Exception: Voltage markings shall be permitted where the cable has multiple listings and voltage marking is required for one or more of the listings.

N **(D) Cable Jacket Compound.** The cable jacket compound shall have a high degree of abrasion resistance.

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ARTICLE
770 Optical Fiber Cables

Part I. General

770.1 Scope. This article covers the installation of optical fiber cables. This article does not cover the construction of optical fiber cables.

Article 770 permits the use of optical fiber technology in conjunction with electrical conductors for communications, signaling, and control circuits in lieu of metallic conductors. Optical fiber cables may be nonconductive, or they may be composite, containing electrical conductors. See Exhibits 770.1 and 770.2. The most common optical fiber cable used in buildings is nonconductive. Because they are not affected by electrical noise, optical fiber cables to transmit data or other communications can be desirable in circumstances where electrical noise is a problem.

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770.3 Other Articles. Installations of optical fiber cables shall comply with 770.3(A) through (D). Only those sections of Chapter 2 and Article 300 referenced in this article shall apply to optical fiber cables.

Δ **(A) Hazardous (Classified) Locations.** Listed optical fiber cables shall be permitted to be installed in hazardous (classified) locations. The cables shall be sealed in accordance with 501.15, 502.15, 505.16, or 506.16, as applicable.

(B) Cables in Ducts for Dust, Loose Stock, or Vapor Removal. The requirements of 300.22(A) for wiring systems shall apply to conductive optical fiber cables.

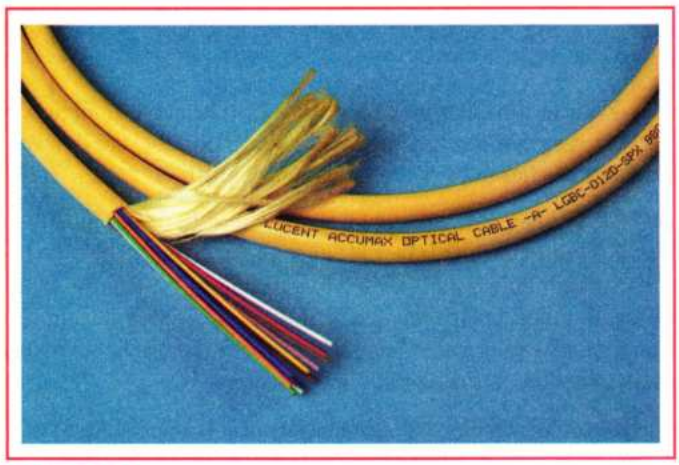


EXHIBIT 770.1 An example of a nonconductive optical fiber cable.

EXHIBIT 770.2 An example of a composite optical fiber cable that also meets the requirements of Article 330 and is referred to as Type MC cable. *(Courtesy of AFC Cable Systems, a Part of Atkore International)*

(C) Hybrid Cables. Hybrid optical fiber cables shall be classified as electrical cables in accordance with the type of electrical conductors. They shall be constructed, listed, and marked in accordance with the appropriate article for each type of electrical cable.

N **(D) Vertical Support for Fire-Resistive Cables.** Vertical installations of circuit integrity (CI) cables installed in a raceway or cables of fire-resistive cable systems shall be installed in accordance with their listing.

770.21 Access to Electrical Equipment Behind Panels Designed to Allow Access. Access to electrical equipment shall not be denied by an accumulation of optical fiber cables that prevents removal of panels, including suspended ceiling panels.

An excess accumulation of wires and cables can limit access to equipment by preventing the removal of access panels. Exhibit 770.3 shows both incorrect and correct installation methods for the installation of communication cables. The correct installation method has the cables supported well above the acoustical ceiling panels, allowing for proper access when needed.

Δ **770.24 Mechanical Execution of Work.**

N **(A) General.** Optical fiber cables shall be installed in a neat and workmanlike manner. Cables installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use. Such cables shall be secured by hardware, including straps; staples; cable ties listed and identified for securement and support; and hangers, or similar fittings, designed and installed so as not to damage the cable.

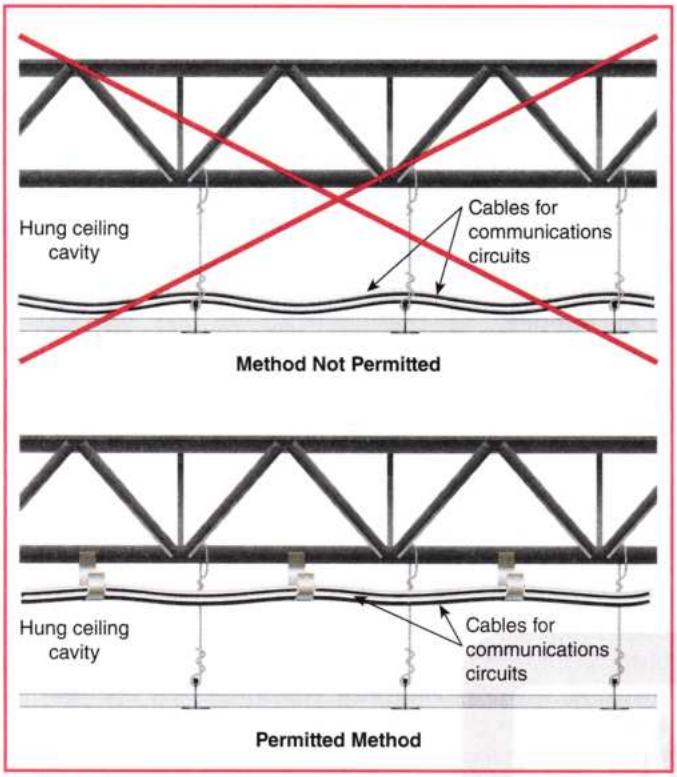


EXHIBIT 770.3 Incorrect installation of cables *(upper diagram)* and correct method *(lower diagram)*.

The installation shall also conform to 300.4 and 300.11. Plenum cable ties and other nonmetallic cable accessories used to secure and support cables in other spaces used for environmental air (plenums) shall be listed as having low smoke and heat release properties in accordance with 800.170.

Informational Note No. 1: See ANSI/NECA/FOA 301-2016, *Standard for Installing and Testing Fiber Optic Cables*, ANSI/TIA-568.0-D-2015, *Generic Telecommunications Cabling for Customer Premises*, and ANSI/TIA 568.3-D-2016, *Optical Fiber Cabling and Components Standard*, for accepted industry practices.

Informational Note No. 2: See NFPA 90A-2021, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, for discrete combustible components installed in accordance with 300.22(C).

Informational Note No. 2 references two requirements in NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, that have an influence on installations covered in the *NEC*®. This is not intended to require products covered by this section to be listed for other than their smoke and heat properties.

Informational Note No. 3: Paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants may result in an undetermined alteration of optical fiber cable properties.

N **(B) Circuit Integrity (CI) Cable.** Circuit integrity (CI) cable shall be supported at a distance not exceeding 610 mm (24 in.). Cable shall be secured to the noncombustible surface of the building structure. Cable supports and fasteners shall be steel.

770.25 Abandoned Cables. The accessible portion of abandoned optical fiber cables shall be removed. Where cables are identified for future use with a tag, the tag shall be of sufficient durability to withstand the environment involved.

See Article 100 for the definition of *accessible (as applied to wiring methods)*. Abandoned cable unnecessarily increases fire loading, and, where installed in plenums, it can affect airflow.

See also

Article 100 for definition of the term cable, *abandoned (abandoned cable)*

770.26 Spread of Fire or Products of Combustion. Installations of optical fiber cables and communications raceways in hollow spaces, vertical shafts, and ventilation or air-handling ducts shall be made so that the possible spread of fire or products of combustion will not be substantially increased. Openings around penetrations of optical fiber cables and communications raceways through fire-resistant–rated walls, partitions, floors, or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.

Informational Note: Directories of electrical construction materials published by qualified testing laboratories contain many listing installation restrictions necessary to maintain the fire-resistive rating of assemblies where penetrations or openings are made. Building codes also contain restrictions on membrane penetrations on opposite sides of a fire resistance–rated wall assembly. An example is the 600-mm (24-in.) minimum horizontal separation that usually applies between boxes installed on opposite sides of the wall. Assistance in complying with 770.26 can be found in building codes, fire resistance directories, and product listings.

N **770.27 Temperature Limitation of Optical Fiber Cables.** Optical fiber cable shall not be used in such a manner that its operating temperature exceeds that of its rating.

Part II. Cables Outside and Entering Buildings

770.44 Overhead (Aerial) Optical Fiber Cables. Overhead optical fiber cables containing a non–current-carrying metallic member entering buildings shall comply with 800.44(A) and (B).

(A) On Poles and In-Span. Where outside plant optical fiber cables and electric light or power conductors are supported by the same pole or are run parallel to each other in-span, the conditions described in 770.44(A)(1) through (A)(4) shall be met.

(1) Relative Location. Where practicable, the outside plant optical fiber cables shall be located below the electric light or power conductors.

(2) Attachment to Cross-Arms. Attachment of outside plant optical fiber cables to a cross-arm that carries electric light or power conductors shall not be permitted.

(3) Climbing Space. The climbing space through outside plant optical fiber cables shall comply with the requirements of 225.14(B).

(4) Clearance. Supply service drops and sets of overhead service conductors of 0 to 750 volts running above and parallel to optical fiber cable service drops shall have a minimum separation of 300 mm (12 in.) at any point in the span, including the point of their attachment to the building. Clearance of not less than 1.0 m (40 in.) shall be maintained between the two services at the pole.

(B) Above Roofs. Outside plant optical fiber cables shall have a vertical clearance of not less than 2.5 m (8 ft) from all points of roofs above which they pass.

Exception No. 1: The requirement of 770.44(B) shall not apply to auxiliary buildings such as garages and the like.

Exception No. 2: A reduction in clearance above only the overhanging portion of the roof to not less than 450 mm (18 in.) shall be permitted if (1) not more than 1.2 m (4 ft) of optical fiber cable service drop cable passes above the roof overhang, and (2) the cable is terminated at a through- or above-the-roof raceway or approved support.

Exception No. 3: Where the roof has a slope of not less than 100 mm in 300 mm (4 in. in 12 in.), a reduction in clearance to not less than 900 mm (3 ft) shall be permitted.

Informational Note: See ANSI/IEEE C2-2017, *National Electric Safety Code, Part 2, Safety Rules for Overhead Lines*, for additional information regarding overhead wires and cables.

770.47 Underground Optical Fiber Cables Entering Buildings. Underground optical fiber cables entering buildings shall comply with 770.47(A) and (B).

(A) Underground Systems with Electric Light, Power, Class 1, or Non–Power-Limited Fire Alarm Circuit Conductors. Underground conductive optical fiber cables entering buildings with electric light, power, Class 1, or non–power-limited fire alarm circuit conductors in a raceway, handhole enclosure, or manhole shall be located in a section separated from such conductors by means of brick, concrete, or tile partitions or by means of a suitable barrier.

Δ **(B) Direct-Buried Cables and Raceways.** Direct-buried conductive optical fiber cables shall be separated by at least 300 mm (12 in.) from conductors of any electric light, power, non-power-limited fire alarm circuit conductors, or Class 1 circuit.

Exception No. 1: Separation shall not be required where the electric service conductors are installed in raceways or have metal cable armor.

Exception No. 2: Separation shall not be required where electric light or power branch-circuit or feeder conductors, non-power-limited fire alarm circuit conductors, or Class 1 circuit conductors are installed in a raceway or in metal-sheathed, metal-clad, or Type UF or Type USE cables.

770.48 Unlisted Cables Entering Buildings.

(A) Conductive and Nonconductive Cables. Unlisted conductive and nonconductive outside plant optical fiber cables shall be permitted to be installed in building spaces, other than risers, ducts used for environmental air, plenums used for environmental air, and other spaces used for environmental air, where the length of the cable within the building, measured from its point of entrance, does not exceed 15 m (50 ft) and the cable enters the building from the outside and is terminated in an enclosure.

The point of entrance shall be permitted to be extended from the penetration of the external wall, roof, or floor slab by continuously enclosing the entrance optical fiber cables in rigid metal conduit (RMC) or intermediate metal conduit (IMC) to the point of emergence.

Informational Note: Splice cases or terminal boxes, both metallic and plastic types, typically are used as enclosures for splicing or terminating optical fiber cables.

Unlisted optical fiber cables are permitted to be installed within a building provided they originate outside the building. They are limited to 50 feet of cable measured from the point at which they enter the building. The point from which this measurement is taken can be extended within the building by enclosing the cables within RMC or IMC.

Δ **(B) Nonconductive Cables in Raceway.** Unlisted nonconductive outside plant optical fiber cables shall be permitted to enter the building from the outside and shall be permitted to be installed in any of the following raceways:

(1) Intermediate metal conduit (IMC)
(2) Rigid metal conduit (RMC)
(3) Rigid polyvinyl chloride conduit (PVC)
(4) Electrical metallic tubing (EMT)

Unlisted nonconductive outside plant cables installed in rigid polyvinyl chloride conduit (PVC) or electrical metallic tubing (EMT) shall not be installed in risers, ducts used for environmental air, plenums used for environmental air, and other spaces used for environmental air.

770.49 Metal Entrance Conduit Grounding. Metal conduit containing optical fiber entrance cable shall be connected by a bonding conductor or grounding electrode conductor to a grounding electrode or, where present, the building grounding electrode system in accordance with 770.100(B).

Part III. Protection

770.93 Grounding, Bonding, or Interruption of Non–Current-Carrying Metallic Members of Optical Fiber Cables. Optical fiber cables entering the building or terminating on the outside of the building shall comply with 770.93(A) or (B).

(A) Entering Buildings. In installations where an optical fiber cable is exposed to contact with electric light or power conductors and the cable enters the building, the non–current-carrying metallic members shall be either grounded or bonded as specified in 770.100 or interrupted by an insulating joint or equivalent device. The grounding or interruption shall be as close as practicable to the point of entrance.

(B) Terminating on the Outside of Buildings. In installations where an optical fiber cable is exposed to contact with electric light or power conductors and the cable is terminated on the outside of the building, the non–current-carrying metallic members shall be either grounded or bonded as specified in 770.100 or interrupted by an insulating joint or equivalent device. The grounding, bonding, or interruption shall be as close as practicable to the point of termination of the cable.

Part IV. Grounding Methods

770.100 Entrance Cable Bonding and Grounding. If required, the non-current-carrying metallic members of optical fiber cables entering buildings shall be bonded or grounded as specified in 770.100(A) through (D).

(A) Bonding Conductor or Grounding Electrode Conductor.

(1) Insulation. The bonding conductor or grounding electrode conductor shall be listed and shall be permitted to be insulated, covered, or bare.

(2) Material. The bonding conductor or grounding electrode conductor shall be copper or other corrosion-resistant conductive material, stranded or solid.

(3) Size. The bonding conductor or grounding electrode conductor shall not be smaller than 14 AWG. It shall have a current-carrying capacity not less than that of the grounded metallic member(s). The bonding conductor or grounding electrode conductor shall not be required to exceed 6 AWG.

(4) Length. The bonding conductor or grounding electrode conductor shall be as short as practicable. In one- and two-family dwellings, the bonding conductor or grounding electrode conductor shall be as short as practicable not to exceed 6.0 m (20 ft) in length.

Informational Note: Similar bonding conductor or grounding electrode conductor length limitations applied at apartment buildings and commercial buildings help to reduce voltages that may develop between the building's power and communications systems during lightning events.

Exception: In one- and two-family dwellings if it is not practicable to achieve an overall maximum bonding conductor or grounding electrode conductor length of 6.0 m (20 ft), a separate ground rod meeting the minimum dimensional criteria of 770.100(B)(3)(2) shall be driven, the grounding electrode conductor shall be connected to the separate ground rod in accordance with 770.100(C), and the separate ground rod shall be bonded to the power grounding electrode system in accordance with 770.100(D).

(5) Run in Straight Line. The bonding conductor or grounding electrode conductor shall be run in as straight a line as practicable.

(6) Physical Protection. Bonding conductors and grounding electrode conductors shall be protected where exposed to physical damage. Where the bonding conductor or grounding electrode conductor is installed in a metal raceway, both ends of the raceway shall be bonded to the contained conductor or to the same terminal or electrode to which the bonding conductor or grounding electrode conductor is connected.

(B) Electrode. The bonding conductor and grounding electrode conductor shall be connected in accordance with 770.100(B)(1), (B)(2), or (B)(3).

(1) In Buildings or Structures with an Intersystem Bonding Termination. If the building or structure served has an intersystem bonding termination as required by 250.94, the bonding conductor shall be connected to the intersystem bonding termination.

Informational Note: See Informational Note Figure 800.100(B)(1) for an illustration of the application of the bonding conductor in buildings or structures equipped with an intersystem bonding termination.

Δ **(2) In Buildings or Structures with Grounding Means.** If an intersystem bonding termination is established, 250.94(A) shall apply.

If the building or structure served has no intersystem bonding termination, the bonding conductor or grounding electrode conductor shall be connected to the nearest accessible location on one of the following:

(1) The building or structure grounding electrode system as covered in 250.50
(2) The power service accessible means external to enclosures using the options identified in 250.94(A), Exception
(3) The nonflexible metal power service raceway
(4) The service equipment enclosure
(5) The grounding electrode conductor or the grounding electrode conductor metal enclosure of the power service
(6) The grounding electrode conductor or the grounding electrode of a building or structure disconnecting means that is connected to a grounding electrode as covered in 250.32
(7) The grounded interior metal water piping system, within 1.5 m (5 ft) from its point of entrance to the building, as covered in 250.52

Informational Note: See Informational Note Figure 800.100(B)(2) for an illustration of the application of the bonding conductor in buildings or structures not equipped with an intersystem bonding termination or terminal block providing access to the building grounding electrode system.

Δ **(3) In Buildings or Structures Without Intersystem Bonding Termination or Grounding Means.** If the building or structure served has no intersystem bonding termination or grounding means, as described in 770.100(B)(2), the grounding electrode conductor shall be connected to either of the following:

(1) To any one of the individual grounding electrodes described in 250.52(A)(1), (A)(2), (A)(3), or (A)(4).
(2) If the building or structure served has no grounding means, as described in 770.100(B)(2) or (B)(3)(1), to any one of the individual grounding electrodes described in 250.52(A)(7) and (A)(8) or to a ground rod or pipe not less than 1.5 m (5 ft) in length and 12.7 mm (½ in.) in diameter, driven, where practicable, into permanently damp earth and separated from lightning protection system conductors as covered in 800.53 and at least 1.8 m (6 ft) from electrodes of other systems. Steam, hot water pipes, or lightning protection system conductors shall not be employed as electrodes for non–current-carrying metallic members.

(C) Electrode Connection. Connections to grounding electrodes shall comply with 250.70.

(D) Bonding of Electrodes. A bonding jumper not smaller than 6 AWG copper or equivalent shall be connected between the grounding electrode and power grounding electrode system at the building or structure served where separate electrodes are used.

Exception: At mobile homes as covered in 770.106.

Informational Note No. 1: See 250.60 for connection to a lightning protection system.

Informational Note No. 2: Bonding together of all separate electrodes limits potential differences between them and between their associated wiring systems.

770.106 Grounding and Bonding of Entrance Cables at Mobile Homes.

Δ **(A) Grounding.** Grounding shall comply with 770.106(A)(1) and (A)(2).

N **(1) Installations Without Mobile Home Service Equipment.** If there is no mobile home service equipment located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, the non-current-carrying metallic members of optical fiber cables entering the mobile home shall be grounded in accordance with 770.100(B)(3).

N **(2) Installations Without Mobile Home Disconnecting Means.** If there is no mobile home disconnecting means grounded in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, the non-current-carrying metallic members of optical fiber cables entering the mobile home shall be grounded in accordance with 770.100(B)(3).

(B) Bonding. The grounding electrode shall be bonded to the metal frame or available grounding terminal of the mobile home with a copper conductor or other equivalent corrosion-resistant material not smaller than 12 AWG under either of the following conditions:

(1) If there is no mobile home service equipment or disconnecting means as in 770.106(A)
(2) If the mobile home is supplied by cord and plug

Part V. Installation Methods Within Buildings

770.110 Raceways, Cable Routing Assemblies, and Cable Trays for Optical Fiber Cables.

(A) Types of Raceways. Optical fiber cables shall be permitted to be installed in any raceway that complies with either 770.110(A)(1) or (A)(2).

(1) Raceways Recognized in Chapter 3. Optical fiber cables shall be permitted to be installed in any raceway included in Chapter 3. The raceways shall be installed in accordance with Chapter 3.

(2) Communications Raceways. Optical fiber cables shall be permitted to be installed in listed communications raceways selected in accordance with Table 800.154(b).

(B) Raceway Fill for Optical Fiber Cables. Raceway fill for optical fiber cables shall comply with either 770.110(B)(1) or (B)(2).

(1) Without Electric Light or Power Conductors. Where optical fiber cables are installed in raceway without electric light or power conductors, the raceway fill requirements of Chapters 3 and 9 shall not apply.

(2) Nonconductive Optical Fiber Cables with Electric Light or Power Conductors. Where nonconductive optical fiber cables are installed with electric light or power conductors in a raceway, the raceway fill requirements of Chapters 3 and 9 shall apply.

(C) Cable Routing Assemblies. Optical fiber cables shall be permitted to be installed in listed cable routing assemblies selected in accordance with Table 800.154(c).

(D) Cable Trays. Optical fiber cables shall be permitted to be installed in metal or listed nonmetallic cable tray systems.

N **770.111 Innerduct for Optical Fiber Cables.** Listed plenum communications raceways, listed riser communications raceways, and listed general-purpose communications raceways selected in accordance with Table 800.154(b) shall be permitted to be installed as innerduct in any type of listed raceway permitted in Chapter 3.

770.113 Installation of Optical Fiber Cables. Installation of optical fiber cables shall comply with 770.113(A) through

(J). Installation of raceways and cable routing assemblies shall comply with 770.110.

(A) Listing. Optical fiber cables installed in buildings shall be listed in accordance with 770.179 and installed in accordance with the limitations of the listing.

Exception: Optical fiber cables that are installed in compliance with 770.48 shall not be required to be listed.

Δ **(B) Ducts Specifically Fabricated for Environmental Air.** Installations of optical fiber cables in ducts specifically fabricated for environmental air shall be in accordance with 770.113(B)(1) and (B)(2).

N **(1) Uses Permitted.** The following cables shall be permitted in ducts specifically fabricated for environmental air as described in 300.22(B) if they are directly associated with the air distribution system:

(1) Up to 1.22 m (4 ft) of Types OFNP and OFCP
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in raceways that are installed in compliance with 300.22(B)

Informational Note: For information on fire protection of wiring installed in fabricated ducts, see NFPA 90A-2018, *Standard for the Installation of Air-Conditioning and Ventilating Systems.*

N **(2) Uses Not Permitted.** Types OFNR, OFCR, OFNG, OFCG, OFN, and OFC shall not be permitted to be installed in ducts specifically fabricated for environmental air as described in 300.22(B).

Informational Note: See NFPA 90A-2021, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, for information on fire protection of wiring installed in fabricated ducts.

Δ **(C) Other Spaces Used for Environmental Air (Plenums).** Installations of optical fiber cables in other spaces used for environmental air shall be in accordance with 770.13(C)(1) and (C)(2).

N **(1) Uses Permitted.** The following cables shall be permitted in other spaces used for environmental air as described in 300.22(C):

(1) Types OFNP and OFCP
(2) Types OFNP and OFCP installed in plenum communications raceways
(3) Types OFNP and OFCP installed in plenum cable routing assemblies
(4) Types OFNP and OFCP supported by open metal cable tray systems
(5) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in raceways that are installed in compliance with 300.22(C)
(6) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC supported by solid bottom metal cable trays with solid metal covers in other spaces used for environmental air (plenums), as described in 300.22(C)
(7) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in plenum riser and general-purpose communications raceways supported by solid bottom metal cable trays with solid metal covers in other spaces used for environmental air (plenums), as described in 300.22(C)

N **(2) Uses Not Permitted.** Types OFNR, OFCR, OFNG, OFCG, OFN, and OFC shall not be permitted to be installed in other spaces used for environmental air (plenums).

Informational Note: See NFPA 90A-2018, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, for information on fire protection of wiring installed in other spaces used for environmental air.

Δ **(D) Risers — Cables in Vertical Runs.** Installations of optical fiber cables in vertical runs shall be in accordance with 770.113(D)(1) and (D)(2).

N **(1) Uses Permitted.** The following cables shall be permitted in vertical runs penetrating one or more floors and in vertical runs in a shaft:

(1) Types OFNP, OFCP, OFNR, and OFCR
(2) Types OFNP, OFCP, OFNR, and OFCR installed in the following:
   a. Plenum communications raceways
   b. Plenum cable routing assemblies
   c. Riser communications raceways
   d. Riser cable routing assemblies

N **(2) Uses Not Permitted.** Types OFNG, OFCG, OFN, and OFC shall not be permitted to be installed in vertical runs.

Informational Note: See 770.26 for firestop requirements for floor penetrations.

(E) Risers — Cables Permitted in Metal Raceways. The following cables shall be permitted in metal raceways in a riser having firestops at each floor:

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in the following:
   a. Plenum communications raceways (innerduct)
   b. Riser communications raceways (innerduct)
   c. General-purpose communications raceways (innerduct)

Informational Note: See 770.26 for firestop requirements for floor penetrations.

(F) Risers — Cables Permitted in Fireproof Shafts. The following cables shall be permitted to be installed in fireproof riser shafts having firestops at each floor:

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC

(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in the following:

a. Plenum communications raceways
b. Plenum cable routing assemblies
c. Riser communications raceways
d. Riser cable routing assemblies
e. General-purpose communications raceways
f. General-purpose cable routing assemblies

Informational Note: See 770.26 for firestop requirements for floor penetrations.

(G) Risers — Cables Permitted in One- and Two-Family Dwellings. The following cables shall be permitted in one- and two-family dwellings:

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in the following:

a. Plenum communications raceways
b. Plenum cable routing assemblies
c. Riser communications raceways
d. Riser cable routing assemblies
e. General-purpose communications raceways
f. General-purpose cable routing assemblies

(H) Cable Trays — Cables Permitted. The following cables shall be permitted to be supported by cable trays:

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in the following:

a. Plenum communications raceways
b. Riser communications raceways
c. General-purpose communications raceways

(I) Distributing Frames and Cross-Connect Arrays — Cables Permitted. The following cables shall be permitted to be installed in distributing frames and cross-connect arrays:

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in the following:

a. Plenum communications raceways
b. Plenum cable routing assemblies
c. Riser communications raceways
d. Riser cable routing assemblies
e. General-purpose communications raceways
f. General-purpose cable routing assemblies

(J) Other Building Locations — Cables Permitted. The following cables shall be permitted to be installed in building locations other than the locations covered in 770.113(B) through (I):

(1) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC
(2) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in:

a. Plenum communications raceways
b. Plenum cable routing assemblies
c. Riser communications raceways
d. Riser cable routing assemblies
e. General-purpose communications raceways
f. General-purpose cable routing assemblies

(3) Types OFNP, OFCP, OFNR, OFCR, OFNG, OFCG, OFN, and OFC installed in a raceway of a type recognized in Chapter 3

Δ **770.114 Grounding.** Non-current-carrying conductive members of optical fiber cables shall be bonded to a grounded equipment rack or enclosure, or grounded in accordance with the grounding methods specified by 770.100(B) using a conductor specified in 770.100(A).

770.133 Installation of Optical Fibers and Electrical Conductors.

(A) In Cable Trays and Raceways. Conductive optical fiber cables contained in an armored or metal-clad-type sheath and nonconductive optical fiber cables shall be permitted to occupy the same cable tray or raceway with conductors for electric light, power, Class 1, non-power-limited fire alarm, Type ITC, or medium-power network-powered broadband communications circuits operating at 1000 volts or less. Conductive optical fiber cables without an armored or metal-clad-type sheath shall not be permitted to occupy the same cable tray or raceway with conductors for electric light, power, Class 1, non-power-limited fire alarm, Type ITC, or medium-power network-powered broadband communications circuits, unless all of the conductors of electric light, power, Class 1, non-power-limited fire alarm, and medium-power network-powered broadband communications circuits are separated from all of the optical fiber cables by a permanent barrier or listed divider.

(B) In Cabinets, Outlet Boxes, and Similar Enclosures. Nonconductive optical fiber cables shall not be permitted to occupy the same cabinet, outlet box, panel, or similar enclosure housing the electrical terminations of an electric light, power, Class 1, non-power-limited fire alarm, or medium-power network-powered broadband communications circuit unless one or more of the following conditions exist:

(1) The nonconductive optical fiber cables are functionally associated with the electric light, power, Class 1, non-power-limited fire alarm, or medium-power network-powered broadband communications circuit.
(2) The conductors for electric light, power, Class 1, non-power-limited fire alarm, Type ITC, or medium-power

network-powered broadband communications circuits operate at 1000 volts or less.

(3) The nonconductive optical fiber cables and the electrical terminations of electric light, power, Class 1, non-power-limited fire alarm, or medium-power network-powered broadband communications circuit are installed in factory- or field-assembled control centers.

(4) The nonconductive optical fiber cables are installed in an industrial establishment where conditions of maintenance and supervision ensure that only qualified persons service the installation.

When optical fibers are within the same hybrid cable for electric light, power, Class 1, non-power-limited fire alarm, or medium-power network-powered broadband communications circuits operating at 1000 volts or less, they shall be permitted to be installed only where the functions of the optical fibers and the electrical conductors are associated.

Optical fibers in hybrid optical fiber cables containing only current-carrying conductors for electric light, power, or Class 1 circuits rated 1000 volts or less shall be permitted to occupy the same cabinet, cable tray, outlet box, panel, raceway, or other termination enclosure with conductors for electric light, power, or Class 1 circuits operating at 1000 volts or less.

Optical fibers in hybrid optical fiber cables containing current-carrying conductors for electric light, power, or Class 1 circuits rated over 1000 volts shall be permitted to occupy the same cabinet, cable tray, outlet box, panel, raceway, or other termination enclosure with conductors for electric light, power, or Class 1 circuits in industrial establishments, where conditions of maintenance and supervision ensure that only qualified persons service the installation.

Δ **(C) With Other Circuits.** Conductive and nonconductive optical fiber cables shall be permitted in the same raceway, cable tray, box, enclosure, or cable routing assembly, with conductors of any of the following:

(1) Class 2 and Class 3 remote-control, signaling, and power-limited circuits in compliance with 645.5(E)(2) or Parts I and II of Article 725

(2) Power-limited fire alarm systems in compliance with Parts I and III of Article 760

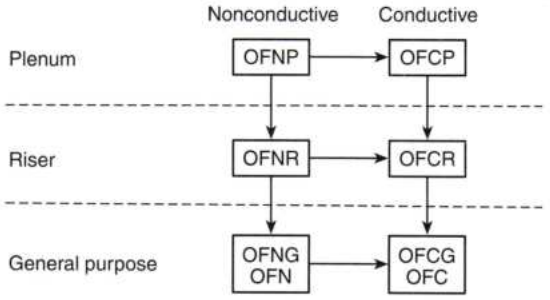
(3) Communications circuits in compliance with Parts I and V of Article 805

(4) Community antenna television and radio distribution systems in compliance with Parts I and V of Article 820

(5) Low-power network-powered broadband communications circuits in compliance with Parts I and V of Article 830

(D) Support of Optical Fiber Cables. Raceways shall be used for their intended purpose. Optical fiber cables shall not be strapped, taped, or attached by any means to the exterior of any conduit or raceway as a means of support.

Exception: Overhead (aerial) spans of optical fiber cables shall be permitted to be attached to the exterior of a raceway-type mast intended for the attachment and support of such cables.



N *FIGURE 770.154 Cable Substitution Hierarchy.*

• N **770.154 Applications of Listed Optical Fiber Cables.** Permitted and nonpermitted applications of listed optical fiber cables shall be as indicated in Table 770.154(a). The permitted applications shall be subject to the installation requirements of 770.110 and 770.113. The substitutions for optical fiber cables in Table 770.154(b) and illustrated in Figure 770.154 shall be permitted.

Part VI. Listing Requirements

770.179 Optical Fiber Cables. Optical fiber cables shall be listed and identified in accordance with 770.179(A) through (G) and shall be marked in accordance with Table 770.179. Optical fiber cables shall have a temperature rating of not less than 60°C (140°F). The temperature rating shall be marked on the jacket of optical fiber cables that have a temperature rating exceeding 60°C (140°F).

Informational Note: See UL 1651-2015, *Standard for Optical Fiber Cable*, for information on optical fiber cables.

Optical fiber cables must have a temperature rating of not less than 60°C (140°F) to correlate with requirements for wires and cables that are addressed in 800.179.

Δ **(A) Types OFNP and OFCP.** Types OFNP and OFCP nonconductive and conductive optical fiber plenum cables shall be suitable for use in ducts, plenums, and other space used for environmental air and shall also have adequate fire-resistant and low-smoke-producing characteristics.

Informational Note: See NFPA 262-2019, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, for one method of defining that a cable has adequate fire-resistant and low-smoke-producing characteristics where the cable exhibits a maximum peak optical density of 0.50 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.52 m (5 ft) or less.

(B) Types OFNR and OFCR. Types OFNR and OFCR nonconductive and conductive optical fiber riser cables shall be suitable for use in a vertical run in a shaft or from floor to floor and shall also have the fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

N ***TABLE 770.154(a)*** *Applications of Listed Optical Fiber Cables in Buildings*

Applications		Listed Optical Fiber Cable Type		
		OFNP, OFCP	OFNR, OFCR	OFNG, OFCG, OFN, OFC
In ducts specifically fabricated for environmental air as described in 300.22(B)	In fabricated ducts	Y*	N	N
	In metal raceway that complies with 300.22(B)	Y*	Y*	Y*
In other spaces used for environmental air (plenums) as described in 300.22(C)	In other spaces used for environmental air	Y*	N	N
	In metal raceway that complies with 300.22(C)	Y*	Y*	Y*
	In plenum communications raceways	Y*	N	N
	In plenum cable routing assemblies	Y*	N	N
	Supported by open metal cable trays	Y*	N	N
	Supported by solid bottom metal cable trays with solid metal covers	Y*	Y*	Y*
In risers	In vertical runs	Y*	Y*	N
	In metal raceways	Y*	Y*	Y*
	In fireproof shafts	Y*	Y*	Y*
	In plenum communications raceways	Y*	Y*	N
	In plenum cable routing assemblies	Y*	Y*	N
	In riser communications raceways	Y*	Y*	N
	In riser cable routing assemblies	Y*	Y*	N
	In one- and two-family dwellings	Y*	Y*	Y*
Within buildings in other than air-handling spaces and risers	General	Y*	Y*	Y*
	Supported by cable trays	Y*	Y*	Y*
	In distributing frames and cross-connect arrays	Y*	Y*	Y*
	In any raceway recognized in Chapter 3	Y*	Y*	Y*
	In plenum communications raceway	Y*	Y*	Y*
	In plenum cable routing assemblies	Y*	Y*	Y*
	In riser communications raceways	Y*	Y*	Y*
	In riser cable routing assemblies	Y*	Y*	Y*
	In general-purpose communications raceways	Y*	Y*	Y*
	In general-purpose cable routing assemblies	Y*	Y*	Y*

Note: "N" indicates that the cable type shall not be permitted to be installed in the application. "Y*" indicates that the cable type shall be permitted to be installed in the application subject to the limitations described in 770.110 and 770.113.

Informational Note No. 1: Part V of Article 770 covers installation methods within buildings. This table covers the applications of listed optical fiber cables in buildings. The definition of *Point of Entrance* is in 770.2.

Informational Note No. 2: For information on the restrictions to the installation of optical fiber cables in ducts specifically fabricated for environmental air, see 770.113(B).

N ***TABLE 770.154(b)*** *Cable Substitutions*

Cable Type	Permitted Substitutions
OFNP	None
OFCP	OFNP
OFNR	OFNP
OFCR	OFNP, OFCP, OFNR
OFNG, OFN	OFNP, OFNR
OFCG, OFC	OFNP, OFCP, OFNR, OFCR, OFNG, OFN

Informational Note: See ANSI/UL 1666-2017, *Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts*, for one method of defining fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

Δ **(C) Types OFNG and OFCG.** Types OFNG and OFCG nonconductive and conductive general-purpose optical fiber cables shall be suitable for general-purpose use, with the exception of risers and plenums, and shall also be resistant to the spread of fire.

TABLE 770.179 *Cable Markings*

Cable Marking	Type
OFNP	Nonconductive optical fiber plenum cable
OFCP	Conductive optical fiber plenum cable
OFNR	Nonconductive optical fiber riser cable
OFCR	Conductive optical fiber riser cable
OFNG	Nonconductive optical fiber general-purpose cable
OFCG	Conductive optical fiber general-purpose cable
OFN	Nonconductive optical fiber general-purpose cable
OFC	Conductive optical fiber general-purpose cable

Informational Note No 1: See CSA Vertical Flame Test — Cables in Cable Trays, as described in CSA C22.2 No. 0.3-2009 (R2019), *Test Methods for Electrical Wires and Cables*, for one method of defining *resistant to the spread of fire* for the damage (char length) not to exceed 1.5 m (4 ft 11 in.) when performing the test.

Informational Note No. 2: See ANSI/UL 1685-2015, *Standard for Safety for Vertical-Tray Fire Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, for another method of defining *resistant to the spread of fire* where the cables do not spread fire to the top of the tray in the UL flame exposure, vertical tray flame test. The smoke measurements in the test method are not applicable.

Δ **(D) Types OFN and OFC.** Types OFN and OFC nonconductive and conductive optical fiber cables shall be suitable for general-purpose use, with the exception of risers, plenums, and other spaces used for environmental air, and shall also be resistant to the spread of fire.

Informational Note No. 1: See ANSI/UL 1685-2015, *Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, for one method of defining *resistant to the spread of fire* where the cables do not spread fire to the top of the tray in the UL flame exposure, vertical tray flame test. The smoke measurements in the test method are not applicable.

Informational Note No. 2: See CSA Vertical Flame Test — Cables in Cables Trays, as described in CSA C22.2 No. 0.3-2009 (R2019), *Test Methods for Electrical Wires and Cables*, for another method of defining *resistant to the spread of fire* where the damage (char length) does not exceed 1.5 m (4 ft 11 in.).

Informational Note No. 3: Cable types are listed in descending order of fire resistance rating. Within each fire resistance rating, nonconductive cable is listed first because it is often substituted for conductive cable.

Δ **(E) Circuit Integrity (CI), Fire-Resistive Cable System, or Electrical Circuit Protective System.** Cables that are used for survivability of critical circuits under fire conditions shall meet either 770.179(E)(1), (E)(2), or (E)(3).

Δ **(1) Circuit Integrity (CI) Cables.** Cables specified in 770.179(A) through (D), and used for survivability of critical circuits, shall be marked with the additional classification using the suffix "CI." In order to maintain its listed fire rating, CI cable shall only be installed in free air in accordance with 770.24. CI cables shall only be permitted to be installed in a raceway where specifically listed and marked as part of a fire-resistive cable system as covered in 770.179(E)(2).

Informational Note: See UL 2196, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining CI cable for establishing a minimum 2-hour fire resistance rating for the cable as specified in UL 1651, *Optical Fiber Cable*. UL *Guide Information for Optical Cable Fiber (QAYK)* contains information to identify the cable and its installation limitations to maintain the fire-resistive rating.

Δ **(2) Fire-Resistive Cables.** Cables specified in 770.179(A) through (D) and 770.179(E)(1) that are part of an electrical circuit protective system shall be fire-resistive cable and identified with the protective system number on the product or on the smallest unit container in which the product is packaged and installed in accordance with the listing of the protective system.

Informational Note: See UL 2196, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining an electrical circuit protective system for establishing a rating for the system. UL *Guide Information for Electrical Circuit Integrity Systems (FHIT)* contains information to identify the system and its installation limitations to maintain a minimum fire-resistive rating.

(F) Field-Assembled Optical Fiber Cables. Field-assembled optical fiber cable shall comply with the following:

(1) The specific combination of jacket and optical fibers intended to be installed as a field-assembled optical fiber cable shall be one of the types in 770.179(A), (B), or (D) and shall be marked in accordance with Table 770.179.
(2) The jacket of a field-assembled optical fiber cable shall have a surface marking indicating the specific optical fibers with which it is identified for use.
(3) The optical fibers shall have a permanent marking, such as a marker tape, indicating the jacket with which they are identified for use.
(4) The jacket without fibers shall meet the listing requirements for communications raceways in 800.182(A), (B), or (C) in accordance with the cable marking.

Δ **(G) Optional Markings.** Cables shall be permitted to be surface marked to indicate special characteristics of the cable materials.

Informational Note: These markings can include, but are not limited to, markings for limited-smoke halogen-free, low-smoke halogen-free, and sunlight resistance.

770.180 Grounding Devices. Where bonding or grounding is required, devices used to connect a shield, a sheath, or non–current-carrying metallic members of a cable to a bonding conductor or grounding electrode conductor shall be listed or be part of listed equipment.