(E) Energy Storage or Backup Power System Requirements. Energy storage or backup power supplies shall not be required.

(F) Voltage and Frequency Control. The stand-alone power sources shall be controlled during operation so that voltage and frequency are supplied within limits compatible with the connected loads.

N ARTICLE 722

Cables for Power-Limited Circuits and Fault-Managed Power Circuits

N Part I. General

N 722.1 Scope. This article covers the general requirements for the installation of single- and multiple-conductor cables used in Class 2 and Class 3 power-limited circuits, power-limited fire alarm (PLFA) circuits, and Class 4 fault-managed power circuits.

To remove redundancy throughout most of Chapter 7, Code-Making Panel No. 3 (CMP-3) consolidated all general cable requirements into a new Article 722. The intent of this consolidation is to help with clarity and usability of the *NEC*® while making room for future technologies as they evolve.

N 722.3 Other Articles. In addition to the requirements of this article, installation of cables shall comply with the articles or sections listed in 722.3(A) through (O). Only those sections of Article 300 referenced in this article shall apply.

N (A) Installation of Cables and Conductors in Raceway. The number and size of conductors and cables, as well as raceway sizing, shall comply with 300.17.

N (B) Spread of Fire or Products of Combustion. Installation of power-limited circuits shall comply with 300.21.

N (C) Ducts, Plenums, and Other Air-Handling Spaces. Power-limited circuits installed in ducts, plenums, or other space used for environmental air shall comply with 300.22.

Exception No. 1: Cables selected in accordance with Table 722.135(B) and installed in accordance with 300.22(B), Exception shall be permitted to be installed in ducts specifically fabricated for environmental air.

Exception No. 2: Cables selected in accordance with Table 722.135(B) shall be permitted to be installed in other spaces used for environmental air (plenums).

N (D) Cables in Ducts for Dust, Loose Stock, or Vapor Removal. Section 300.22(A) for wiring systems shall apply.

Exception: Nonconductive optical fiber cables shall be permitted in ducts used for dust, loose stock, or vapor removal.

N (E) Cable Trays. Cable tray installations shall comply with Parts I and II of Article 392.

N (F) Instrumentation Tray Cable. Circuits wired using instrumentation tray cable shall comply with 335.1 and 335.4 through 335.9.

N (G) Raceways or Sleeves Exposed to Different Temperatures. Section 300.7(A) shall apply.

Condensation often forms in raceways that run between spaces of differing temperatures, such as a walk-in cooler or freezer. Section 722.3(G) brings the requirements of 300.7(A) into Article 722.

See also

300.7(A) and its associated commentary

N (H) Vertical Support for Fire-Resistive Cables and Conductors. Vertical installations of circuit integrity (CI) cables and conductors installed in a raceway or conductors and cables of electrical circuit protective systems and fire resistive-cable systems shall be installed in accordance with 300.19.

N (I) Installation of Cables with Other Systems. Section 300.8 shall apply.

N (J) Corrosive, Damp, or Wet Locations. The installation of power-limited cables shall comply with the applicable requirements in 110.11, 300.5(B), 300.6, 300.9, and 310.10(F) when installed in corrosive, damp, or wet locations.

N (K) Cable Routing Assemblies. Cables installed in cable routing assemblies shall be selected in accordance with Table 800.154(c), listed in accordance with 800.182, and installed in accordance with 800.110(C)(1)), 800.110(C)(2), and 800.113.

N (L) Communications Raceways. Cables communications raceways shall be selected in accordance with Table 800.154(b), listed in accordance with 800.182, and installed in accordance with 800.113 and 362.24 through 362.56, where the requirements applicable to electrical nonmetallic tubing (ENT) apply.

N (M) Temperature Limitation of Cables. The requirements of 310.14(A)(3) on the temperature limitation of conductors shall apply to power-limited circuit cables and fault-managed power cables.

N (N) Identification of Equipment Grounding Conductors. Equipment grounding conductors shall be identified in accordance with 250.119.

Exception: Cables that do not contain an equipment grounding conductor shall be permitted to use a conductor with green insulation, or green insulation with one or more yellow stripes, for other than equipment grounding purposes.

N (O) Specific Requirements. As appropriate, the installation of wires and cables shall also comply with the following:

(1) Class 2 and Class 3 cables — Part II of Article 725
(2) Class 4 cables — Part IV of Article 726

(3) Fire alarm cables — Part III of Article 760
(4) Optical fiber cables — Part V of Article 770

N 722.10 Hazardous (Classified) Locations. Class 4 cables shall be permitted to be used in hazardous (classified) locations where specifically permitted by other articles of this *Code*.

N 722.12 Uses Not Permitted. Class 4 cables shall not be permitted for any applications that are not part of a Class 4 system.

Exception: Use of Class 4 cable for other applications shall be permitted if the cable has been listed as suitable for the other applications.

N 722.21 Access to Electrical Equipment Behind Panels Designed to Allow Access. Access to electrical equipment shall not be denied by an accumulation of cables that prevents removal of panels, including suspended ceiling panels.

Excess accumulation of wires and cables, often due to improper installation, can limit access to electrical equipment by preventing the removal of access panels and ceiling tiles. To safely service, rearrange, or install electrical equipment, the worker must have an accessible work space. See Exhibit 722.1.

See also

300.11(B), which permits the use of support wires and approved fittings that are independent of the suspended ceiling support wires

N 722.24 Mechanical Execution of Work.

N (A) General. 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, hangers, listed cable ties identified for securement and support, or similar fittings, designed and installed so as not to damage the cable. The installation shall conform to 300.4 and 300.11.

A bushing shall be installed where cables emerge from raceway used for mechanical support or protection in accordance with 300.15(C).

Nonmetallic 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 300.22(C).

Informational Note No. 1: See NFPA 90A-2021, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, for discrete combustible components.

Informational Note No. 2: Paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants could result in an undetermined alteration of cable properties.

Cable must be attached to or supported by the building structure by cable ties, straps, clamps, hangers, and so forth. The installation method must not damage the cable. In addition, the location of the cable should be carefully evaluated to ensure that activities and processes within the building do not cause damage to the cable. See Exhibit 722.1.

Section 300.4(D) requires protection of cables that are installed on or in framing members. Such cables are required to be installed in a manner that protects them from nail or screw penetration. This section permits attachment to baseboards and non-load-bearing walls, which are not structural components.

N (B) Support of Cables. Cables shall not be strapped, taped, or attached by any means to the exterior of any conduit or other raceway as a means of support.

Exception No. 1: Class 2 circuit conductors or cables shall be permitted to be installed as permitted by 300.11(C)(2).

Exception No. 2: 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 (C) 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.

N 722.25 Abandoned Cables. The accessible portion of abandoned cables shall be removed. Where cables are identified

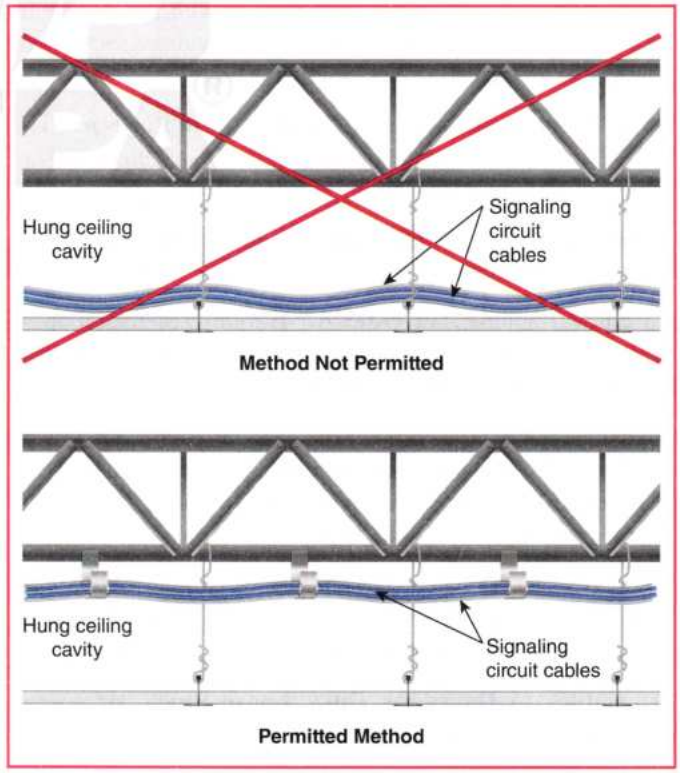

EXHIBIT 722.1 Incorrect cable installation *(upper diagram)* and correct method *(lower diagram)*.

for future use with a tag, the tag shall be of sufficient durability to withstand the environment involved.

N **722.31 Safety-Control Equipment.** Where damage to power-limited circuits can result in a failure of safety-control equipment that would introduce a direct fire or life hazard, the power limited circuits shall be installed using Class 1 circuit wiring methods in accordance with 724.46. All conductors of such circuits shall be installed in rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, electrical metallic tubing, Type MI cable, or Type MC cable, or be otherwise suitably protected from physical damage.

N **722.135 Installation of Cables.** The installation of cables shall comply with 722.135(A) through (I), as applicable.

N **(A) Listing.** Cables installed in buildings shall be listed.

N **(B) Cables in Buildings.** The installation of cables shall comply with Table 722.135(B).

Informational Note No. 1: See NFPA 90A-2021, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 4.3.4 and 4.3.11.3.3, for information on fire protection of wiring installed in ducts specifically fabricated for environmental air and other spaces used for environmental air (plenums).

Informational Note No. 2: See 300.21 for firestop requirements for floor penetrations.

Informational Note No. 3: See Chapter 3 for the installation requirements for PLTC cables installed outdoors in cable trays.

Informational Note No. 4: See UL 2024, *Cable Routing Assemblies and Communications Raceways*, for applicable requirements for plenum, riser, and general-purpose cable routing assemblies and raceways.

N **(C) Industrial Establishments.** In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, Type PLTC cable shall be permitted in accordance with either of the following:

(1) Where the cable is not subject to physical damage, Type PLTC cable that complies with the crush and impact requirements of Type MC cable and is identified as Type PLTC-ER for such use shall be permitted to be exposed between the cable tray and the utilization equipment or device. The cable shall be continuously supported and protected against physical damage using mechanical protection such as dedicated struts, angles, or channels. The cable shall be supported and secured at intervals not exceeding 1.8 m (6 ft). Where not subject to physical damage, Type PLTC-ER cable shall be permitted to transition between cable trays and between cable trays and utilization equipment or devices for a distance not to exceed 1.8 m (6 ft) without continuous support. The cable shall be mechanically supported where exiting the cable tray to ensure that the minimum bending radius is not exceeded.

(2) Type PLTC cable, with a metallic sheath or armor in accordance with 722.179(A)(6), shall be permitted to be installed exposed. The cable shall be continuously supported and protected against physical damage using mechanical protection such as dedicated struts, angles, or channels. The cable shall be secured at intervals not exceeding 1.8 m (6 ft).

N **(D) In Hoistways.** In hoistways, cables shall be installed in rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible nonmetallic conduit, or electrical metallic tubing. For elevators or similar equipment, these conductors shall be permitted to be installed as provided in 620.21.

N **(E) Cable Substitutions.** The substitutions for cables listed in Table 722.135(E) shall be permitted. Where substitute cables are installed, the installation requirements of the articles described in 722.3(O) shall also apply. CI cables shall be permitted to be installed to provide 2-hour circuit integrity. See 722.135(F).

Informational Note: See 800.179 for information on Types CMP, CMR, CM, and CMX.

N **(F) Circuit Integrity (CI) Cable, Fire-Resistive Cable System, or Electrical Circuit Protective System.** CI cable, a fire-resistive cable system, or a listed electrical circuit protective system shall be permitted for use in systems that supply critical circuits to ensure survivability for continued circuit operation for a specified time under fire conditions.

N **(G) Thermocouple Circuits.** Conductors in Type PLTC cables used for Class 2 thermocouple circuits shall be permitted to be any of the materials used for thermocouple extension wire.

N **(H) Bundling of 4-Pair Cables Transmitting Power and Data.** Where 4-pair cables are used to transmit power and data to a powered device, 725.144 shall apply.

N **(I) Installation of Circuit Conductors Extending Beyond One Building.** Circuit conductors that extend beyond one building and are run such that they are subject to accidental contact with electric light or power conductors operating over 300 volts to ground, or are exposed to lightning on interbuilding circuits on the same premises, shall comply with the following:

(1) For other than coaxial conductors, 800.44, 800.53, 800.100, 805.50, 805.93, 805.170(A), and 805.170(B)
(2) For coaxial conductors, 800.44, 820.93, and 820.100
(3) The installation requirements of Part I of Article 300

N Part II. Listing Requirements

N **722.179 Listing and Marking of Cables.** Cables installed in buildings shall be listed in accordance with 722.179(A) and marked in accordance with 722.179(B), and they shall be permitted to be marked in accordance with 722.179(C).

N ***TABLE 722.135(B)*** *Installation of Listed Cables in Buildings*

Applications		Cable Type[1]					
		Plenum	Riser	General-Purpose	Limited-Use	Under Carpet	PLTC
In ducts specifically fabricated for environmental air as described in 300.22(B)[2]	Cables in lengths as short as practicable to perform the required function	Y	N	N	N	N	N
	In metal raceway that complies with 300.22(B)	Y	Y	Y	Y	N	Y
In other spaces used for environmental air (plenums) as described in 300.22(C)	Cables in other spaces used for environmental air	Y	N	N	N	N	N
	Cables in metal raceway that complies with 300.22(C)	Y	Y	Y	Y	N	Y
	Cables in plenum communications raceways	Y	N	N	N	N	N
	Cables in plenum cable routing assemblies	Y	N	N	N	N	N
	Cables supported by open metal cable trays	Y	N	N	N	N	N
	Cables or cables installed in raceways or cable routing assemblies supported by solid bottom metal cable trays with solid metal covers	Y	Y	Y	Y	N	Y
In risers and vertical runs	Cables in vertical runs penetrating one or more floors and in vertical runs in a shaft	Y	Y	N	N	N	N
	Cables in metal raceways	Y	Y	Y	Y	N	Y
	Cables in fireproof shafts	Y	Y	Y	N	N	Y
	Cables in plenum communications raceways	Y	Y	N	N	N	N
	Cables in plenum cable routing assemblies	Y	Y	N	N	N	N
	Cables in riser communications raceways	Y	Y	N	N	N	N
	Cables in riser cable routing assemblies	Y	Y	N	N	N	N
	Cables in one- and two-family dwellings	Y	Y	Y	Y[3]	N	Y
Cables and innerducts installed in metal raceways in a riser having firestops at each floor[2]	Cables	Y	Y	Y	Y	N	Y
	Cables in plenum communications raceways (innerduct)	Y	Y	Y	Y	N	Y
	Cables in riser communications raceways (innerduct)	Y	Y	Y	Y	N	Y
	Cables in general-purpose communications raceways (innerduct)	Y	Y	Y	Y	N	Y
In fireproof riser shafts having firestops at each floor[2]	Cables	Y	Y	Y	N	N	Y
	Cables in plenum communications raceways or plenum cable routing assemblies	Y	Y	Y	N	N	Y
	Cables in riser communications raceways or riser cable routing assemblies	Y	Y	Y	N	N	Y
	Cables in general-purpose communications raceways or general-purpose cable routing assemblies	Y	Y	Y	N	N	Y
In cable trays	Outdoors	N	N	N	N	N	Y
	Cables, or cables in plenum, riser, or general-purpose communications raceways, installed indoors	Y	Y	Y	N	N	Y
In cross-connect arrays	Cables, and cables in plenum, riser, or general-purpose communications raceways or cable routing assemblies	Y	Y	Y	N	N	Y
In one-, two-, and multifamily dwellings, and in building locations other than the locations covered above	Cables	Y	Y	Y	Y[3]	N	Y
	Cables in plenum, riser, or general-purpose communications raceways or cable routing assemblies, or raceways recognized in Chapter 3	Y	Y	Y	Y	N	Y
	Cables in nonconcealed spaces	Y	Y	Y	Y[4]	Y	Y
	Under carpet, floor covering, modular flooring, and planks	N	N	N	N	Y	N

[1]"N" indicates that the cable type shall not be installed in the application. "Y" indicates that the cable type shall be permitted to be installed in the application, subject to any limitations described in this article or the articles described in 722.3(O).

[2]In 300.22(B), cables shall be permitted in ducts specifically fabricated for environmental air only if directly associated with the air distribution system.

[3]Limited-use cable shall be permitted to be installed only in one-, two-, and multifamily dwellings and only if the cable is smaller in diameter than 6.35 mm (0.25 in.).

[4]The exposed length of cable shall not exceed 3.05 m (10 ft).

N ***TABLE 722.135(E)*** *Cable Substitutions*

Cable Type	Permitted Substitutions
CL3P	CMP
CL2P	CMP, CL3P
CL3R	CMP, CL3P, CMR
CL2R	CMP, CL3P, CL2P, CMR, CL3R
PLTC	None
CL3	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC
CL2	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3
CL3X	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC, CL3, CMX
CL2X	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3, CL2, CMX, CL3X
FPLP	CMP
FPLR	CMP, FPLP, CMR
FPL	CMP, FPLP, CMR, FPLR, CMG, CM
OFNP	None
OFCP	OFNP
OFNR	OFNP
OFCR	OFNP, OFCP, OFNR
OFNG, OFN	OFNP, OFNR
OFCG, OFC	OFNP, OFCP, OFNR, OFCR, OFNG, OFN
CMUC	None

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

N **(A) Listing of Cables.** Cables installed as wiring methods within buildings shall be listed as resistant to the spread of fire and other criteria in accordance with 722.179(A)(1) through (A)(16).

Informational Note No. 1: See UL 13, *Standard for Power-Limited Circuit Cables*, for applicable requirements for listing of Class 2 and Class 3 cable and power-limited tray cable (PLTC).

Informational Note No. 2: See UL 1424, *Cables for Power-Limited Fire-Alarm Circuits*, for applicable requirements for listing of power-limited fire alarm cable.

Informational Note No. 3: See UL 1651, *Optical Fiber Cable*, for applicable requirements for listing of optical fiber cable.

Informational Note No. 4: See UL 1400-2, *Outline for Fault-Managed Power Systems — Part 2: Requirements for Class 4 Cables*, for applicable requirements for listing of Class 4 cable.

N **(1) Plenum Cable.** Plenum cable shall be listed as suitable for use in ducts, plenums, and other space for environmental air and shall be listed as having adequate fire-resistant and low-smoke producing characteristics. Refer to Table 722.179(B) for plenum cable types.

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 the test method used to determine that a cable is low-smoke producing and fire resistant, exhibiting 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.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, is a test method for electrical wires and cables that are to be installed without raceways in plenums and other spaces used for environmental air. NFPA 262 was originally developed as an adaptation of the Steiner Tunnel test (ASTM E84/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*).

NFPA 262 does not list pass/fail criteria. The criteria for acceptance of a given application are given in the appropriate sections of the *NEC*. In addition to the informational note in this section, see the informational notes that follow 722.179(A)(1), 770.179(A), and 800.182(A).

A Class 2 or Class 3 cable that has passed the requirements of this test can be used in ducts, plenums, or other air-handling spaces. In addition, such cable can be used anywhere in a building where Class 2 or Class 3 cable is permitted. [See Table 722.135(E).]

N **(2) Riser Cable.** Riser cable shall be listed as suitable for use in a vertical run in a shaft or from floor to floor and shall be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

Informational Note: See ANSI/UL 1666-2012, *Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts*, for the cable requirements defining fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

In the fire test covered in UL 1666, *Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts*, cables are arranged in a simulated vertical shaft and subjected to an ignition source. The shaft is a 19-foot-high concrete shaft divided into two compartments by a 1-foot by 2-foot opening at the 12-foot level. To pass, cables must not propagate flame to the top of the 12-foot-high compartment during the 30-minute test.

N **(3) General-Purpose Cable.** General-purpose cable shall be listed as resistant to the spread of fire and as suitable for general-purpose use, except for use in risers, ducts, plenums, and other space used for environmental air.

Informational Note: See UL 2556, *Wire and Cable Test Methods*, for defining resistant to the spread of fire. One method is to demonstrate that 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.

A method of defining resistant to the spread of fire is for the damage (char length) not to exceed 1.5 m (4 ft 11 in.) when performing the FT4 Vertical Flame Test.

N **(4) Alternative General-Purpose Cable.** Alternative general-purpose optical fiber cable shall be listed as suitable for general-purpose use, with the exception of risers and plenums, and shall also be resistant to the spread of fire.

Informational Note: See CSA C22.2 No. 0.3-M-2001, *Test Methods for Electrical Wires and Cables*, for the CSA vertical flame test — cables in cable trays, that can also be used to define resistance to the spread of fire when the damage (char length) does not exceed 1.5 m (4 ft 11 in.).

N (5) Limited-Use Cable. Limited-use cable shall be listed as suitable for use in dwellings and raceways and shall be listed as resistant to flame spread.

Informational Note: See ANSI/UL 2556, *Standard for Wire and Cable Test Methods,* for one method of determining that cable is resistant to flame spread by testing the cable to the FV-2/VW-1 test.

N (6) Type PLTC. Type PLTC nonmetallic-sheathed, power-limited tray cable shall be listed as being suitable for cable trays, resistant to the spread of fire, and sunlight- and moisture-resistant. Type PLTC cable used in a wet location shall be listed for use in wet locations and marked "wet" or "wet location."

Informational Note: See ANSI/UL 1685-2010, *Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, for the UL flame exposure, vertical tray flame test that is used to determine resistance to the spread of fire when cables do not spread fire to the top of the tray. The smoke measurements in the test method are not applicable.

See CSA C22.2 No. 0.3-M-2001, *Test Methods for Electrical Wires and Cables*, for the CSA vertical flame test — cables in cable trays that can also be used to define resistance to the spread of fire when the damage (char length) does not exceed 1.5 m (4 ft 11 in.).

N (7) Circuit Integrity (CI) Cable, Fire-Resistive Cable System, or Electrical Circuit Protective System. Cables that are used for survivability of critical circuits under fire conditions shall comply with either 722.179(A)(7)(a), (A)(7)(b), or (A)(7)(c).

Section 722.179(A)(7) permits the use of circuit integrity (CI) cable for applications where continuity of the operations of critical circuits is needed during a fire. Such circuits could be essential to fire-fighting operations or could be circuits whose interruption could cause a more dangerous condition to occur. A smoke removal system is an example of where it could be necessary to use CI cables for control circuits to ensure that the dampers operate during a fire.

Informational Note: See *NFPA 72, National Fire Alarm and Signaling Code*, 12.4.3 and 12.4.4, for additional information on fire alarm CI cable, fire-resistive cable systems, or electrical circuit protective systems used for fire alarm circuits to comply with the survivability requirements to maintain the circuit's electrical function during fire conditions for a defined period of time.

(a) *CI Cables.* CI cables of the types specified in 722.179(A)(1), (A)(2), (A)(3), (A)(4), and (A)(6) and used for survivability of critical circuits shall be marked with the additional classification using the suffix "CI." To maintain its listed fire-resistive rating, CI cable shall only be installed in free air in accordance with 722.24(C). 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 722.179(A)(7)(b).

Informational Note: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables,* and UL 1425, *Cables for Non–Power-Limited Fire-Alarm Circuits*, for information on establishing a rating for CI cable. The *UL Guide Information for Nonpower-limited Fire Alarm Circuits* (HNHT) contains information to identify the cable and its installation limitations to maintain the fire-resistive rating.

(b) *Fire-Resistive Cables.* Fire-resistive cables of the types specified in 722.179(A)(1), (A)(2), (A)(3), (A)(4), (A)(6), and (A)(7)(a) that are part of a fire-resistive cable system shall be identified with the system identifier and hourly rating marked on the protectant or the smallest unit container and installed in accordance with the listing of the system.

Informational Note: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for information on establishing a rating for a fire-resistive cable system. The *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.

(c) *Electrical Circuit Protective System.* Protectants for cables of the types specified in 722.179(A)(1), (A)(2), (A)(3), (A)(4), and (A)(6) that are part of an electrical circuit protective system shall be identified with the protective system identifier and hourly rating marked on the protectant or the smallest unit container and installed in accordance with the listing of the protective system.

Informational Note: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems,* for information on establishing a rating for an electrical circuit protective system. The *UL Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain the fire-resistive rating.

N (8) Class 3 Single Conductors. Class 3 single conductors used as other wiring within buildings shall be listed Type CL3 and shall not be smaller than 18 AWG.

Informational Note: See ANSI/UL 1685-2010, *Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, for the UL flame exposure, vertical tray flame test that is used to determine resistance to the spread of fire when cables do not spread fire to the top of the tray. The smoke measurements in the test method are not applicable.

See CSA C22.2 No. 0.3-M-2001, *Test Methods for Electrical Wires and Cables*, for the CSA vertical flame test — cables in cable trays that can also be used to define resistance to the spread of fire when the damage (char length) does not exceed 1.5 m (4 ft 11 in.).

N (9) Limited Power (LP) Cable. Class 2 and Class 3 LP cables shall be listed as suitable for carrying power and data up to a specified current limit for each conductor without exceeding the temperature rating of the cable. The cables shall be marked with

the suffix "-LP (XXA)" where XXA designates the current limit in amperes per conductor.

Informational Note: An example of the marking on 23 AWG, 4-pair, Class 2 cable rated 75°C with an LP current rating of 0.6 amperes per conductor is "CL2-LP (0.6A) 75°C 23 AWG 4-pair."

N **(10) Undercarpet Cables.** Undercarpet cable shall be listed as suitable for use under carpet, floor covering, modular tiles, and planks.

Informational Note: See UL 444, *Standard for Safety for Communications Cables*, for the compressive loading test used to determine the suitability of cable for undercarpet use.

N **(11) Wet Locations.** Cable used in a wet location shall be listed for use in wet locations and be marked "wet" or "wet location" or have a moisture-impervious metal sheath.

N **(12) Field-Assembled Optical Fiber Cables.** Field-assembled optical fiber cable shall comply with 722.179(A)(12)(a) through (d).

(a) 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 722.179(A)(1), (A)(2), or (A)(3) and shall be marked in accordance with Table 179(B).

(b) 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.

(c) The optical fibers shall have a permanent marking, such as a marker tape, indicating the jacket with which they are identified for use.

(d) 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.

N **(13) Cables Containing Optical Fibers.** Composite optical fiber cables shall be listed as electrical cables based on the type of electrical conductors.

N **(14) Class 2 and Class 3 Cable Voltage and Temperature Ratings.** Class 2 cables shall have a voltage rating of not less than 150 volts. Class 3 cables shall have a voltage rating of not less than 300 volts. Class 2 and Class 3 cables shall have a temperature rating of not less than 60°C (140°F).

N **(15) Power-Limited Fire Alarm (PLFA) Cables.** PFLA cables shall comply with 722.179(A)(15)(a) through (A)(15)(d).

(a) Conductors for cables, other than coaxial cables, shall be solid or stranded copper. Coaxial cables shall be permitted to use 30 percent conductivity copper-covered steel center conductor wire.

(b) The size of conductors in a multiconductor cable shall not be smaller than 26 AWG. Single conductors shall not be smaller than 18 AWG. Conductors of 26 AWG shall be permitted only where spliced with a connector listed as suitable for 26 AWG to 24 AWG or larger conductors that are terminated on equipment or where the 26 AWG conductors are terminated on equipment listed as suitable for 26 AWG conductors.

(c) Cables shall have a voltage rating of not less than 300 volts.

(d) Cables shall have a temperature rating of not less than 60°C (140°F).

N **(16) Class 4 Cable Construction.**

N **(1) Sizes.** Conductors of sizes not smaller than 24 AWG shall be permitted to be used.

N **(2) Insulation.** Insulation on conductors shall be rated not less than 450 volts dc.

N **(3) Voltage Rating.** Cables shall have a voltage rating of not less than 450 volts dc. Voltage ratings shall not be marked on the cables.

N **(4) Temperature Rating.** Cables shall have a temperature rating of not less than 60°C (140°F).

N **(5) Cabling.** Cables shall comply with any requirements provided in the listing of the system.

Informational Note: See UL 1400-1, *Outline for Fault-Managed Power Distribution Technologies — Part 1: General Requirements*, for information on determining applicable requirements for the listing of Class 4 power systems. Excessive cable lengths can result in higher capacitance which could affect the safety of the circuit.

N **(B) Marking.** Cables shall be durably marked on the surface in accordance with the following:

(1) The AWG size or circular mil area shall be repeated at intervals not exceeding 610 mm (24 in.).
(2) All other markings shall be repeated at intervals not exceeding 1.0 m (40 in.).
(3) The proper type designation for the type of cable shall be marked in accordance with Table 722.179(B).
(4) The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified shall be marked.
(5) The AWG size or circular mil area shall be marked.

Informational Note No. 1: See Chapter 9, Table 8, for conductor area expressed in SI units for conductor sizes specified in AWG or circular mil area.

(6) The temperature rating for a temperature rating exceeding 60°C (140°F) shall be marked.

Informational Note No. 2: A minimum temperature rating of 60°C is assumed for cables not marked with a temperature rating.

(7) Voltage ratings shall not be marked on the cables.

N ***TABLE 722.179(B)*** *Cable Type Markings*

Cable Type	Cable Marking
Class 4 plenum cable	CL4P
Class 3 plenum cable	CL3P
Class 2 plenum cable	CL2P
Power-limited fire alarm plenum cable	FPLP
Nonconductive optical fiber plenum cable	OFNP
Conductive optical fiber plenum cable	OFCP
Class 4 riser cable	CL4R
Class 3 riser cable	CL3R
Class 2 riser cable	CL2R
Power-limited fire alarm riser cable	FPLR
Nonconductive optical fiber riser cable	OFNR
Conductive optical fiber riser cable	OFCR
Class 4 general-purpose cable	CL4
Class 3 general-purpose cable	CL3
Class 2 general-purpose cable	CL2
Power-limited fire alarm cable	FPL
Nonconductive general-purpose optical fiber cable	OFN
Conductive general-purpose optical fiber cable	OFC
Alternative nonconductive general-purpose optical fiber cable	OFNG
Alternative conductive general-purpose optical fiber cable	OFCG
Class 3 cable — limited use	CL3X
Class 2 cable — limited use	CL2X
Undercarpet cable	CMUC

Note: All types of CL2, CL3, and FPL cables containing optical fibers are provided with the suffix "-OF."

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

Informational Note No. 3: Voltage markings on cables could be misinterpreted to suggest that the cables may be suitable for Class 1 electric light and power applications.

Informational Note No. 4: Cable types are listed in descending order of fire resistance rating.

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

Informational Note No. 1: Examples of these characteristics include, but are not limited to, limited smoke, halogen free, low smoke and halogen free, and sunlight resistant.

Informational Note No. 2: Some examples of optional markings are ST1 to indicate limited smoke characteristics. See UL 2556, *Wire and Cable Test Methods*; HF to indicate halogen free. See in UL 2885, *Outline of Investigation for Acid Gas, Acidity and Conductivity of Combusted Materials*; and LSHF to indicate halogen free and low-smoke characteristics. See IEC 61034-2, *Measurement of smoke density of cables burning under defined conditions — Part 2: Test procedure and requirements.*

N ARTICLE 724

Class 1 Power-Limited Circuits and Class 1 Power-Limited Remote-Control and Signaling Circuits

N **724.1 Scope.** This article covers Class 1 circuits, including power-limited Class 1 remote-control and signaling circuits, that are not an integral part of a device or utilization equipment.

Informational Note: See 300.26 for classifications of remote-control and signaling circuits.

Article 724 may include systems such as security system circuits, access control circuits, nurse call circuits, some computer network systems, some control circuits for lighting dimmer systems, and some low-voltage control circuits that originate from listed appliances or from listed computer equipment.

The installation requirements for the wiring of information technology equipment (electronic data processing and computer equipment) located within the confines of a room that is constructed according to the requirements of NFPA 75, *Standard for the Fire Protection of Information Technology Equipment*, are not covered by Article 724. The wiring within those specially constructed rooms is covered by Article 645.

In addition, if listed computer equipment is interconnected and all the interconnected equipment is in close proximity, the wiring is considered an integral part of the equipment and, therefore, not subject to the requirements of Article 724. If the wiring leaves the group of equipment to connect to other devices in the same room or elsewhere in the building, the wiring is considered "wiring within buildings" and is subject to the requirements of Article 724.

According to 90.3, the general wiring methods found in Chapters 1 through 4 of the *NEC*® apply to remote-control, signaling, and power-limited circuits, except as amended by Article 724 for specified conditions.

A remote-control, signaling, or power-limited circuit is the portion of the wiring system between the load side of the overcurrent device or the power-limited supply and all connected equipment.

Class 1 circuits are not permitted to exceed 30 volts and 1000 volt-amperes. In many cases, Class 1 circuits are extensions of power systems and are subject to the requirements of the power systems, except under the following conditions:

1. Conductors size 16 AWG and 18 AWG may be used. (See 724.43.)
2. Where damage to the circuit would introduce a hazard, the circuit must be mechanically protected. (See 724.31.)
3. The adjustment factors of 310.15(C) apply only if such conductors carry a continuous load exceeding 10 percent of the ampacity of the conductor. (See 724.51.)

Class 1 remote-control circuits are commonly used to operate motor controllers in conjunction with moving equipment or mechanical processes, elevators, conveyors, and other such