SECTION 16120

WIRE AND CABLE (600 VOLTS AND LESS)

PART 1 GENERAL

1.1 SUMMARY

A. Description Of Systems
   1. Provide wire and cable systems as required, and all material and equipment, including wire cable, connectors and lugs, fittings, and wire and cable identification, as indicated or specified.

1.2 QUALITY ASSURANCE

A. Requirements Of Regulatory Agencies
   1. Wire and Cable. Listed by Underwriters' Laboratories as meeting National Electrical Code requirements and be so labeled.

B. Source Quality Control
   1. Furnish wire and cable on which standard factory tests established by ASTM, ANSI, ICEA and NEMA have been performed.

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this SECTION by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to SECTION 01340 for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this SECTION are specified herein under this Article.

B. Submit product data for each type and size of wire and cable. Identify material, construction data, insulation thickness, and jacket thickness. Submit color coding schemes for branch circuit wiring. Submit cable identifications.

C. Submit test data for wire and cable as specified under the paragraph "SOURCE QUALITY CONTROL". Do not install wire and cable for which test data has been requested until test data is approved.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Wire And Cable Delivery
   1. Deliver all wire and cable to the site on reels or in coils, plainly marked for complete identification, including the wire or cable size, the number of conductors, type of wire or cable, length, weight, thickness and character of the insulation and the name of the manufacturer. Furnish 600 volt wires and cables on coils and reels carrying original date perforated inspection labels of the Underwriters' Laboratories showing the number of feet and type of wire contained.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wire And Cable
   1. General Requirements. Furnish wire and cable per standard specifications established for such material and construction by ASTM, ANSI, ICEA and NEMA, where applicable. Furnish copper conductors unless otherwise specified, not less than No. 12 AWG, except control conductors which may be No. 14 AWG. Furnish conductor sizes as indicated. Furnish solid or stranded conductors for sizes No. 10 AWG and smaller, and stranded conductors for sizes No. 8 AWG and larger.
      a. American Insulated Wire Corp.
      b. General Cable Corp.
      c. The Okonite Co.
      d. Pirelli Cable Corp.
      e. Service Wire Company
      f. Southwire
      g. Aetna Insulated Wire Corp.
   2. *Wire for Final Connection in Conduit [U]*; to Incandescent Fixtures, Remote Ballasts. No. 14 AWG Stranded copper, NEC Type SF-2 rated 200 degC, 600 volts.
   3. *Wire for Use in Fluorescent Fixture Wiring Channels [U]:* Stranded copper, NEC Type RHH, THHN, or XHHW-2, rated 90 degC, 600 volts.
   4. *Wire for Exposed Cord Connection to Fluorescent Fixtures [U]:* Three conductor stranded copper, NEC Type SO rated 60 degC, 600 volts.
   5. *Wire for General Interior and Exterior Use [U]:* Single conductor, annealed copper, NEC Type XHHW-2 or RHW-2 rated 90 degC in dry locations and 75 degC in wet locations, 600 volts, XHHW or THHN/ THWN rayed 90 deg C in dry locations and 75 degC in wet locations, 600 Volts, or NEC Type RHW rated 75 degC, 600 volts.
   6. *Wire for Direct Burial or In Underground Duct or Conduit [U]:* Single USE-2 or multi-conductor, as indicated on the DRAWINGS, NEC Type USE-2 rated 90 degC, 600 volts.
   7. *Multi-Conductor Control Cable for Installation in Conduit [U]:* Size and number of conductors as indicated consisting of stranded annealed copper individual conductors insulated with 20 mils polyethylene and 10 mils PVC, rated 90 degC, 600 volts, color-coded in conformance with ICEA, cabled round with fillers and binder tape, and covered with an overall jacket of PVC.

B. Connectors For Splicing Copper Conductors
   1. Connectors for Straight Splicing Conductors; Up To and Including No. 8 AWG. Insulated solderless compression type.
      a. FCI/Burndy “Hylink”
      b. Ilsco
      c. Panduit
      d. Thomas & Betts “Sta-Kon”
   2. Connectors for Pigtail Splicing Conductors; Up To and Including No. 8 AWG. Solderless type; with a metallic insert connector within a plastic insulating cover having a temperature rating of 105 degC, 600 volts.
      a. Buchanan

b. Ideal
c. Scotchlok

3. Connectors for Straight Splicing Conductors; No. 6 AWG and Larger. Solderless compression 2-way type.
   a. FCI/Burndy Type YS-L
   b. Thomas & Betts 54500 Series
   c. Ilsco CT Series
4. Connectors for 3-Way Splicing Conductors; No. 4 AWG and Larger. Solderless compression type.
   a. FCI/Burndy YST
   b. Thomas & Betts 54700 Series
   c. Panduit

C. Lugs For Terminating Copper Conductors
1. Lugs for Terminating Power Conductors Up To and Including No. 8 AWG: Solderless type, manufacturer's standard, unless otherwise specified.
2. Lugs for Terminating Power Conductors No. 6 AWG and Larger: Solderless compression type, one hole for No. 6 AWG through No. 4/0 AWG inclusive, and two hole for larger sizes.
   a. FCI/Burndy Type YA-L (One Hole), YA-2L (Two Hole)
   b. Panduit
   c. Thomas & Betts Series 54000
   d. Ilsco Type CRA (One Hole), CRL2 (Two Hole)
3. Lugs for Terminating Conductors Larger Than No. 4/0 AWG: UL listed AL/CU compression type, two hole.
   a. FCI/Burndy YA-A-TN
   b. Thomas & Betts 60200 Series
   c. Ilsco 2ACL Series
4. Lugs for Terminating Control and Switchboard Wiring: Solderless compression type with tinned ring tongue.
   a. FCI/Burndy "Hylug"
   b. Ilsco
   c. Thomas & Betts "Sta-Kon"
   d. Panduit

D. Wire Labels
1. Wire Labels for Identification of Conductors; Per SECTION 16050-Appendix "A".

E. Insulating Tape
1. General Use Tape:
   a. Okonite Type CLF Catalog Series 602-20
   b. 3M Co. Scotch 33 Plus
   c. Plymouth/Bishop No. 4453
2. High Temperature Area Tape:
   a. 3M Co. Scotch 27
   b. Plymouth/Bishop Insulating Products "77 Plyglas"

F. Insulation For Waterproof Splices And Taps
   1. Insulation for Inline Splices: Heat shrinkable tubing with internal sealant or molded compound or gel splice kit, suitable for submersion in water as used in manholes and handholes for installations of 1000 volts or less.
      a. TYCO/Raychem – WCSW (Heat shrink or gel wrap.)
      b. 3M Co. Scotchcast 82-A Series (Resin).
   2. Insulation for Taps: Heat shrinkable sleeve with internal sealant or molded compound or gel splice kits, suitable for submersion in water, in manholes and handholes for installations of 1000 volts or less.
      a. TYCO Electronic/Raychem -CRSM-CT (Heat Shrink) or H-Frame GHFC (Gel).
      b. 3M Co. – Scotchcast 85 Series (Resin).

G. Miscellaneous
   1. Lubricating Compound:
      a. American Polywater Corp.
      b. Ideal 77 Yellow or Wire Lube
   2. Cable ties:
      a. Panduit PAN-TY Series.
      b. 3M 06220 Series.
      c. Thomas & Betts TY-RAP.

PART 3 EXECUTION

3.1 INSTALLATION

A. General
   1. Install wiring in raceway systems, as indicated and as specified, except where exposed wiring is indicated or specified. Install wiring only in completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices, between equipment, where possible. Where splices are required, make up splices in boxes; do not use fittings for same.
   2. Install phase and neutral conductors of each branch or feeder circuit in a single conduit except where paralleling circuits are indicated. Install paralleling circuits of identical makeup and length as the paralleled circuit, and terminate conductors at the same location, mechanically and electrically, at both ends, to ensure equal division of the total current between conductors.
   3. Continuously lubricate all nonarmored cables size #8 AWG and larger at the pull-in point of conduit systems with an approved compound compatible with conductor insulation or jacket.
   4. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by ICEA and/or the manufacturer. Do not exceed manufacturer’s recommended values for maximum pulling tension applied to any wire or cable.
   5. Connect all power wiring to equipment such that phasing shall be A-B-C-N left to right, top to bottom and front to back, where possible, and permanently identify phasing on the structure or housing adjacent to bus. Phase identification A-B-C is equivalent to transformer phase identification X1-X2-X3 and H1-H2-H3.

6. Connect phase wiring to all 3 phase receptacles to insure the same phase rotation in all receptacles with interchangeable plugs.

B. Color Coding And Conductor Identification
   1. See SECTION 16050 - Appendix A.
   2. Provide single conductor cables having black insulation for power feeders and subfeeders. Do not color-code these circuits. Identify individual feeder and subfeeder conductors as to phase connection A, B, C by means of wire labels at each splice and termination.
   3. Identify individual phase conductors of branch power and lighting circuits as to phase and system voltage by means of color coding. Develop a unique color scheme for each different voltage system maintaining conformance with Section 210-5 of the NEC. Match existing schemes where such exist. Submit color schemes for approval of the ARCHITECT-ENGINEER prior to implementation. Provide conductor color coding by means of colored insulating materials or by means of colored wire labels attached to individual conductors in all outlet, pull or junction boxes and at all terminations.
   4. Identify each control circuit wire at each termination by means of wire labels. Provide identification as indicated. Mark the white marking strip of all control terminal blocks with the same identification as the connecting wire in permanent black ink.

C. Direct Burial
   1. Excavate trench for direct burial cable a minimum of 3 inches below the depth at which cable is to be installed. Provide a 3 inch minimum sand bed in the trench and thoroughly tamp. Install cable in the trench with sufficient slack for free movement of the cable due to expansion or contraction. Install more than one cable group in a common trench when so indicated; install cable groups with not less than 24 inches of sand fill between cable groups. After cable installation, provide a minimum of 3 inches of sand fill over the top of the cables; thoroughly tamp. Use Type NS sand per SECTION 01640. Refer to SECTION 01640 for compaction methods and requirements. Provide a concrete slab cover on top of the sand fill, not less than 2 inches thick and of a width equal to the trench, or in any case, not less than the overall dimension of the cable as installed. Provide underground hazard tape 12 inches below grade, directly above concrete slab, per SECTION 16050. Provide a rigid steel conduit sleeve for each group passing under a road or railroad and extend sleeve a minimum of 5 feet beyond each edge of the road or railroad. Fill end of sleeve with nonwater-soluble compound. Fill the remainder of the trench, and carefully tamp, with materials and compaction methods to suit project conditions per SECTION 01640.

D. Splices And Terminations
   1. Splice and terminate conductors with connectors and lugs as specified for the specific size and type of conductor. Do not splice direct burial cable underground. Indent all compression type connectors and lugs with tools as recommended by the connector or lug manufacturer.
   2. Thoroughly clean wire ends before connectors or lugs are applied.
   3. Whenever copper lugs are terminated on aluminum bus, use a Belleville washer and two tin or cadmium plated washers, one on each side in combination with aluminum joint compound on all contacting surfaces. Tighten and or torque bolts until Belleville washer is flat. Provide new Belleville washer after original use.

4. Insulate all bare surfaces of conductors with a minimum of four layers (half lap in two directions) of electrical insulating tape. On larger splices and terminals, build up connection with electrical insulating putty before applying tape, to eliminate both sharp edges and voids.
5. All splices and taps in manholes shall be waterproof, suitable for submersion in water. Splices and taps shall be made using split bolt or compression type connectors and insulating materials, as specified in Part 2 of this SECTION. Splices and taps in manholes and handholes shall be avoided whenever possible.

E. Cable Identification
1. See SECTION 16050 - Appendix "A".
2. Identify cable groups and conduit at entering and leaving locations in manholes by means of 1/8 inch thick lead die-stamped tags with punched ears. Fasten tags around the cable group or conduit with No. 12 AWG copper wire.
3. Designate source and load, or feeder or cable identification on tags. Submit identification for the approval of the ARCHITECT-ENGINEER.

END OF SECTION

Revision History	
Date	**Rev. No.**
A	0
B	0
D	0
E	0
F	0
02-19-09	0

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