

SECTION 16120 - WIRES AND CABLES

PART 1 GENERAL

1.1 SUMMARY:

- A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
- C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's data on electrical wires, cables and connectors.

1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver wire and cable properly packaged in factory- fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):

- 1. Wire and Cable:
 - a. American Insulated Wire
 - b. Anaconda-Ericsson Inc; Wire and Cable Div.
 - c. Belden Div; Cooper Industries.
 - d. Brand-Rex Div; Pyle National Co.
 - e. General Cable Corporation.
 - f. Hitemp Wires, Inc.
 - g. Phelps Dodge Cable and Wire Co.
 - h. Rome Cable Corp.
 - i. Southwire Company

- j. Okonite
- k. Superior Essex:
 - 1) Triangle
 - 2) Excel
 - 3) Royal

2. Connectors:

- a. O-Z/Gedney Co.
- b. AMP, Inc.
- c. Burndy Corporation.
- d. Ideal Industries, Inc.
- e. 3M Company
- f. Thomas and Betts Corp.

2.2 WIRES AND CABLES:

- A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed. Building wire shall be insulated with THHN/THWN/XHHW insulation, rated 600 volt.
- B. Conductors: Provide solid conductors for power, control, and lighting circuits 10 AWG and smaller. Provide stranded conductors for 8 AWG and larger.
- C. Conductor Material: Provide copper for all wires and cables.
 - 1. Metal Clad Cable - Type MC: Sizes 14 AWG through 10 AWG, copper conductors with 600 volt thermoplastic insulation rated 90 degrees C, steel OR aluminum interlocked metal type covering.
 - 2. Armored-Type HCF Cable: Sizes 14 AWG through 10 AWG, copper conductors with 600 volt thermoplastic insulation rated 90degrees C, steel OR aluminum interlocked metal type armor and bond wire that is clearly identified as an acceptable return grounding path. A green insulated equipment grounding conductor shall be included in the assembly. Armor shall be galvanized steel, color coated green.
 - 3. Portable Cord:
 - a. Type SO: Sizes 14 AWG through 2 AWG, copper conductors with 600 volt thermoset insulation 0.1 resistant insulation.
 - b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000 volt, 90 degreesC, ethylene-propylene insulation.
 - 4. Cables: Provide the following types of cables in NEC approved locations and applications where permitted by the contract documents. Cables shall be U.L. listed and approved by the local building authority. All cables shall contain a green insulated equipment ground conductor of the same size as the neutral conductor.

2.3 CONNECTORS:

- A. General: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.

- B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections. (Including phase, neutral and grounding conductors.)
- C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE:

- A. Building Wire: Install all building wire in raceway regardless of location.
- B. Metal Clad Cable/HCF:
 - 1. Maximum of 6 feet length for connecting luminaires in accessible ceilings to the local junction box.
 - 2. Maximum of 3 feet length for connecting luminaires in non-accessible ceilings to the local junction box.
 - 3. In stud walls and casework for horizontal branch circuit runs between devices.
 - 4. For vertical branch circuit drops from a local junction box above an accessible ceiling to the direct or single device in a stud wall, casework, under-cabinet lighting.
 - 5. May not be used for branch circuit home runs, feeders, motor feeder circuits or in the following locations:
 - a. Hazardous locations
 - b. Emergency Systems
- C. Portable Cord: Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.

3.2 INSTALLATION OF WIRES AND CABLES:

- A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- D. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.
- E. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect unspliced wire to numbered terminal strips at each end.
- F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

- G. Use splice and tap connectors which are compatible with conductor material.
- H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque values specified in UL Std 486A for copper and 486B for aluminum.
- I. Support cables above accessible ceilings, do not rest cables on ceiling tiles. Use spring clips and hanger rods independent from the ceiling suspension system to support cables from structure.
- J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.
- K. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.
- L. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.
- M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- N. Thoroughly tape the ends of spare conductors in boxes and cabinets.
- O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
- P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.
- Q. Branch circuits whose length from panel to first outlet exceeds 100 feet for 120 volt circuits or 175 feet for 277 volt circuit shall be #10 or larger, as required to comply with the National Electrical Code.
- R. Parallel conductors shall be cut to the same length.
- S. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.
- T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.
- U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting, transfer switch, and fire alarm cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.
 - 1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.

- V. Color coding of switchlegs, travelers, etc. shall be different and distinct from phase and neutral conductors. Where systems utilize two (2) different voltages, the color coding of switchlegs, travelers, etc. shall be different and distinct for each voltage system.

3.3 FIELD QUALITY CONTROL:

- A. Prior to energizing of circuitry, check installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meggered after installation, and prior to termination. Submit test report.
- B. Prior to energizing, test wires and cables for electrical continuity and for short-circuit faults.
- C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 COLOR CODING SCHEDULE:

- A. Color code secondary service, feeder, and branch circuit conductors as follows:

| <u>120/208 Volts</u> | <u>Phase</u> | <u>277/480 Volts</u> |
|----------------------|--------------|----------------------|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray |
| Green | Ground | Green |

- B. Conductors shall be solid color for entire length.
- C. If solid color conductors are not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:
- Conductors 10 AWG and smaller shall be solid color for the entire length.
 - Conductors 8 AWG and larger shall be black with color coding at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped $\frac{3}{4}$ inch plastic tape in the specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

END OF SECTION 16120