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Mike Holt's Illustrated Guide to

UNDERSTANDING NEC® REQUIREMENTS FOR FIRE ALARM WIRING

Extracted from Mike Holt's Understanding the National Electrical Code® - Volume 2

April 28, 2018

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Author: Mike Holt

Technical Illustrator: Mike Culbreath

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ABOUT THE AUTHOR

Mike Holt worked his way up through the electrical trade. He began as an apprentice electrician and became one of the most recognized experts in the world as it relates to electrical power installations. He's worked as a journeyman electrician, master electrician, and electrical contractor. Mike's experience in the real world gives him a unique understanding of how the *NEC* relates to electrical installations from a practical standpoint.

You'll find his writing style to be direct, nontechnical, and powerful.

Did you know Mike didn't finish high school? So if you struggled in high school or didn't finish at all, don't let it get you down. However, realizing that success depends on one's continuing pursuit of education, Mike immediately attained his GED, and ultimately attended the University of Miami's Graduate School for a Master's degree in Business Administration.

Mike resides in Central Florida, is the father of seven children, has five grandchildren, and enjoys many outside interests and activities. He's a nine-time National Barefoot Water-Ski Champion (1988, 1999, 2005–2009, 2012–2013). He's set many national records and continues to train year-round at a World competition level (www.barefootwaterskier.com).

What sets him apart from some is his commitment to living a balanced lifestyle; placing God first, family, career, then self.



*I dedicate this book to the
Lord Jesus Christ,
my mentor and teacher.
Proverbs 16:3*



ARTICLE 760

FIRE ALARM SYSTEMS

Introduction to Article 760—Fire Alarm Systems

Article 760 covers the installation of wiring and equipment for fire alarm systems, including circuits controlled and powered by the fire alarm. These include fire detection and alarm notification, guard's tour, sprinkler waterflow, and sprinkler supervisory systems. NFPA 72, *National Fire Alarm Code* provides other fire alarm system requirements.

Part I. General

760.1 Scope

Article 760 covers the installation of wiring and equipment for fire alarm systems, including circuits controlled and powered by the fire alarm system. ▶Figure 760-1



▶Figure 760-1

Author's Comment:

- Residential smoke alarm systems, including interconnecting wiring, aren't covered by Article 760, because they aren't powered by a fire alarm system as defined in NFPA 72.

Note 1: Fire alarm systems include fire detection and alarm notification, guard's tour, sprinkler waterflow, and sprinkler supervisory systems. Other circuits that might be controlled or powered by the fire alarm system include elevator capture, elevator shutdown, door release, smoke doors and damper control, fire doors and damper control, and fan shutdown. NFPA 72, *National Fire Alarm and Signaling Code*, provides the requirements for the selection, installation, performance, use, testing, and maintenance of fire alarm systems.

Author's Comment:

- Building control circuits associated with the fire alarm system, such as elevator capture and fan shutdown, must comply with Article 725 [760.3(E)]. Article 760 applies if these components are powered and directly controlled by the fire alarm system.
- NFPA 101—*Life Safety Code* or the local building code specifies when and where a fire alarm system is required.

760.2 Definitions

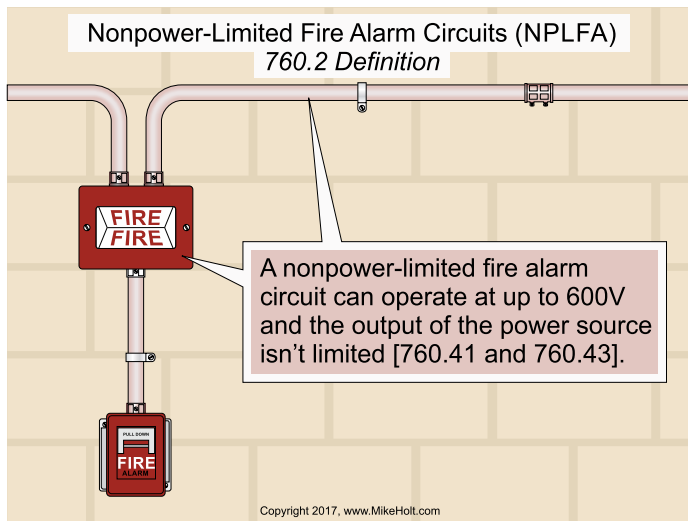
Abandoned Fire Alarm Cable. A cable that isn't terminated to equipment and not identified for future use with a tag.

Author's Comment:

- Section 760.25 requires the accessible portion of abandoned cables to be removed.

Fire Alarm Circuit. The portion of the wiring system and connected equipment powered and controlled by the fire alarm system. Fire alarm circuits are classified as either nonpower-limited or power-limited.

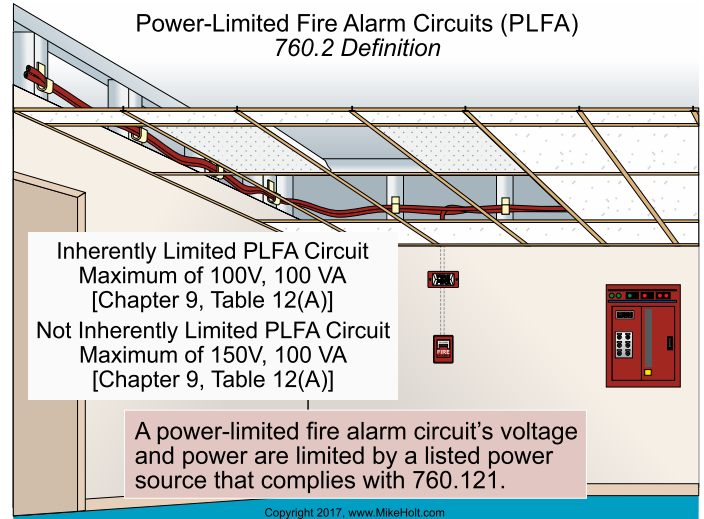
Nonpower-Limited Fire Alarm Circuit. A nonpower-limited fire alarm circuit can operate at up to 600V, and the power output isn't limited [760.41 and 760.43]. ▶Figure 760-2



▶Figure 760-2

Power-Limited Fire Alarm Circuit. A power-limited fire alarm circuit must have the voltage and power limited by a listed power supply that complies with 760.121 as follows: ▶Figure 760-3

Inherently Limited (ac) [Chapter 9, Table 12(A)]	
Voltage	Power
0V to 20V	5.00 x V
21V to 100V	100 VA



▶Figure 760-3

Not Inherently Limited [Chapter 9, Table 12(A)]

Overcurrent Voltage	Power	Protection
0V to 20V	5.00 x V	5A
21V to 100V	100 VA	100/V
101V to 150V	100 VA	1A

Author's Comment:

- Inherently limited power supplies are designed to burn out if overloaded.

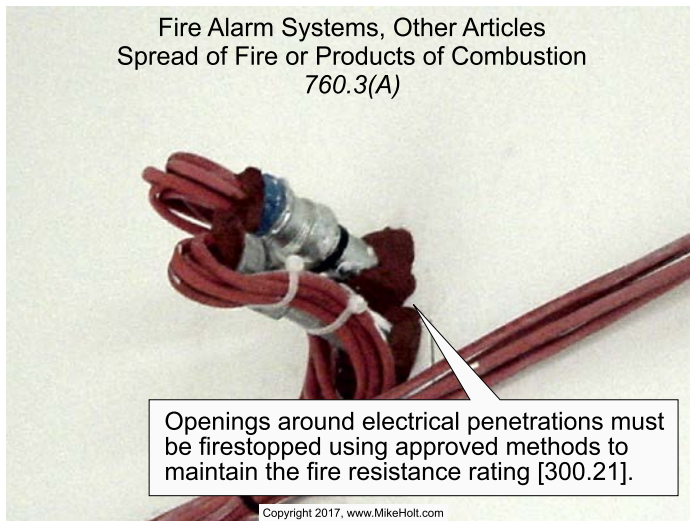
760.3 Other Articles

Only those sections contained in Article 300 specifically referenced below apply to fire alarm systems.

(A) Spread of Fire or Products of Combustion. Fire alarm circuits installed through fire-resistant-rated walls, partitions, floors, or ceilings must be firestopped to limit the possible spread of fire or products of combustion in accordance with the instructions supplied by the manufacturer for the specific type of cable and construction material (drywall, brick, and so forth) [300.21]. ▶Figure 760-4

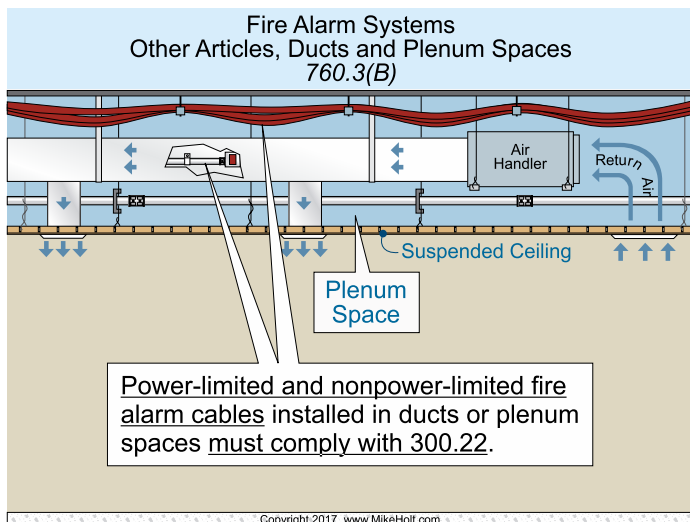
(B) Ducts and Plenum Spaces. Power-limited and nonpower-limited fire alarm cables installed in ducts or plenum spaces must comply with 300.22. ▶Figure 760-5

Fire Alarm Systems, Other Articles Spread of Fire or Products of Combustion 760.3(A)



►Figure 760-4

Fire Alarm Systems Other Articles, Ducts and Plenum Spaces 760.3(B)



►Figure 760-5

Ex 1: Power-limited fire alarm cables selected in accordance with Table 760.154 and installed in accordance with 760.135(B) and 300.22(B) Ex, are permitted to be installed in ducts specifically fabricated for environmental air.

Ex 2: Power-limited fire alarm cables selected in accordance with Table 760.154 and installed in accordance with 760.135(C) are permitted to be installed in plenum spaces.

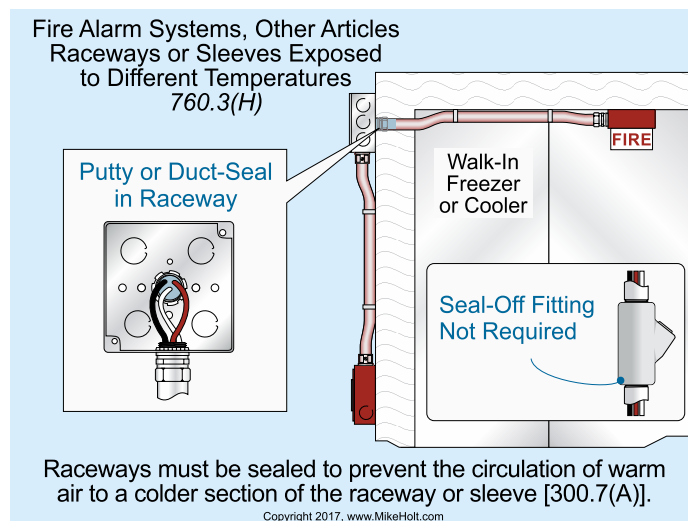
(D) Corrosive, Damp, or Wet Locations. Fire alarm circuits installed in corrosive, damp, or wet locations must be identified for use in the operating environment [110.11], must be of materials suitable for the environment in which they're to be installed, and must be of a type suitable for the application [300.5(B), 300.6, 300.9, and 310.10(G)].

(E) Building Control Circuits. Class 1, 2, and 3 circuits used for building controls (elevator capture, fan shutdown, and so on), associated with the fire alarm system, but not controlled and powered by the fire alarm system, must be installed in accordance with Article 725 [760.1].

(F) Optical Fiber Cables. Optical fiber cables utilized for fire alarm circuits must be installed in accordance with Article 770.

(H) Raceways or Sleeves Exposed to Different Temperatures. If a raceway or sleeve is subjected to different temperatures, and where condensation is known to be a problem, the raceway or sleeve must be filled with a material approved by the authority having jurisdiction that will prevent the circulation of warm air to a colder section of the raceway. An explosionproof seal isn't required for this purpose [300.7(A)]. ►Figure 760-6

Fire Alarm Systems, Other Articles Raceways or Sleeves Exposed to Different Temperatures 760.3(H)



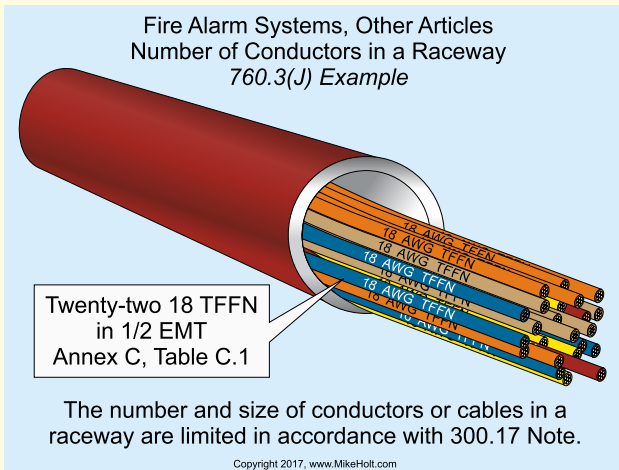
►Figure 760-6

(J) Number and Size of Conductors in a Raceway. Raceways must be large enough to permit the installation and removal of conductors without damaging conductor insulation [300.17].

Author's Comment:

- When all conductors within a raceway are the same size and insulation, the number of conductors permitted can be found in Annex C for the raceway type.

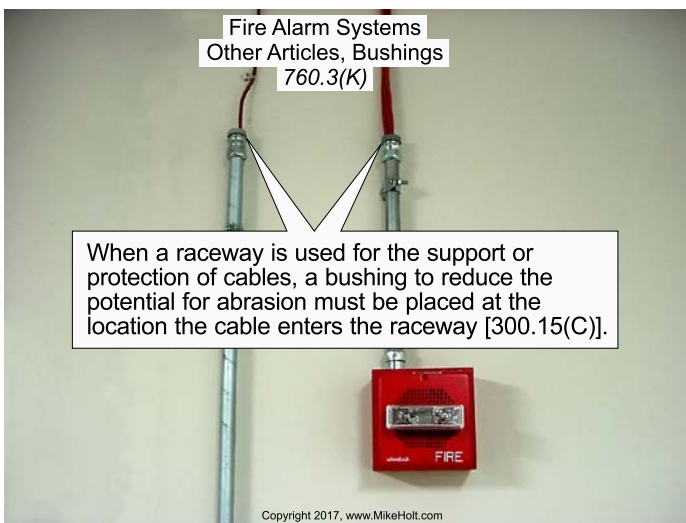
Example: How many 18 TFFN fixture wires can be installed in trade size ½ electrical metallic tubing? ► **Figure 760–7**



► **Figure 760–7**

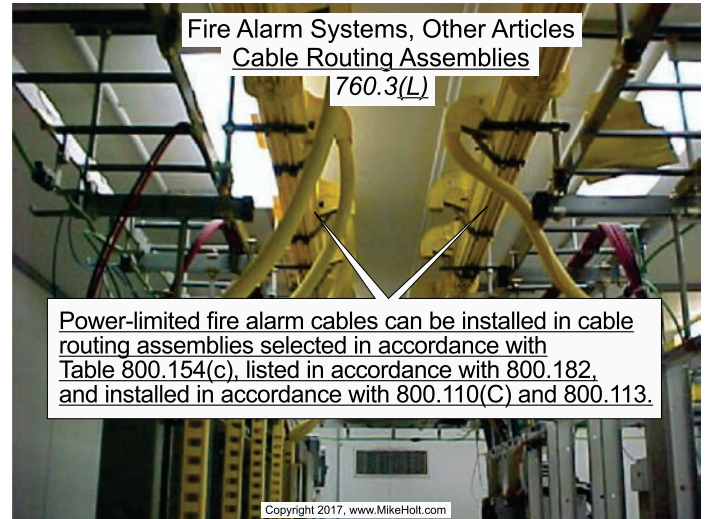
Answer: Twenty-two 18 TFFN fixture wires can be installed in trade size ½ electrical metallic tubing conductors [Annex C, Table C.1].

(K) Bushing. When a raceway is used for the support or protection of cables, a bushing to reduce the potential for abrasion must be placed at the location where the cables enter the raceway in accordance with 300.15(C). ► **Figure 760–8**



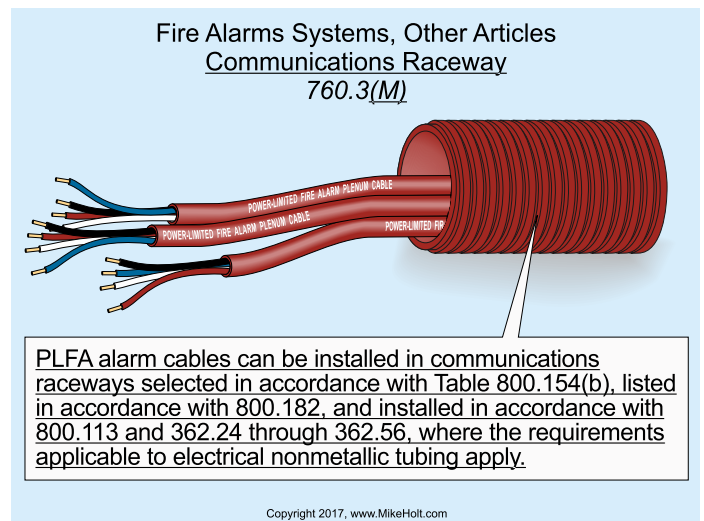
► **Figure 760–8**

(L) Cable Routing Assemblies. Power-limited fire alarm cables can be installed in cable routing assemblies selected in accordance with Table 800.154(c), listed in accordance with 800.182, and installed in accordance with 800.110(C) and 800.113. ► **Figure 760–9**



► **Figure 760–9**

(M) Communications Raceways. Power-limited fire alarm cables can be installed in communications raceways 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 apply. ► **Figure 760–10**



► **Figure 760–10**

760.21 Access to Electrical Equipment Behind Panels Designed to Allow Access

Access to equipment isn't permitted to be prohibited by an accumulation of cables that prevents the removal of suspended-ceiling panels.

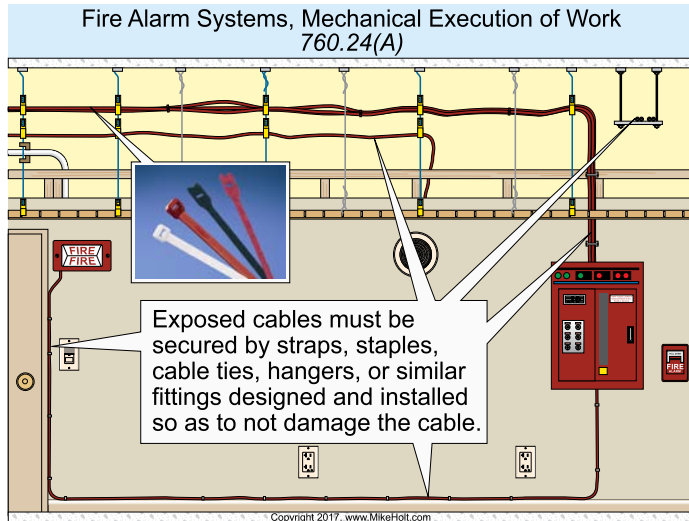
Author's Comment:

- Cables must be located so suspended-ceiling panels can be moved to provide access to electrical equipment.

760.24 Mechanical Execution of Work

(A) General. Equipment and cabling must be installed in a neat and workmanlike manner.

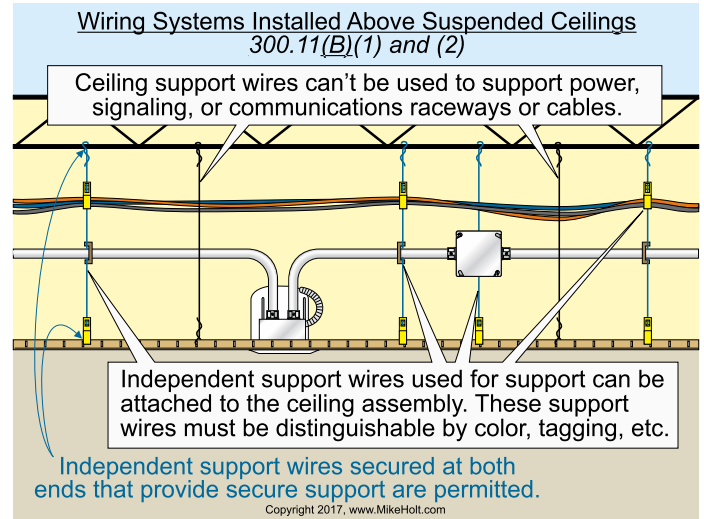
Exposed cables must be supported by the structural components of the building so the cable won't be damaged by normal building use. Cables must be supported by straps, staples, hangers, cable ties, or similar fittings designed and installed in a manner that won't damage the cable. ▶Figure 760-11



▶Figure 760-11

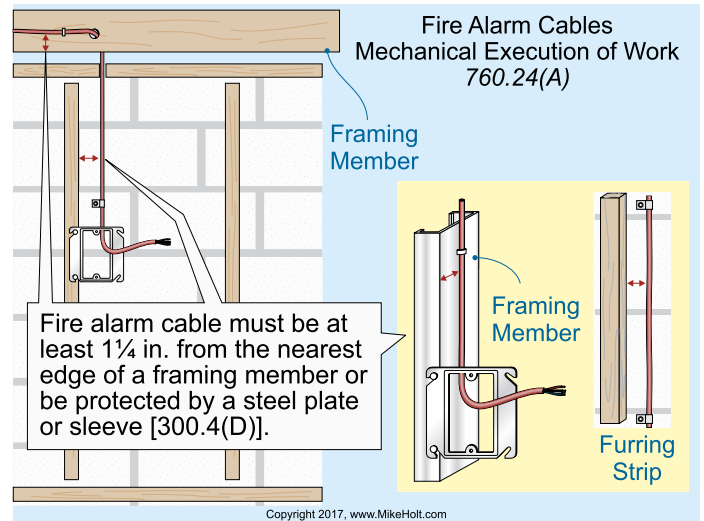
Author's Comment:

- Raceways and cables above a suspended ceiling must be supported by independent support wires attached to the suspended ceiling [300.11(B), 760.46, and 760.130]. ▶Figure 760-12



▶Figure 760-12

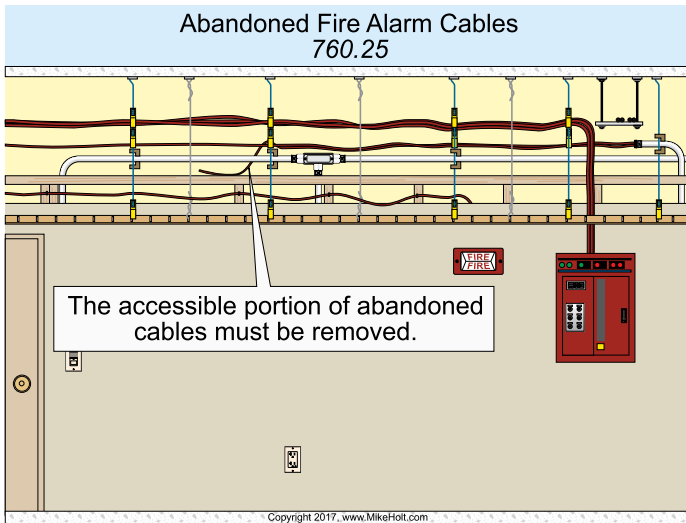
Cables installed through or parallel to framing members or furring strips must be protected where they're likely to be penetrated by nails or screws, by installing the wiring method so it isn't less than 1¼ in. from the nearest edge of the framing member or furring strips, or by protecting them with a 1/16 in. thick steel plate or the equivalent [300.4(D)]. ▶Figure 760-13



▶Figure 760-13

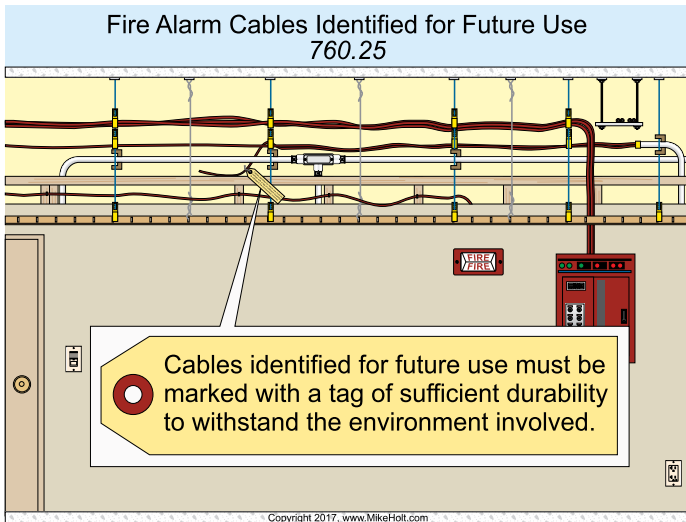
760.25 Abandoned Cable

To limit the spread of fire or products of combustion within a building, the accessible portion of cable that isn't terminated at equipment and not identified for future use with a tag must be removed [760.2]. ▶Figure 760-14



▶Figure 760-14

Tags identifying cables for future use must be able to withstand the environment involved. ▶Figure 760-15



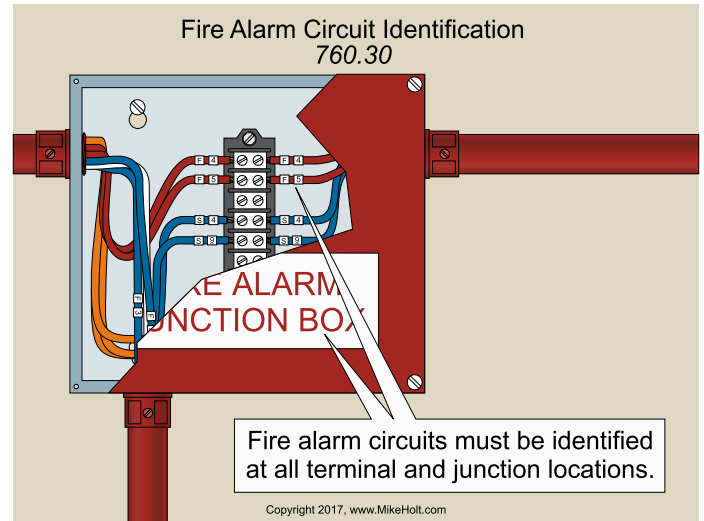
▶Figure 760-15

Author's Comment:

- Cables installed in concealed raceways aren't considered "accessible"; therefore, they're not required to be removed.

760.30 Fire Alarm Circuit Identification

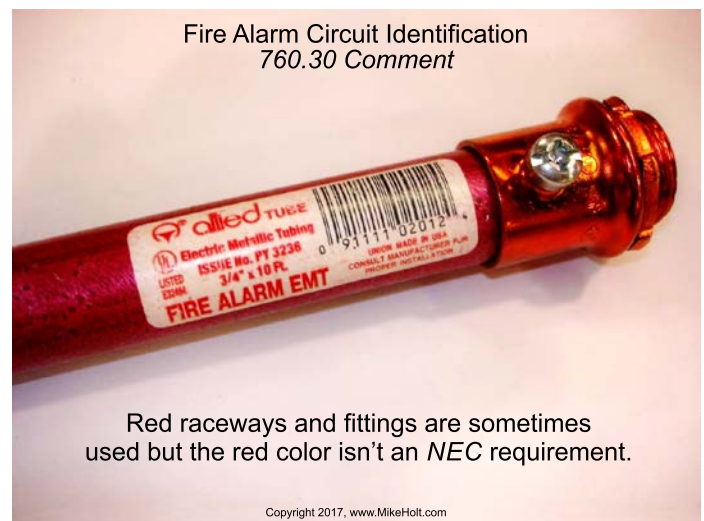
Fire alarm circuits must be identified at terminal and junction locations. The identification must be in such a manner that will help to prevent unintentional signals on the fire alarm system circuits during testing and servicing of other systems. ▶Figure 760-16



▶Figure 760-16

Authors Comment:

- Red raceways and fittings are sometimes used but the red color isn't an NEC requirement. ▶Figure 760-17



▶Figure 760-17

760.32 Fire Alarm Circuit Cables Extending Beyond a Building

If fire alarm circuit conductors extend beyond a building and run outdoors, they must be installed in accordance with Parts II, III, and IV of Article 800, and they must also be installed in accordance with Part I of Article 300.

760.35 Fire Alarm Circuit Requirements

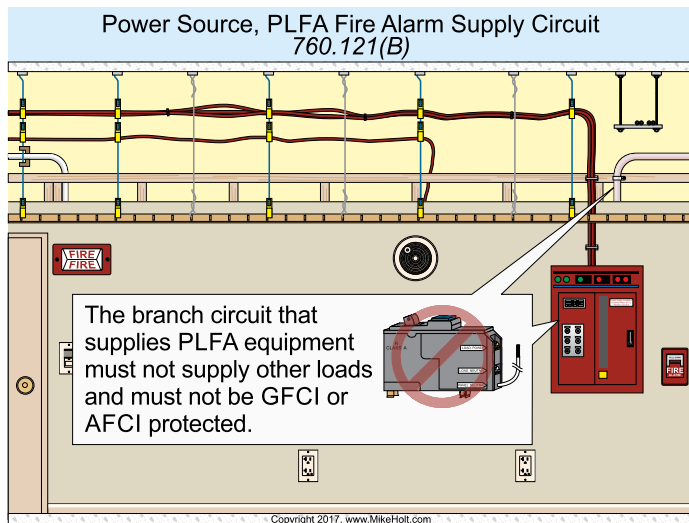
(A) Nonpower-Limited Fire Alarm Circuits. Nonpower-limited fire alarm (NPLFA) circuits must comply with Parts I and II of this article.

(B) Power-Limited Fire Alarm Circuits. Power-limited fire alarm (PLFA) circuits must comply with Parts I and III of this article.

Part III. Power-Limited Fire Alarm (PLFA) Circuits

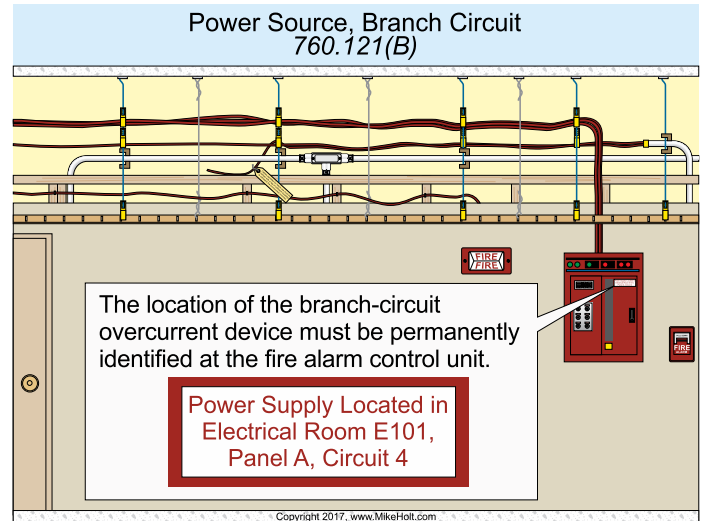
760.121 Power Sources for Fire Alarm Circuits

(B) Branch Circuit. Power-limited fire alarm equipment must be supplied by a branch circuit that supplies no other load and isn't GFCI or AFCI protected. ▶Figure 760-18



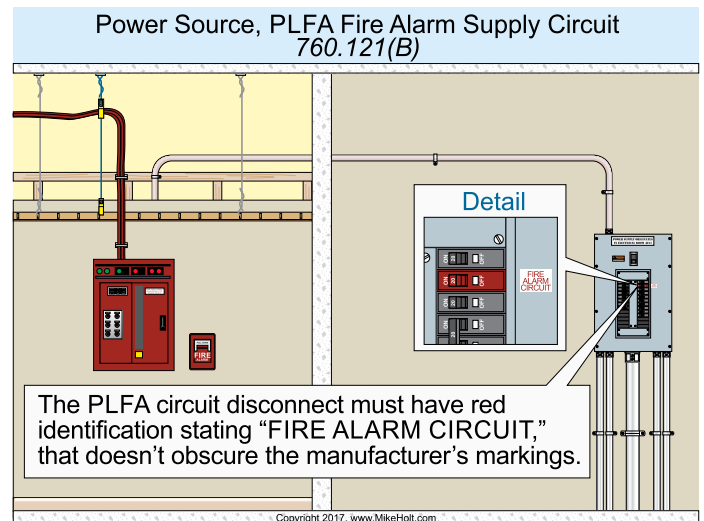
▶Figure 760-18

The location of the branch-circuit overcurrent protection device for the power-limited fire alarm equipment must be permanently identified at the fire alarm control unit. ▶Figure 760-19



▶Figure 760-19

The branch-circuit overcurrent protection device must be identified in red, accessible only to qualified personnel, and identified as “FIRE ALARM CIRCUIT.” The red identification must not damage the overcurrent protective device or obscure any manufacturer’s markings. ▶Figure 760-20



▶Figure 760-20

760.124 Equipment Marking

Fire alarm equipment supplying power-limited fire alarm cable circuits must be durably marked to indicate each circuit that’s a power-limited fire alarm circuit.

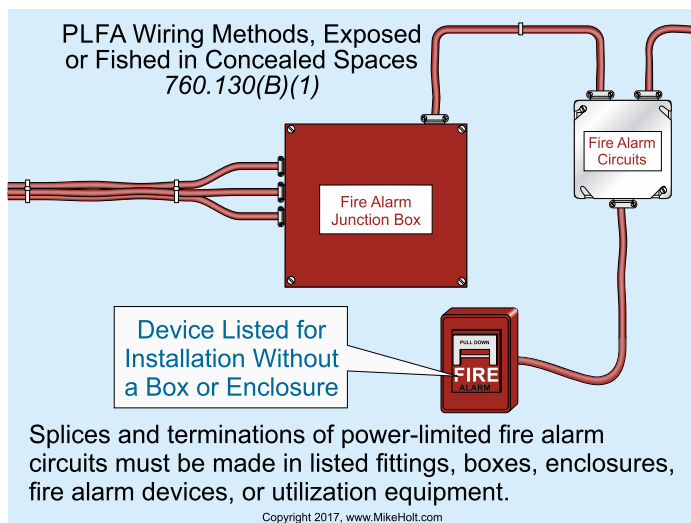
Author’s Comment:

- Fire alarm circuits must be marked at terminal and junction locations [760.30].

760.130 Wiring Methods on Load Side of Fire Alarm Power Source

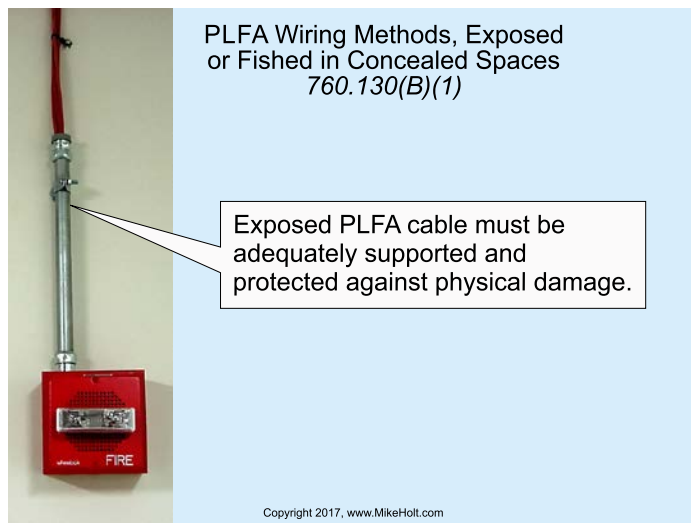
(B) PLFA Wiring Methods and Materials. Power-limited fire alarm conductors and cables described in 760.179 must be installed as detailed in:

(1) Exposed or Fished in Concealed Spaces. Cable splices or terminations must be made in listed fittings, boxes, enclosures, fire alarm devices, or utilization equipment. ▶Figure 760–21



▶Figure 760–21

Power-limited fire alarm cable installed exposed must be adequately supported and protected against physical damage. ▶Figure 760–22



▶Figure 760–22

Author's Comment:

- Exposed cables must be supported by the structural components of the building so the cable won't be damaged by normal building use. Cables must be secured by straps, staples, hangers, or similar fittings designed and installed in a manner that won't damage the cable. Cables installed through or parallel to framing members or furring strips must be protected where they're likely to be penetrated by nails or screws, by installing the wiring method so it isn't less than 1¼ in. from the nearest edge of the framing member or furring strips, or it must be protected by a ¼ in. thick steel plate or the equivalent [760.24(A)].

760.135 Installation of PLFA Cables in Buildings

Installation of power-limited fire alarm cables in buildings must comply with 760.135(A) through (J).

(A) Listing. PLFA cables installed in buildings must be listed.

(B) Ducts Specifically Fabricated for Environmental Air Spaces. Plenum rated PLFA cables are permitted to be installed within ducts specifically fabricated for environmental air spaces in accordance with 300.22(B) if the cable is directly associated with the air distribution system and complies with (1) and (2):

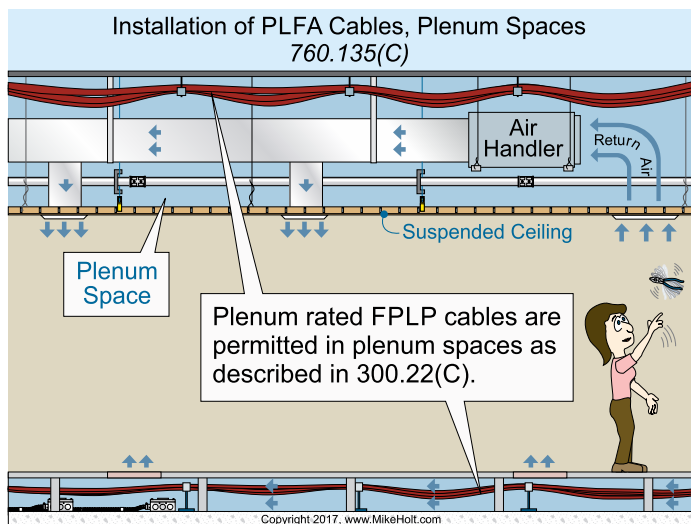
- (1) The cable is plenum rated with a length as short as practical to perform the required function.
- (2) The cable is nonplenum rated within a raceway in accordance with 300.22(B).

(C) Plenum Spaces. Plenum rated FPLP cables are permitted in plenum spaces as described in 300.22(C). ▶Figure 760–23

(H) Other Building Locations. The following cables are permitted to be installed in building locations other than the locations covered in 770.113(B) through (H):

- (1) Types FPLP, FPLR, and FPL cables
- (2) Types FPLP, FPLR, and FPL cables 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 FPLP, FPLR, and FPL cables installed within a raceway of a type recognized in Chapter 3



►Figure 760-23

760.136 Separation from Power Conductors

(A) General. Power-limited fire alarm conductors aren't permitted to be placed in any enclosure, raceway, or cable with conductors of electric light, power, or Class 1 circuits.

(B) Separated by Barriers. If separated by a barrier, power-limited fire alarm circuits are permitted with electric power conductors.

Author's Comment:

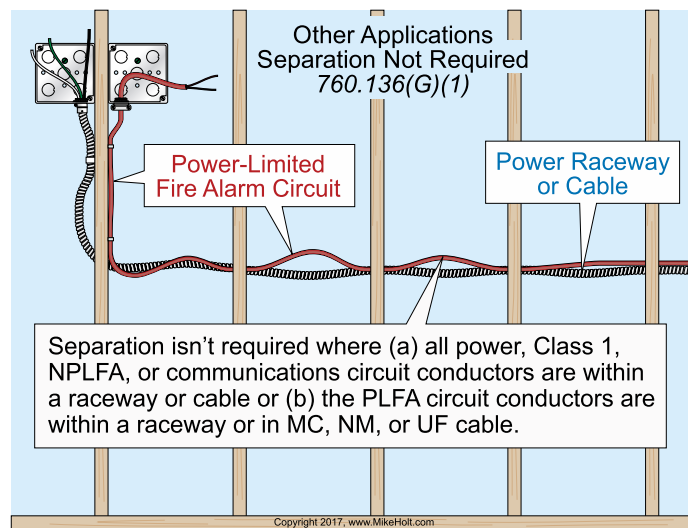
- Separation is required to prevent a fire or shock hazard that can occur from a short between the fire alarm circuit and the higher-voltage circuits.

(D) Associated Systems Within Enclosures. Power-limited fire alarm conductors can be mixed with electric light, power, and Class 1 circuit conductors in enclosures where these other conductors are introduced solely for connection to the same equipment, and:

- (1) A minimum of ¼ in. separation is maintained from the power-limited fire alarm cable conductors.

(G) Other Applications. Power-limited fire alarm circuit conductors must be separated by not less than 2 in. from insulated conductors of electric light, power, or Class 1 circuits unless:

- (1) Electric light, power, Class 1 circuit conductors, or power-limited fire alarm circuit conductors, are within a raceway or in metal-sheathed, metal-clad, nonmetallic-sheathed, or underground feeder cables. ►Figure 760-24



►Figure 760-24

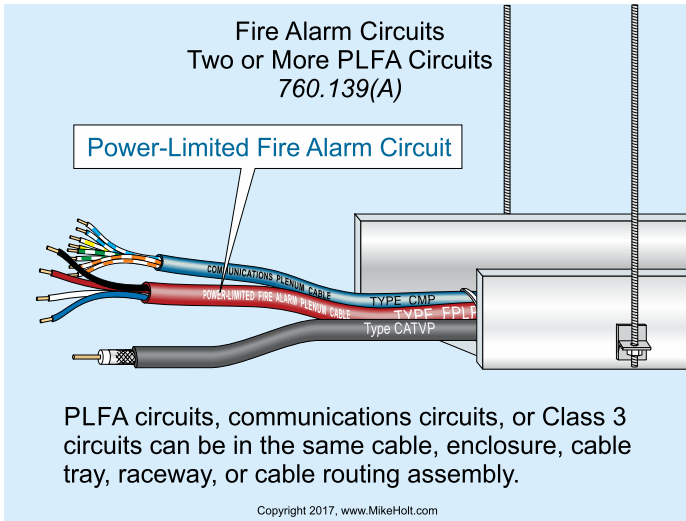
760.139 Fire Alarm Circuits, Class 2, Class 3, and Communications Circuits

(A) Two or More PLFA Circuits. Power-limited fire alarm circuits, communications circuits, or Class 3 circuits can be in the same cable, enclosure, cable tray, raceway, or cable routing assembly. ►Figure 760-25

(B) PLFA and Class 2 Circuits. Class 2 circuits can be within the same cable, cable routing assembly, enclosure, cable tray, or raceway as conductors of power-limited fire alarm circuits provided the Class 2 circuit conductor insulation isn't less than that required for the power-limited fire alarm circuits.

Author's Comment:

- Listed Class 2 cables have an insulation voltage rating of at least 150V [725.179(G)], whereas listed power-limited fire alarm cables have a voltage rating of not less than 300V [760.179(C)].



►Figure 760-25

(D) Audio System Circuits and Power-Limited Fire Alarm Circuits. Audio system circuits [640.9(C)] using Class 2 or Class 3 wiring methods [725.133 and 725.154] aren't permitted to be installed in the same cable, cable routing assembly, cable tray, or raceway with power-limited fire alarm conductors or cables.

Author's Comment:

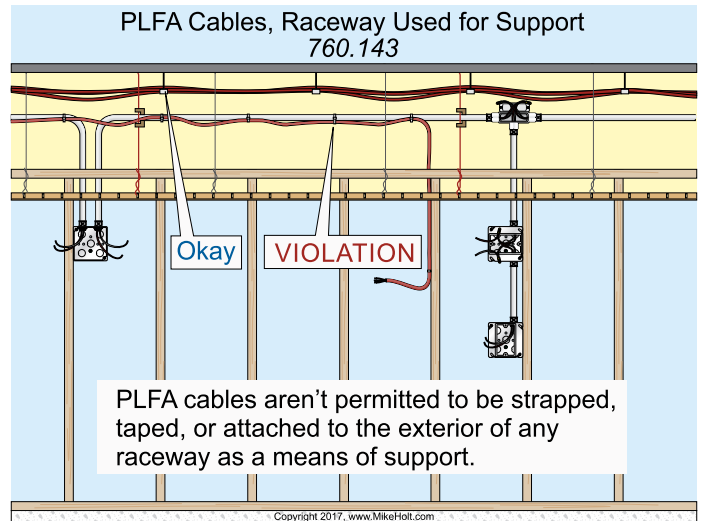
- The concern is that a fault from audio amplifier circuits to fire alarm circuits has the potential to create a hazard by disrupting the operation of fire alarm systems. However, this restriction doesn't apply to the voice annunciation audio circuits supplied and controlled from a fire alarm panel and commonly required in high-rise buildings and similar applications.

760.143 Support

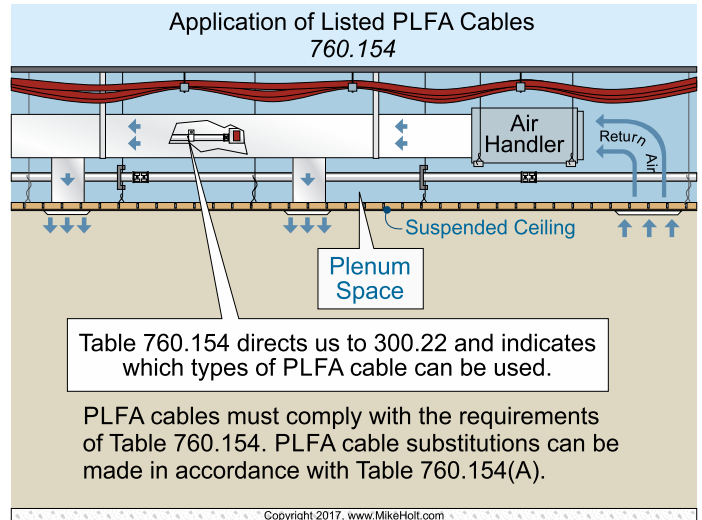
Power-limited fire alarm cables aren't permitted to be strapped, taped, or attached to the exterior of any raceway as a means of support. ►Figure 760-26

760.154 Applications of Listed Fire Alarm Cables (PLFA)

PLFA cables must meet the requirements of Table 760.154, or the substitutions allowed in 760.154(A). ►Figure 760-27



►Figure 760-26



►Figure 760-27

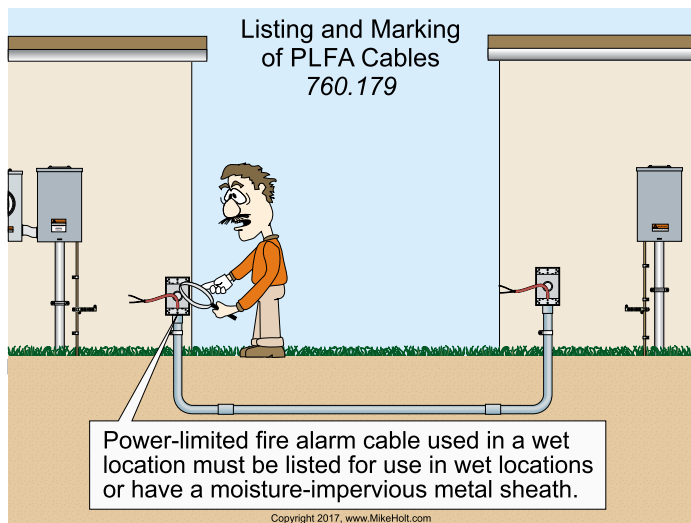
Part IV. Listing Requirements

760.179 Listing and Marking of Power-Limited Fire Alarm Cables (PLFA)

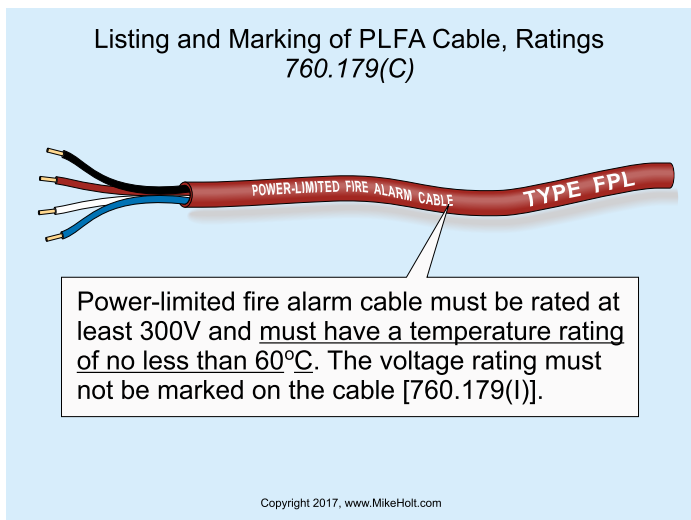
PLFA cables installed as wiring within buildings must be listed as being resistant to the spread of fire and other criteria in accordance with 760.179(A) through (H) and be marked in accordance with 760.179(I).

Cable used in a wet location must be listed for use in wet locations or have a moisture-impervious metal sheath. ►Figure 760-28

(C) Ratings. Fire alarm cable must have a voltage rating of not less than 300V and a temperature rating of no less than 60°C. ►Figure 760-29

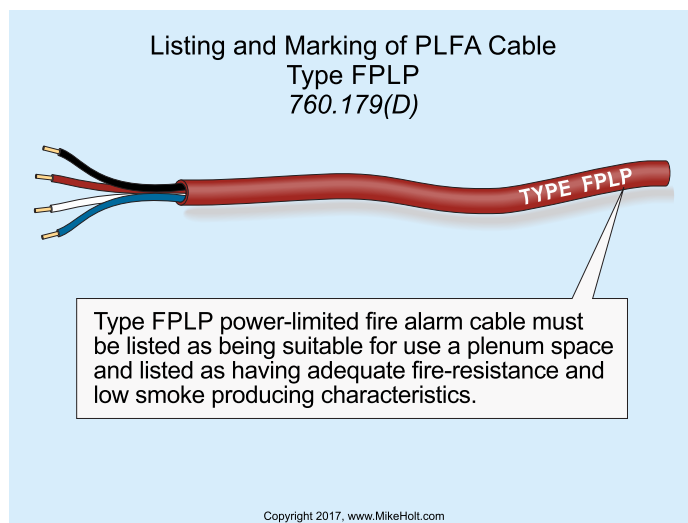


►Figure 760-28



►Figure 760-29

(D) Type FPLP. Type FPLP plenum cable must be listed as being suitable for use in a plenum space. ►Figure 760-30



►Figure 760-30

(I) Marking. Cables must be marked in accordance with Table 760.179(I). Voltage ratings aren't permitted to be marked on the cable.

Note: Voltage markings on cables may suggest that the cables are suitable for Class 1 or electric power and light applications, which they aren't.

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