable.

Direct burial, multi-conductor 600-volt cable.

Portable cord.

Portable cable fittings.

MC cable.

* + - * 1. Submittals of the following materials shall consist only of a listing of the manufacturer’s name and the applicable catalog numbers of the items to be utilized. Upon review of the list, further information may be requested.

Connectors.

Branch circuit conductor splices.

Splices with compression fitting and heat-shrinkable insulator.

* + - * 1. Submit cable test data per testing requirements of Part 3.

1. PRODUCTS
   * + 1. GENERAL
          1. With the exception of lighting and receptacle circuits, the type, size, and number of conductors shall be as specified on the drawings or schedules. Lighting and receptacle circuit conductors are unscheduled and shall be sized in accordance with the NEC to limit-voltage drop to 3 percent.
       2. COLOR CODING
          1. Power Conductors: Single‑conductor power conductors shall have the following color codes for the indicated-voltage:

|  | 480/277V | 208/120V | 240/120V |
| --- | --- | --- | --- |
| Phase A | Brown | Black | Black |
| Phase B | Orange | Red | Red |
| Phase C | Yellow | Blue | -- |
| Ground | Green | Green | Green |
| Neutral | Gray | White | White or Gray\* |
| \* If installed with 480/277V or 208/120V in the same raceway, box, gutter, or other enclosure, 240/120V neutral conductor color shall differ from the other system neutral conductor per NEC 200.6(D). | | | |

* + - * 1. Multi‑conductor power cable color coding shall be the manufacturer’s standard.
        2. Cables sized No. 4-AWG and larger may be black with 3/4-inch vinyl colored plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be colored at terminations and in pull boxes, handholes, and manholes.
      1. LIGHTING AND RECEPTACLE CIRCUIT CONDUCTORS
         1. Lighting and receptacle circuit conductors shall be stranded except for No. 12-AWG which may be solid. Minimum conductor size shall be No. 12-AWG.
         2. Conductors shall have the following characteristics:

Voltage: 600-volts.

Conductor: Bare annealed copper, stranded in accordance with ASTM B8.

Insulation:

Dry Areas and Above Grade: THWN/THHN, 90ºC dry, 75ºC wet, polyvinylchloride (PVC) in accordance with UL 83

Dry/Wet Areas & Below Grade: XHHW, 90ºC dry, 75ºC wet, cross linked polyethylene in accordance with UL 44.

Jacket: Nylon. Not applicable.

Flame Resistance: UL 83. UL 44.

Manufacturer: Cablec, Essex, Okonite, Southwire, or equal.

* + - 1. POWER CONDUCTORS AND CABLE, 600-volt
         1. Single Conductor:

Single conductor cable shall be stranded and used in conduits for power and control circuits. Unless otherwise specified, minimum size for power applications shall be No. 12-AWG and minimum size for control applications shall be No. 14-AWG.

Conductors installed in cable tray shall be UL labeled, Type TC, designated for cable tray, installation in accordance with NEC Article 336.

Conductors shall have the following characteristics:

Voltage: 600-volts.

Conductor: Coated, Class B, stranded annealed copper in accordance with ASTM B8.

Insulation:

Dry Areas & Above Grade: THWN/THHN, 90ºC dry, 75ºC wet, polyvinylchloride (PVC) in accordance with UL 83.

Dry/Wet Areas & Below Grade: XHHW, 90ºC dry, 75ºC wet, cross linked polyethylene in accordance with UL 44.

Flame Resistance: IEEE 383 flame test. UL 44, UL 83.

Manufacturer: Anixter, Cablec, Essex, Okonite, Southwire, or equal.

* + - * 1. Multi‑Conductor Cable: Multi‑conductor cable may be used for power and control circuits. Cables shall be UL labeled, Type TC, designed for cable tray installation in accordance with NEC Article 336. The type of insulation, number of conductors, and size of conductor shall be as specified.

Power Cable:

Multi‑conductor power cable shall contain two, three, or four conductors, as specified, plus an equipment grounding conductor. Unless otherwise specified, minimum conductor size shall be No. 12-AWG.

Cable shall be provided with the following characteristics.

Voltage: 600-volts.

Conductors: Annealed copper, stranded in accordance with ASTM B8, coated in accordance with ASTM B33.

Insulation: Ethylene propylene in accordance with UL 1581.

Overall Jacket: Chlorosulfonated polyethylene (CSPE) in accordance with UL 1277. Minimum thickness 45 mils.

Flame Resistance: 210,000 Btu/hr. flame test, UL 1277.

Manufacturer: Anixter, Okonite, or equal.

* + - 1. PORTABLE CORD
         1. Portable cord shall be UL listed, type SO for sizes No. 10-AWG and smaller. Cords shall contain an equipment grounding conductor. Cord characteristics shall be as follows:

Conductors: Flexible rope stranded in accordance with ASTM B189 and B33. Conductors shall be coated except ground conductors may be uncoated.

Insulation: Insulation shall be ethylene propylene (EPR) or water-resistant synthetic rubber (EPDM) and rated for continuous operation at 90° C.

Jacket: Heavy-duty neoprene.

Manufacturer: Anixter, or equal.

Compliance: Meets or exceeds electrical and physical requirements of ICEA S-95-658/NEMA WC-70.

* + - * 1. Cords with conductors larger than No. 10-AWG shall be 600-volt, UL and/or MSHA listed, Type G. Cords shall contain an equipment grounding conductor. Cord characteristics shall be as follows:

Conductors: Flexible rope stranded in accordance with ASTM B172 and B33. Conductors shall be coated except ground conductors may be uncoated

Insulation: Insulation shall be ethylene propylene (EPR) or oil and water-resistant synthetic rubber (EPDM) and rated for continuous operation at 90°C.

Jacket: Extra heavy-duty thermoset CSPE.

Manufacturer: AIWC, Amercable, or equal.

Compliance: Meets or exceeds electrical and physical requirements of ICEA S-75-381/NEMA WC-58.

* + - 1. SPLICING AND TERMINATING MATERIALS
         1. 600-Volt Conductor and Cable Connectors:

Connectors shall be one‑piece tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin‑plated electrolytic copper. Connectors for wires No. 10-AWG and smaller shall be self-insulating ring tongue or locking spade terminals. Connectors for No. 8-AWG and larger shall be one‑hole lugs up to size No. 3/0-AWG and two‑hole or four‑hole lugs for size No. 4/0 and larger. Mechanical clamp or screw type connectors are not acceptable.

120-Volt Branch Circuit Conductor Splices: Live spring type, Scotch‑Lok, Ideal Wing Nut; self‑stripping type, 3M Series 560; or equal.

600-Volt Branch Circuit Conductor Splices: #10 and #12 conductors may be live spring type, Scotch-Loc, Ideal Wing Nut; self-stripping type, 3M series 560; or equal.

Only use in‑line splices and taps where specifically called for on the drawings or by written consent of the Owner. Splices shall be compression type, made with a compression tool die approved for the purpose, as made by Thomas and Betts Corp., or equal. Splice shall be covered with a heat‑shrinkable sleeve or boot.

* + - * 1. Portable Cable Fittings: Portable cable fittings for terminating the cable shall provide a watertight seal between the cord and the terminator and between the terminator and mounting hub. The cable terminator shall have a neoprene liner which grips the cord jacket when the back‑nut on the fitting is tightened. In addition, on all pendant cord applications and other applications where called for, there shall be a stainless-steel wire mesh cord grip as an integral part of the cord terminator.

1. EXECUTION
   * + 1. GENERAL
          1. Wire shall be continuous between each end of a conduit. Splices and terminals are not permitted within a conduit run.
          2. Each main and branch circuit shall have its own dedicated neutral conductor. Do not install shared or common neutrals.
          3. Pull wire and cable into conduit or trays without damaging or putting undue stress on the cable insulation. UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed.
          4. Provide a cable support whenever a cable leaves a raceway.
          5. When flat bus bar connections are made with unplated bar, scratch‑brush the contact areas. Torque bolts to the bus manufacturer’s recommendations.
       2. 600-VOLT CONDUCTORS AND CABLE
          1. Incoming wire in panels, No. 6-AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, and neatly spread into trees and connected to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Lace with plastic cable ties or linen lacing twine.
          2. Where plastic panel wiring duct is provided for wire runs, lacing is not necessary when the wire is properly installed in the ducts. Provide slack in junction and pull boxes and in handholes and manholes. Amount of slack shall be equal to the largest perimeter dimension of the box.
          3. Wire crossing hinges shall be stranded and made up into groups not exceeding 12 and shall be arranged so that they will be protected from chafing when the hinged member is moved.
          4. Terminate stranded wire as described in Part 2 except where terminals will not specifically accept such terminations. In these cases, terminate the wires directly on the terminal block. Install compression lugs and connectors using manufacturer’s recommended tools.
          5. Solid wire shall not be lugged. Do not use electrical spring connectors, set screws, wire nuts, and wing nut connectors on anything other than solid wires in lighting and receptacle circuits. Install lugs and connectors with a compression tool.
          6. All splices and terminations are subject to inspection prior to and after insulating. Terminations at 460‑volt motors shall be made by bolt-connecting the lugged connectors. Insulate and seal connections with factory-engineered kits. Motor connection kits shall consist of heat shrinkable, polymeric insulating material over the connection area and a high dielectric-strength mastic to seal the ends against moisture and contamination. Keep bolt connection area free of mastic and fillers to facilitate rapid stripping and re-entry. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer’s tolerances.
          7. In‑line splices and tees (where approved) shall be made with tubular compression connectors and insulated with factory‑engineered kits. Kits shall consist of heat shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against moisture and contamination. Keep connection area free of mastic and fillers to facilitate rapid stripping and re‑entry. Wires No. 10-AWG and smaller may be spliced using self‑insulating connectors as specified in Part 2.
          8. In-line splices and tees (where approved) shall be made with tubular compression connectors and insulated as specified above for motor terminations, except that wires No. 10-AWG and smaller may be spliced using self-insulating connectors as specified in Part 2.
          9. Insulate splices and tees in underground handholes or pull boxes using Scotch-cast epoxy resin splicing kits. Provide conductor and cable markers at splice and termination points and use self-insulating tubular compression connectors.
          10. Make terminations at solenoid valves, 120-volt, and other devices furnished with pigtail leads using self-insulating tubular compression connectors.
       3. PORTABLE CORD
          1. Portable cord feeding permanent installations, such as pumps, cranes, hoists, and portable equipment, shall have a wire mesh cord grip of flexible stainless-steel wire to take tension from the cable termination. Use weatherproof strain relief fittings for all connections. Use 45 degree and 90-degree connectors where applicable to prevent unnecessary strain on cords. Flexible cords feeding submersible motors shall be of a non-wicking neoprene construction. Connect portable cords to permanent wiring with terminals. Use in-line taps and splices only where specified.
          2. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
       4. FIELD TESTING
          1. 600-volt rated conductors greater than or equal to 500-kcmil, or in parallel runs, shall be tested by the Contractor for continuity and shall be meggered after installation and prior to termination. Provide the megger, rated 1,000-volts d.c., and record and maintain the results, in tabular form, clearly identifying each conductor being tested; submit copies. Repeat testing after any cables are replaced.

Replace cables when test value is less than 15 megohms.

Cable test submittal shall include results, equipment used, date, and the Owner inspector’s signature.

* + - 1. EXISTING CIRCUITS
         1. Confirm the destination and purpose of each existing circuit before connecting to new equipment and new wiring. Connections shown on the one‑line diagram drawing are the preferred connections.
         2. Remove existing terminations leaving as much existing cable as possible. Conserve existing cable when making splices to new cables. Existing cable length may require different routings within manhole vaults than are shown on the drawings. Do not unnecessarily cut off any existing cable length.

END OF SECTION 260519