

1. SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
- Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

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, except as specifically indicated.
- 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:

- Where not otherwise restricted, may be used:
 - Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - In addition to other applicable restrictions, may not be used:
 - Unless approved by Owner.
 - Where exposed to damage.
- For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Conductor Material:

- Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
- Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
 - Services: Copper conductors size 1/0 AWG and larger.
 - Where aluminum conductors are substituted for copper, comply with the following:
 - Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
 - Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.

3. Provide aluminum equipment grounding conductor sized according to NFPA 70.
4. Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

- Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

- Tinned Copper Conductors: Comply with ASTM B33.

E. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

- 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
- 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
- 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.

2. Control Circuits: 14 AWG.

F. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

G. Conductor Color Coding:

1. Color code conductors as called for within the NEC or otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Circulating Requirements:

- Unless dimensioned, circuit routing indicated is diagrammatic.
- When circuit destination is indicated without specific routing, determine exact routing required.
- Arrange circuiting to minimize splices.
- Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
- Maintain separation of wiring for emergency systems in accordance with NFPA 70.

B. 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. Installation in Raceway:

- Type ends of conductors and cables to prevent infiltration of moisture and other contaminants.
- Pull all conductors and cables together into raceway at same time.
- Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
- Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

4. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
5. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

6. 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.
7. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

8. Install conductors with a minimum of 12 inches of slack at each outlet.
9. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
11. 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.

2. SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 PRODUCTS

1.01 GROUNDING AND BONDING REQUIREMENTS

- A. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- B. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

C. Grounding Electrode System:

- Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
- Metal Underground Water Pipe(s):
 - Metal In-Ground Support Structure:
 - Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - Concrete-Encased Electrode:
 - Ground Ring:
 - Ground Rod Electrode(s):
 - Space electrodes not less than 8 feet from each other and any other ground electrode.
 - Ground Bar: Provide ground bar, separate from service equipment enclosures, for common connection point of grounding electrode system bonding lugs as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

D. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:

- A. Transformers (except autotransformers such as buck-boost transformers).
- B. Uninterruptible power supplies (UPS), when configured as separately derived systems.
- C. Generators, when neutral is switched in the transfer switch.

2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at building (grounded) bus in space enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, when not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

E. Bonding and Equipment Grounding:

- Provide bonding for equipment grounding conductors, equipment ground buses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing energized conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Provide bonding for integral metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.

F. Isolated Ground System:

- Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.

G. Communications Systems Grounding and Bonding:

- Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

1.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

- Provide products listed, classified, and labeled as suitable for the purpose intended.
- Provide products listed and labeled as complying with UL 467 where applicable.

B. Connectors for Grounding and Bonding:

- Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
- Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

- C. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

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2. SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 PRODUCTS

1.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

- Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
- Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported; include consideration for vibration, equipment operation, and shock loads where applicable.

- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:

- Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 2 EXECUTION

2.01 INSTALLATION

- A. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- B. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

- C. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- D. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

4. SECTION 26 0533.13
- CONDUIT FOR ELECTRICAL SYSTEMS
- PART 1 PRODUCTS

1.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

- C. Underground:
 - Use galvanized steel rigid metal conduit, PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
- D. Concealed: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

- E. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

- G. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
- Maximum Length: 6 feet.

- H. Connections to Vibrating Equipment:
- Dry Locations: Use flexible metal conduit.
 - Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - Maximum Length: 6 feet unless otherwise indicated.

1.02 CONDUIT REQUIREMENTS

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

PART 2 EXECUTION

2.01 INSTALLATION

- A. Conduit Routing:
- Conceal all conduits unless specifically indicated to be exposed.
 - Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within closets in areas with no ceiling.
 - Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

- B. Conduit Support:
- Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

- C. Connections and Terminations:
- Conduits and Termination:

1. Use suitable adapters where required to transition from one type of conduit to another.

2. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.

3. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

D. Penetrations:

- Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
- Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

3. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.

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

- E. Conduction Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent conduction.

- F. Provide grounding and bonding in accordance with Section 26 0526.

5. SECTION 26 0533.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 PRODUCTS

1.01 BOXES

A. General Requirements:

- Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
- Provide all boxes, fittings, supports, and accessories required for a complete raceway system, and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
- Use raised covers suitable for the type of wall construction and device configuration where required.
 - Use shallow boxes where required by the type of wall construction.

3. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with feature stud to accommodate mounting of luminaire where required.

4. Boxes for Ganged Devices: Use multi-gang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

5. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.

- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
- Comply with NFPA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - NEMA 250 Environment Type, Unless Otherwise Indicated:

3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

- D. Floor Boxes:
- Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.

PART 2 EXECUTION

2.01 INSTALLATION

- A. Box Locations:
- Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 - Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

3. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.

- B. Install boxes plumb and level.
- C. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

- D. Close unused box openings.
- E. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

4. 26 0533.23

SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 PRODUCTS

1.01 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

1.02 EMBREWAYS

- A. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- B. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2. SECTION 26 0533.23
- SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS
- PART 1 PRODUCTS

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- SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS
- PART 1 PRODUCTS

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- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
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- PART 1 PRODUCTS

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- PART 1 PRODUCTS

1.01 RACEWAY REQUIREMENTS

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- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

1. Colors: Comply with NEMA WD 1.

2. Cord Construction: NFPA 70, Type SJO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

1.02 EQUIPMENT CONNECTIONS

- A. As indicated in equipment schedules on drawings or as indicated on plans.
- PART 2 EXECUTION

- 2.01 EQUIPMENT CONNECTIONS
- A. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

- B. Control heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

- C. Provide receptacle outlet to accommodate connection with attachment plug.

- D. Provide cord and cap where field-supplied attachment plug is required.

- E. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

- F. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

- G. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- H. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

4. SECTION 26 0919