SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal-clad cable.

B. Wire and cable for 600 volts and less.

C. Wiring connectors.

1.02 SUBMITTALS

A. NONE REQUIRED.

1.03 DESIGN INTENT

A. MC cable is acceptable above accessible ceilings for branch circuits 30A or less. Transition to EMT prior to entering the new power panel.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Metal-clad cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Above accessible ceilings. Never used exposed in finished spaces.

D. Concealed Dry Interior Locations: Use only building wire with Type THHN/THWN insulation in raceway.

E. Exposed Dry Interior Locations: Use only building wire with Type THHN/THWN_ insulation in raceway.

F. Above Accessible Ceilings: Use only building wire with Type THHN/THWN insulation in raceway.

G. Wet or Damp Interior Locations: Use only building wire with Type THHN/THWN insulation in raceway.

H. Exterior Locations: Use only building wire with Type XHHW insulation in raceway.

I. Use solid conductor for feeder and branch circuits #10AWG and smaller.

J. Use stranded conductor for feeder and branch circuits #8 AWG and larger.

K. Use stranded conductors for control circuits.

L. Use conductor not smaller than 12 AWG for power and lighting circuits.

M. Use conductor not smaller than 16 AWG for control circuits.

N. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

O. Use copper conductors for conductor sizes less than 100 amps. Use Aluminum for conductors 100A and larger, except for feeders to chillers. No aluminum conductors shall be used to supply chillers, only copper.

2.02 ALL CONDUCTORS AND CABLES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
   2. Tinned Copper Conductors: Comply with ASTM B33.

H. Conductor Color Coding:
   1. Color code conductors as indicated. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
   3. Color Code:
      a. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      b. Equipment Ground, All Systems: Green.
      c. Isolated Ground, All Systems: Green with yellow stripe.

2.03 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

E. Grounding: Full-size integral equipment grounding conductor.

F. Armor: Steel, interlocked tape.

G. Manufacturers:
   1. Southwire, United Copper Industries, Cerro Wire and Cable, Okonite, Coleman, Corraclad, AFC Cable Systems.
   2. Substitutions: See Section 01 6000 - Product Requirements.

H. MC Cable Description:
   1. MC cable shall be rated for the application.
   2. MC cable shall have a steel armor which shall be spiral wrapped.
   3. MC cable shall be used for sizes #12 AWG or #10 AWG only.
   4. MC cable shall contain a green equipment grounding conductor.
   5. Color code the conductors as specified for the application voltage. Black insulation with color code tape shall not be acceptable.
   6. Provide conductors quantity as required by the application.

I. Application Location for MC Cable:
   1. MC cable shall be allowed inside casework as an alternative to conductor in conduit. Provide MC cable from casework outlets, concealed through casework, to a homerun box located in the casework. MC cable shall not be exposed.
   2. MC cable may be used above accessible ceilings.
   3. Conduit, not MC cable, shall be provided through fire rated surfaces. Conduit, not MC cable, shall be used in wet or damp locations.

4. Coordinate MC locations with the Design Professional before stubbing in. The Design Professional reserves the right to require conductor-in-conduit rather than MC cable if the Design Professional considers the MC cable to be exposed or mis-applied.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

2.05 LACING AND LUBRICANTS

A. Lacing: wiring in cabinets, panels, pullboxes, junction boxes and electrical gear shall be laced and held with one of the following:
   1. T&B Ty-Raps
   2. Fastway Wire Ties
   3. Burndy Uni Raps

B. Lubricants: Electro Y-ER-EAS, Ideal Yellow 77, or Minerallac #100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as shown on the drawings.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

B. Verify that interior of building has been protected from weather.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated and routing is not shown, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location shown.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

G. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

H. Install conductors with a minimum of 12 inches of slack at each outlet.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

L. Insulate ends of spare conductors using vinyl insulating electrical tape.

M. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

O. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

P. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA-1.

Q. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Include circuit of lengths required to install connected devices within 10 ft of location shown.

R. Use wiring methods indicated.

S. Use suitable wire pulling lubricant for building wire #4 AWG and larger, and for smaller sizes where require to pull without conductor damage. Manufacturers include but are not limited to Electro Y-ER-EAS, Ideal Yellow 77, Minerallac #100, or Polywater.

T. Pull all conductors into raceway at the same time.

U. Do not pull wires until conduit system is complete.

V. Raceway shall be continuous.

W. Terminations and Equipment Connections: compression fittings shall be installed with the manufacturer's recommended procedures and tools. Mechanical connections shall be torqued utilizing the manufacturer's published torque requirements utilizing tools indicating torque values for the device being tightened.

X. Use suitable wire pulling lubricant for building wire #4 AWG and larger.

Y. Protect exposed cable from damage.

Z. All splices, taps and joints in exterior circuits shall be waterproofed by use of UL listed kits.

AA. Use suitable cable fittings and connectors.

AB. Neatly train and lace wiring inside boxes, equipment, and panelboards.

AC. Conductors shall be continuous and unspliced between junction boxes, panels, or equipment terminations.

AD. Provide manufacturer's compatible fittings meeting U.L. at boxes.

3.04 MC Cable Installation:

A. Install MC cable with minimum 12 inches of slack cable per run at each end of each cable, accessible for future use at the boxes.

B. MC cable two feet or shorter may be supported at boxes only. Support MC cable longer than two feet within 12 inches of each end of cable, and at maximum 5 foot intervals along the cable.

C. Route MC cable parallel with building walls and structure, and neatly support MC cable from them. Utilize conduit clamps or unistrut support to hold one, two or three MC cables. Utilize unistrut support to hold more than three MC cables.

D. Conform to the requirements of conduit routing and clearances from other utilities. Support MC cable according to N.E.C.

E. Provide manufacturer's compatible fittings meeting U.L. at boxes.

F. Provide metal clips or clamps within two feet of cable ends and maximum six feet intervals.

G. Conform to NEC bend radius.

H. Route MC cable parallel with building walls and structure, and neatly support MC cable from them. Do not "Beeline".

I. At turns in the MC cable, conform to NEC bend radius and provide slack. Do not pull MC cable tight around corners or other utilities.

3.05 SPLICES, TAPS, TERMINATIONS

A. Clean conductor surfaces before installing lugs and connectors.

B. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

C. Conductors #6 AWG and larger: Provide mechanical connectors containing pre-formed and molded insulation designed with the connector as a system.

D. Conductors #6 AWG and larger: provide Terminal Lugs. Anderson Versa-Crimp, Burndy Hydent or T & B Color-Keyed.

E. Conductors #6 AWG and larger: Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

G. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
   1. Use Hi Bakelite wire connectors, 3M Skotchloks or Ideal Wing Nut. Conductors insulation shall extend into the wire connector.
   2. The connector shall be covered with vinyl plastic tape or with Raychem 600VAC heatshrink insulation.

H. Splices, taps and joints in exterior circuits shall be waterproofed by use of UL listed kits.
   1. In damp or wet locations such as outside lighting, provide watertight conductor connections.
   2. Sealing system shall be flame-retardant heat shrinkable watertight seal with heat activated sealants, Raychem or equal.

I. Compression fittings shall be installed with the manufacturer's recommended procedures and tools.

J. Mechanical connections shall be torqued utilizing the manufacturer's published torque requirements utilizing tools indicating torque values for the device being tightened.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection to assure all provisions of this specification are incorporated prior to Final Inspection.

B. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION