SECTION 26 0519

WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wires and cables rated 600 volts and less.

B. Type MC as permitted in Part 3.

1.2 RELATED SECTIONS

A. Underground ducts: Section 26 0544.

B. Conduits: Section 26 0533.

C. Surface metal raceways: Section 26 0535.

D. Fire Detection and Alarm System: Division 28.

1.3 REFERENCES

A. ANSI/NEMA WC 70: Power Cables rated 2000 Volts or Less for Distribution of Electrical Energy.

B. ASTM B3: Standard Specification for Soft or Annealed Copper Wire.

C. ASTM B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors.

D. UL 44: Standard for Thermoset-Insulated Wires and Cables.

E. UL 83: Standard for Thermoplastic-Insulated Wires and Cables.

F. Additional UL Standards as indicated.

1.4 SUBMITTALS

A. Product data:

1. Each type of wire and cable, including accessories.
2. Include copies of UL certifications showing compliance with requirements in “Quality Assurance” below.

B. Product schedule: Provide schedule or detailed statement on use of wires and cables. Indicate wire or cable type, product use, and representative location(s).

1. Identify proposed use of wire or cable types in locations not specifically listed in specifications or on drawings.

1.5 QUALITY ASSURANCE

A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


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B. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer's instructions.

1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
2. Protect wire and cable during storage (both onsite and offsite).

a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.
4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600 volts maximum)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.

B. Conductor insulation: Type THHN / THWN-2: Comply with UL 83; PVC insulation, nylon jacket.

C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor.

| COLOR CODE (600 volts maximum) | | | | |
|---|---|---|---|---|
| VOLTAGE | NEUTRAL | PHASE | | |
| | | A | B | C |
| 120 volts, 2-wire | White | Black, Red, or Blue depending on phase | | |
| 277 volts, 2-wire | Gray | Brown, Orange, or Yellow depending on phase | | |
| 208 volts, single-phase, 2-wire | | Black/Red, Red/Blue, or Blue/Black | | |
| 208/120 volts wye, 3-phase, 4-wire | White | Black | Red | Blue |
| 480/277 volts wye, 3-phase, 4-wire | Gray | Brown | Orange | Yellow |
| 480 volts delta, 3-phase, 3-wire | | Brown | Orange | Yellow |

D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

## 2.2 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.

B. Twist-on wire connectors (dry locations):

1. Color-keyed.
2. Basis of design: Ideal Industries, Inc., Wingnut®, 3M Company "Scotchlok", or King Innovation.

C. Twist-on wire connectors (damp and wet locations):

1. Connectors shall be listed under UL 486D.
2. Basis of design: Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or 3M Company.

D. Compression connectors:

1. Color-keyed.
2. Basis of design: 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors, "20000" series for aluminum conductors, or Thomas & Betts (Blackburn) or Ilsco.

E. Compression connectors (damp and wet locations):

1. Protect connectors with a waterproof system, UL-listed for direct burial and 600 volts.
2. Basis of design: 3M Company 8420 series, Thomas & Betts Model DBSK82, or Ilsco.

F. Compression taps:

1. Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps,
2. Basis of design: Burndy Corporation "Versitap" or OZ/Gedney.

G. Power distribution blocks:

1. Basis of design: Hubbell Burndy “U-Blok.”

H. Multi-tap connectors, clear insulated:

1. Basis of design: Burndy Corporation "UNITAP" or Ilsco "Cleartap".

## 2.3 UNDERGROUND CONDUCTORS

A. Underground cable, Type THHN / THWN-2: Single-conductor, underground cable.

1. Cable: UL 83 listed; NEMA WC 70 construction; 600-volt, single-conductor. Solid copper No. 10 and smaller, stranded copper No. 8 and larger; and with PVC and nylon jacket insulation.

## 2.4 METAL-CLAD CABLE, TYPE MC

A. Cable: UL 83 and UL 1569 listed; 600-volt, single- or multi-circuit Type MC Cable, multi-conductor with ground conductor; aluminum or steel interlocked armor.

B. Conductors: Solid copper No. 10 and smaller, and stranded copper No. 8 and larger; conforming to ASTM B 3 or B 8.

C. Conductor Insulation: Type THHN/THWN insulated single conductors including ground conductor.

D. Fittings:

1. UL 514B listed, steel or malleable iron fittings. Zinc die-cast fittings shall not be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide wire and cable indicated in accordance with national, state, and local electrical codes.

B. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable serving systems over 100 volts shall be installed in raceways, except where otherwise noted on drawings.

D. Wire and cable serving systems rated below 100 volts shall be installed in raceways, except where otherwise noted in individual specification sections. Refer to paragraph “INSTALLING CABLE RATED BELOW 100 VOLTS” below for additional information.

3.2 INSTALLING INTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 120-volt branch circuits:

a. Homerun from first outlet to panel: No. 12 when run is 50 feet (15,000 mm) or less; No. 10 when run is between 50 feet (15,000 mm) and 100 feet (30,000 mm); No. 8 when run is more than 100 feet (30,000 mm).
b. First outlet to other outlets: No. 12.

2. Exit light and emergency lighting circuits: No. 10. Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.
3. Other systems (over 100-volts): Minimum No. 12 unless specified or shown on drawings to be smaller.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders: Type THHN / THWN-2, single conductors in raceway.
2. Branch circuits, concealed in ceilings, walls, and partitions:

a. Unless otherwise indicated, utilize Type THHN / THWN-2, single conductors in raceway.
b. Metal-clad cable, Type MC cable - Refer to section “INSTALLING MC CABLE” below for acceptable locations.

3. Branch circuits, exposed: Type THHN / THWN-2, single conductors in raceway.
4. All other applications: Provide Type THHN / THWN-2, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including over boilers and breechings, and fixture channels.

E. Wires shall be neatly shaped in panels, wireways, boxes, and appurtenances.

3.3 COORDINATION WITH DEVICES AND EQUIPMENT

A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment which is not sized for the connection:

1. Provide a junction box as near the equipment as possible, but no more than 10 feet (3 m) away. Obtain approval of location before installing.
2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.
3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

3.4 INSTALLING EXTERIOR WIRING

A. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders and branch circuits, exposed: Type THHN / THWN-2, single conductors in raceway.
2. Feeders and branch circuits, underground: Type THHN / THWN-2, single conductors in raceway.

B. Splicing shall be done in outlet boxes and junction boxes and not in conduit. Treat these boxes as wet locations.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

3.5 INSTALLING CABLE RATED BELOW 100 VOLTS

A. Install in raceway, unless otherwise indicated in individual specification sections.

B. Where individual specification sections allow cable to be installed either in raceway or on J-hooks, install as follows:

1. Wiring method:

a. Wiring in walls, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway.

c. Wiring concealed above accessible suspended ceilings: Install cables on J-hooks in corridors and J-hooks elsewhere.
d. Wiring within enclosures, consoles, cabinets, desks, and counters: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and/or distribution spools.

2. Conceal raceway and cables, except in unfinished spaces, and in open ceiling spaces and raceways on existing walls.
3. Cable not in raceways:

   a. Do not install in hangers used for pipes, electric conduits, or ceiling hangers, nor support it in any way by attachments to pipes, conduits, or ceiling hangers.
   b. Install without damaging conductors, shield, or jacket. Cables shall not run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
   c. Install away from potential EMI sources, including electrical power lines and equipment.
   d. Install parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

4. Cable support with J-hooks:

   a. Install J-hooks at intervals not exceeding 48 inches.
   b. Secure cables on J-hooks with cable ties.

5. Each cable run shall contain an ‘S’ loop or other means to accommodate expansion or contraction.
6. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in conduit or use UL listed plenum cable.

C. For cable installed in conduit, comply with requirements for raceways and boxes specified in Section 26 0533, Conduits, and Section 26 0534, Boxes.

   1. Provide separate conduit systems for each low-voltage system.
   2. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

      a. Pull cables simultaneously if more than one is being installed in same raceway.
      b. Use pulling compound or lubricant, if necessary. Use compounds that will not damage conductor or insulation.
      c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

D. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cable. If cable must be placed close to such utilities, keep it separate and protect with insulation.

E. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

F. Tag cables connected to electronic equipment, to show function and the location of other end. Securely fasten labels to the cable.

3.6 INSTALLING MC CABLE

A. Install in compliance with NFPA 70.

   1. Bend radius shall not be less than 7 times the external diameter of the cable.

2. Securely fasten in place at intervals of not more than six feet, with suitable clamps or fasteners of approved type.
3. Maintain at least 6-inch clearance between MC cables and other piping systems.
4. Do not fasten MC cable to conduits, pipes, or ducts.
5. Support individual MC cables hung from roof structure or structural ceiling by independently supported hangers using hanger rods, jack chains, or No. 10 wire.
6. Support groups of MC cable run in parallel on trapeze hangers suspended from 0.5-inch hanger rods, held in place with MC cable clamps or fasteners.
7. Installing hangers for MC cable shall be similar to installing conduit hangers.
8. Support MC cable on each side of a bend and not more than 1 foot from an enclosure where an MC cable is terminated.

B. Sizes: Cables larger than No. 8 shall not be permitted.

C. Locations: Type MC cable may be used for branch circuits in the following locations and conditions, unless otherwise indicated:

1. Concealed in accessible ceiling spaces or within casework.
2. Light fixture whips from junction box in accessible ceiling to recess-mounted lighting fixtures.
3. Within drywall partitions / metal stud wall construction: Between wiring devices and from wiring device to nearest junction box in accessible ceiling.
4. From pullbox or wireway located in accessible ceiling space above or below respective panelboard to branch circuit loads served.
5. Do not install in masonry partitions or masonry walls.

D. Connect cable with wiring accessories specified above.

E. MC cable run to switches shall have a neutral conductor. This conductor is not indicated on the drawings.

F. Provide junction box in accessible ceiling space of each room and terminate MC cables in room at box.

END OF SECTION


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