

For many years, messenger-supported wiring systems have been used in industrial installations as well as to supply services for commercial and residential installations.

#### See also

**225.6(A)** and **(B)** for references to messenger-supported wiring

## Part II. Installation

### 396.10 Uses Permitted.

**(A) Cable Types.** The cable types in Table 396.10(A) shall be permitted to be installed in messenger-supported wiring under the conditions described in the article or section referenced for each.

**TABLE 396.10(A) Cable Types**

Cable Type	Section	Article
Medium-voltage cable		315
Metal-clad cable		330
Mineral-insulated, metal-sheathed cable		332
Multiconductor service-entrance cable		338
Multiconductor underground feeder and branch-circuit cable		340
Other factory-assembled, multiconductor control, signal, or power cables that are identified for the use		
Power and control tray cable		336
Power-limited tray cable	Table 722.135(B), 722.135(C), and 722.179(A)(6)	

**(B) In Industrial Establishments.** In industrial establishments only, where conditions of maintenance and supervision ensure that only qualified persons service the installed messenger-supported wiring, the following shall be permitted:

- (1) Any of the conductor types shown in Table 310.4(1) or Table 310.4(2)
- (2) MV cable

Where exposed to weather, conductors shall be listed for use in wet locations. Where exposed to direct rays of the sun, conductors or cables shall be sunlight resistant.

Some of the triplex and quadruplex cables used by utilities as service-drop cable do not use conductors recognized in Table 310.4(1) and do not meet the requirements of Article 310.

#### See also

**310.15(B)** and **Table 310.20** or two or three single-insulated conductors supported on a messenger wire

**310.15(C)** and **Table B.2(3)** in Informative Annex B for ampacities of conductors for other cable types

**(C) Hazardous (Classified) Locations.** Messenger-supported wiring shall be permitted to be used in hazardous (classified) locations where the contained cables and messenger-supported wiring are specifically permitted by other articles in this *Code*.

**396.12 Uses Not Permitted.** Messenger-supported wiring shall not be used in hoistways or where subject to physical damage.

### 396.30 Messenger.

**(A) Support.** The messenger shall be supported at dead ends and at intermediate locations so as to eliminate tension on the conductors. The conductors shall not be permitted to come into contact with the messenger supports or any structural members, walls, or pipes.

**(B) Neutral Conductor.** Where the messenger is used as a neutral conductor, it shall comply with the requirements of 225.4, 250.184(A), 250.184(B)(7), and 250.187(B).

**(C) Equipment Grounding Conductor.** Where the messenger is used as an equipment grounding conductor, it shall comply with the requirements of 250.32(B), 250.118, 250.184(B)(8), and 250.187(D).

**396.56 Conductor Splices and Taps.** Conductor splices and taps made and insulated by approved methods shall be permitted in messenger-supported wiring.

**396.60 Grounding.** The messenger shall be grounded as required by 250.80 and 250.86 for enclosure grounding.

#### ARTICLE

## 398

## Open Wiring on Insulators

## Part I. General

**398.1 Scope.** This article covers the use, installation, and construction specifications of open wiring on insulators.

Open wiring on insulators is an exposed wiring method that is not permitted to be concealed by the building structure or finish. It is permitted indoors or outdoors, in dry or wet locations, and where subject to corrosive vapors, provided the insulation choice from Table 310.4(1) is suitable for use in a corrosive environment.

This wiring method is not permitted for temporary lighting and power circuits on construction sites but is permitted for lighting and power circuits in agricultural buildings (see 547.20). It may also be used for services (see 230.43).

#### See also

**Tables 310.17** and **310.19** for ampacities of conductors

## Part II. Installation

**398.10 Uses Permitted.** Open wiring on insulators shall be permitted only for industrial or agricultural establishments on systems of 1000 volts, nominal, or less, as follows:



- (1) Indoors or outdoors
- (2) In wet or dry locations
- (3) Where subject to corrosive vapors
- (4) For services

**398.12 Uses Not Permitted.** Open wiring on insulators shall not be installed where concealed by the building structure.

### 398.15 Exposed Work.

**(A) Dry Locations.** In dry locations, where not exposed to physical damage, conductors shall be permitted to be separately enclosed in flexible nonmetallic tubing. The tubing shall be in continuous lengths not exceeding 4.5 m (15 ft) and secured to the surface by straps at intervals not exceeding 1.4 m (4½ ft).

**(B) Entering Spaces Subject to Dampness, Wetness, or Corrosive Vapors.** Conductors entering or leaving locations subject to dampness, wetness, or corrosive vapors shall have drip loops formed on them and shall then pass upward and inward from the outside of the buildings, or from the damp, wet, or corrosive location, through noncombustible, nonabsorbent insulating tubes.

Informational Note: See 230.52 for individual conductors entering buildings or other structures.

**(C) Exposed to Physical Damage.** Conductors within 2.1 m (7 ft) from the floor shall be considered exposed to physical damage. Where open conductors cross ceiling joists and wall studs and are exposed to physical damage, they shall be protected by one of the following methods:

- (1) Guard strips shall not be less than 25 mm (1 in.) nominal in thickness and at least as high as the insulating supports, placed on each side of and close to the wiring.
- (2) A substantial running board at least 13 mm (½ in.) thick in back of the conductors with side protections. Running boards shall extend at least 25 mm (1 in.) outside the conductors, but not more than 50 mm (2 in.), and the protecting sides shall be at least 50 mm (2 in.) high and at least 25 mm (1 in.), nominal, in thickness.
- (3) Boxing made in accordance with 398.15(C)(1) or (C)(2) and furnished with a cover kept at least 25 mm (1 in.) away from the conductors within. Where protecting vertical conductors on side walls, the boxing shall be closed at the top and the holes through which the conductors pass shall be bushed.
- (4) Rigid metal conduit (RMC), intermediate metal conduit (IMC), rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or electrical metallic tubing (EMT). When installed in metal piping, the conductors shall be encased in continuous lengths of approved flexible tubing.

**398.17 Through or Parallel to Framing Members.** Open conductors shall be separated from contact with walls, floors, wood cross members, or partitions through which they pass by

tubes or bushings of noncombustible, nonabsorbent insulating material. Where the bushing is shorter than the hole, a waterproof sleeve of noninductive material shall be inserted in the hole and an insulating bushing slipped into the sleeve at each end in such a manner as to keep the conductors absolutely out of contact with the sleeve. Each conductor shall be carried through a separate tube or sleeve.

Informational Note: See 310.14(A)(3) for temperature limitation of conductors.

**398.19 Clearances.** Open conductors shall be separated at least 50 mm (2 in.) from metal raceways, piping, or other conducting material, and from any exposed lighting, power, or signaling conductor, or shall be separated therefrom by a continuous and firmly fixed nonconductor in addition to the insulation of the conductor. Where any insulating tube is used, it shall be secured at the ends. Where practicable, conductors shall pass over rather than under any piping subject to leakage or accumulations of moisture.

**398.23 In Accessible Attics.** Conductors in unfinished attics and roof spaces shall comply with 398.23(A) or (B).

**(A) Accessible by Stairway or Permanent Ladder.** Conductors shall be installed along the side of or through bored holes in floor joists, studs, or rafters. Where run through bored holes, conductors in the joists and in studs or rafters to a height of not less than 2.1 m (7 ft) above the floor or floor joists shall be protected by substantial running boards extending not less than 25 mm (1 in.) on each side of the conductors. Running boards shall be securely fastened in place. Running boards and guard strips shall not be required for conductors installed along the sides of joists, studs, or rafters.

**(B) Not Accessible by Stairway or Permanent Ladder.** Conductors shall be installed along the sides of or through bored holes in floor joists, studs, or rafters.

*Exception: In buildings completed before the wiring is installed, in attic and roof spaces that are not accessible by stairway or permanent ladder and have headroom at all points less than 900 mm (3 ft), the wiring shall be permitted to be installed on the edges of rafters or joists facing the attic or roof space.*

### 398.30 Securing and Supporting.

**(A) Conductor Sizes Smaller Than 8 AWG.** Conductors smaller than 8 AWG shall be rigidly supported on noncombustible, nonabsorbent insulating materials and shall not contact any other objects. Supports shall be installed as follows:

- (1) Within 150 mm (6 in.) from a tap or splice
- (2) Within 300 mm (12 in.) of a dead-end connection to a lampholder or receptacle
- (3) At intervals not exceeding 1.4 m (4½ ft) and at closer intervals sufficient to provide adequate support where likely to be disturbed



**(B) Conductor Sizes 8 AWG and Larger.** Supports for conductors 8 AWG or larger installed across open spaces shall be permitted up to 4.5 m (15 ft) apart if noncombustible, nonabsorbent insulating spacers are used at least every 1.4 m (4½ ft) to maintain at least 65 mm (2½ in.) between conductors.

Where not likely to be disturbed in buildings of mill construction, 8 AWG and larger conductors shall be permitted to be run across open spaces if supported from each wood cross member on approved insulators maintaining 150 mm (6 in.) between conductors.

Mill construction is generally considered to be a building in which the floors and ceilings are supported by wood timbers or beams or wood cross members spaced approximately 15 feet apart. This type of construction is sometimes referred to as plank-on-timber construction. Conductors 8 AWG and larger are permitted to span the 15-foot distance where the ceilings are high and free of obstructions and the conductors are unlikely to come into contact with other objects.

**(C) Industrial Establishments.** In industrial establishments only, where conditions of maintenance and supervision ensure that only qualified persons service the system, conductors of sizes 250 kcmil and larger shall be permitted to be run across open spaces where supported at intervals up to 9.0 m (30 ft) apart.

The installation of open feeders on insulators mounted on the bottom of roof trusses at every bay location was once common in industrial buildings. Many bays are more than 15 feet wide.

Therefore, size 250 kcmil and larger conductors are permitted to be supported at 30-foot intervals in industrial buildings, where qualified persons must service the system.

In addition to the ease and economy of installation or alteration of open wiring, the close spacing of conductors reduces the reactance of a circuit and, hence, reduces the voltage drop.

**(D) Mounting of Conductor Supports.** Where nails are used to mount knobs, they shall not be smaller than tenpenny. Where screws are used to mount knobs, or where nails or screws are used to mount cleats, they shall be of a length sufficient to penetrate the wood to a depth equal to at least one-half the height of the knob and the full thickness of the cleat. Cushion washers shall be used with nails.

**(E) Tie Wires.** Conductors 8 AWG or larger and supported on solid knobs shall be securely tied thereto by tie wires having an insulation equivalent to that of the conductor.

**398.42 Devices.** Surface-type snap switches shall be mounted in accordance with 404.10(A), and boxes shall not be required. Other type switches shall be installed in accordance with 404.4.

### Part III. Construction Specifications

**Δ 398.104 Conductors.** Conductors shall be of a type identified in Table 310.4(1).