RICHMOND

INTERNATIONAL CODE COUNCIL 2018

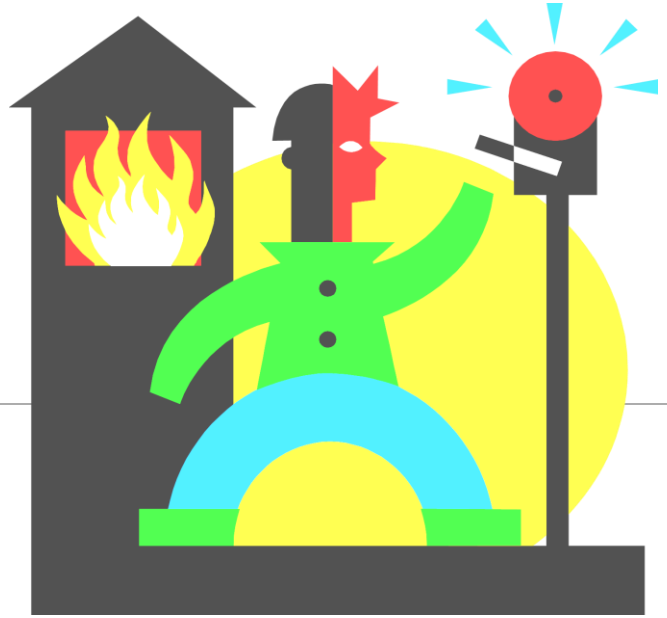
Welcome to the

2018 Annual Conference Educational Sessions

Session: Fire Alarm Installation

Sponsored by ORACLE

FIRE ALARM INSTALLATION SEMINAR



PRESENTED BY: MICHAEL L. SAVAGE, LLC.

About the speaker…

Director of Building Safety in Marion County, Florida

Licensed Inspector in Maryland for 23 years.

Licensed in New Mexico.

Serves on ICC, IAPMO and NFPA Committees including the NEC.

36 ICC Certifications including MCP and CBO

Member of the Board of Governors for ICC ES.

Chair of ICC Compliance Code Action Committee (CCAC)

Member of ICC Code Correlation Committee (CCC)

ICC Preferred Provider for Continuing Education.

What is a Fire Alarm System?

A system or portion of a combination system that consists of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals.

This is the NFPA preferred definition.

When are Fire Alarms required??

SECTION 907 FIRE ALARM AND DETECTION SYSTEMS (907.1 General.) This section covers the application, installation, performance and maintenance of fire alarm systems and their components.

907.2 Where required—new buildings and structures. An approved fire alarm system installed in accordance with the provisions of this code and NFPA 72 shall be provided in new buildings and structures in accordance with Sections 907.2.1 through 907.2.23 and provide occupant notification in accordance with Section 907.5, unless other requirements are provided by another section of this code.

Not fewer than one manual fire alarm box shall be provided in an approved location to initiate a fire alarm signal for fire alarm systems employing automatic fire detectors or water-flow detection devices. Where other sections of this code allow elimination of fire alarm boxes due to sprinklers, a single fire alarm box shall be installed.

WHAT CODES APPLY TO FIRE ALARM SYSTEMS?

2018 INTERNATIONAL BUILDING CODE®

SECTION 907 FIRE ALARM AND DETECTION SYSTEMS

907.1 General. This section covers the application, installation, performance and maintenance of fire alarm systems and their components.

907.1.1 Construction documents

907.2 Where required—new buildings and structures

907.3 Fire safety functions

National Electrical Code® (NFPA 70®)

The *National Electrical Code® (NEC®)* covers all of the necessary requirements for all electrical work performed in a building.

The Fire Protective Signaling Systems portion of the code **(NEC Article 760)** details the specific requirements for wiring and equipment installation for fire protection signaling systems. Specifications include installation methods, connection types, circuit identification, and wire types (including gauges and insulation).

The *NEC®* places restrictions on the number and types of circuit combinations that can be installed in the same enclosure.

National Fire Alarm Code® (NFPA 72®)

The recommended requirements for installation of fire alarm systems and equipment in residential and commercial facilities are covered in this code. *Explains where to provide the fire alarm system (dictated by the occupancy chapter).*

Included are requirements for installation of initiating devices (sensors) and notification appliances (visual or audible).

Inspection, testing, and maintenance requirements for fire alarm systems and equipment are also covered.

Life Safety Code® (NFPA 101®)

This document is focused on the preservation and protection of human life, as opposed to property.

Life safety requirements are detailed for both new construction and existing structures. Specifically, necessary protection for unique building features and construction are detailed.

In addition, chapters are organized to explain when, where, and for what applications fire alarm systems are required, the necessary means of initiation and occupant notification, and the means by which to notify the fire department.

This code also details any equipment exceptions to these requirements.

Other Codes and Standards.

Uniform Fire Code™ (NFPA 1) – This code was established to help fire authorities continually develop safeguards against fire hazards. A chapter of this code is dedicated to fire protection systems. Information and requirements for testing, operation, installation, and periodic preventive maintenance of fire alarm systems are included in this portion of the code.

Other Codes and Standards.

The NFPA also publishes specific standards that are used by fire alarm system professionals. These include:

NFPA 75, Standard for Protection of Electronic Computer/Data Processing Equipment

NFPA 80, Standard for Fire Doors and Other Opening Protectives

NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

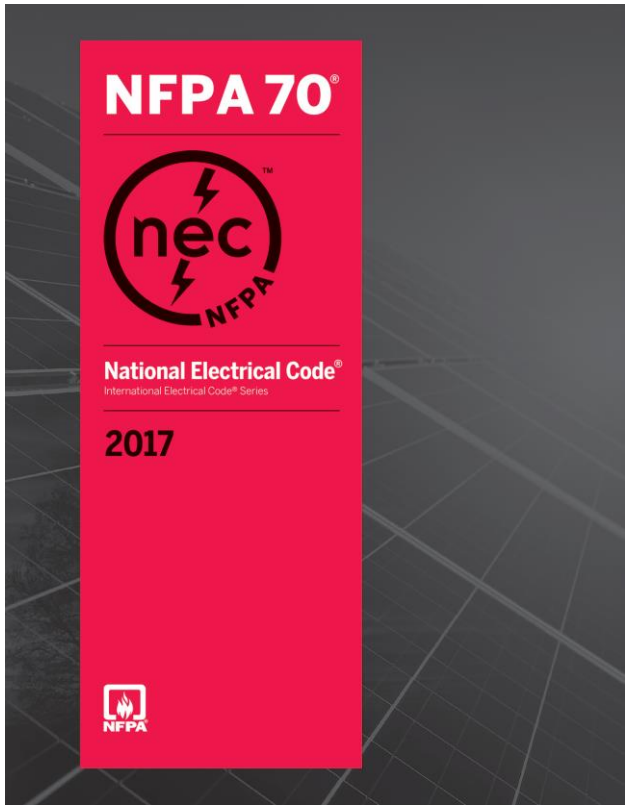
NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems

NFPA 92A, Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences

Americans with Disability Act - Accessible Guidelines (ADA-AG): *Explains where to provide visual notification for the hearing impaired.*

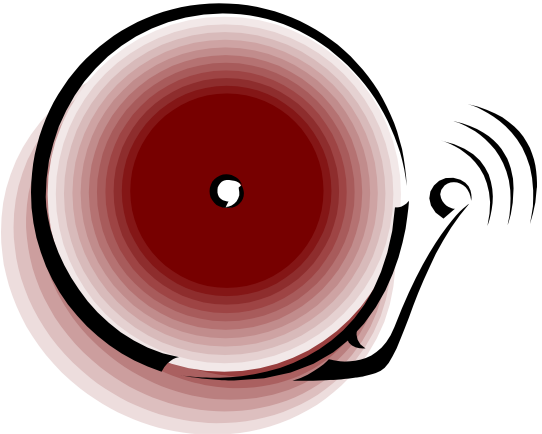
NFPA 70, Article 760

Fire Alarm Systems



What’s Covered in the NEC?

760.1 Scope. This article covers the installation of wiring and equipment of fire alarm systems including all circuits controlled and powered by the fire alarm system.



Fire Alarm System Installation

NEC Article 760 specifies the wiring methods and special cables required for fire protective signaling systems.

The following special cable types are used in protective signaling systems:

Power-limited fire alarm (FPL) cable

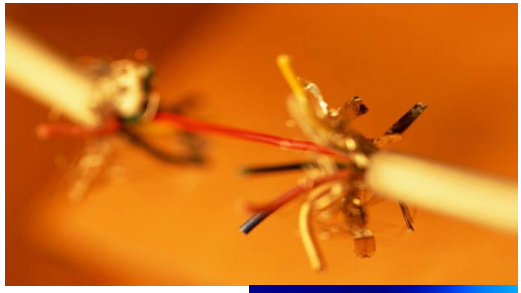
Power-limited fire alarm riser (FPLR) cable

Power-limited fire alarm plenum (FPLP) cable

Nonpower-limited fire alarm (NPLF) circuit cable

Nonpower-limited fire alarm riser (NPLFR) circuit riser cable

Nonpower-limited fire alarm plenum (NPLFP) circuit cable



760.3 Other Articles *(Fire Alarm Systems)*

Fire alarm circuits required to comply with Article 760.

These same fire alarm circuits are required to comply with other articles and sections of the *Code* as required by 760.3

Only those sections of Article 300 referenced in this article shall apply to fire alarm systems.

- Spread of Fire or Products of Combustion. See 300.21
- Ducts, Plenums, and Other Air-Handling Spaces. See 300.22

General Wiring Requirements

In addition to NEC Article 760, the following *NEC*® articles cover other items of concern for fire alarm system installations.

NEC Sections 110.11 and 300.6(A),(B), and (C), Corrosive, Damp, or Wet Locations

NEC Section 300.21, Spread of Fire or Products of Combustion

NEC Section 300.22, Ducts, Plenums, and Other Air Handling Spaces

NEC Articles 500 through 516 and 517, Part IV, Locations Classified as Hazardous

NEC Article 695, Fire Pumps

NEC Article 725, Remote-Control and Signaling Circuits (Building Control Circuits)

NEC Article 770, Fiber Optics

NEC Article 800, Communications Circuits

NEC Article 810, Radio and Television Equipment

760.3 Other Articles (Fire Alarm Systems)

Circuits and equipment shall comply with 760.3(A) through (K). Only those sections of Article 300 referenced in this article shall apply to fire alarm systems.

(A) Spread of Fire or Products of Combustion - Section 300.21

(B) Ducts, Plenums, and Other Air-Handling Spaces - Section 300.22

(C) Hazardous (Classified) Locations - Articles 500 through 516 and Article 517

(D) Corrosive, Damp, or Wet Locations - Sections 110.11, 300.6, and 310.10(G)

(E) Building Control Circuits - Article 725

(F) Optical Fiber Cables - Article 770

(G) Installation of Conductors with Other Systems - Section 300.8

(H) Raceways or Sleeves Exposed to Different Temperatures - Section 300.7(A)

(I) Vertical Support for Fire Rated Cables and Conductors - Section 300.19

(J) Number and Size of Cables and Conductors in Raceway - Section 300.17

(K) Bushing - Section 300.15(C)

References to Article 300 provisions applying to fire alarm circuits were expanded

760.3(A) Spread of Fire or Products of Combustion.

- **760.3(A) & 300.21 Spread of Fire or Products of Combustion.**

Electrical installations 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 electrical penetrations into or through fire-resistant-rated walls, partitions, floors, or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.

FIRE SEALANT


CABLE PROTECTION SPRAY

INTUMESCENT PUTTY


INTUMESCENT PIPE SLEEVE

760.3(B) Ducts, Plenums, and Other Air-Handling Spaces.

760.3(B) See 300.22.

Section 300.22, where installed in ducts or plenums or other spaces used for environmental air.

Wiring in air handling spaces requires the use of approved wiring methods, such as:

- Special plenum-rated cable
- Flexible metal tubing (Greenfield)
- Electrical metallic tubing (EMT)
- Intermediate metallic conduit (IMC)
- Rigid metallic conduit (hard wall or Schedule 80 conduit)

300.22(B) Other Space Used for Environmental Air.

Low Volt, ATC and Thermostat Cables Shall be Listed.

Plenum Rated Cables

Photo: IAEI Archives

760.3(C) Hazardous (Classified) Locations.

The *NEC*® includes requirements for wiring in hazardous locations. Some areas that are considered hazardous are listed below:

- ***NEC Article 511,*** *Commercial Garages, Repair and Storage*
- ***NEC Article 513,*** *Aircraft Hangars*
- ***NEC Article 514,*** *Gasoline Dispensing and Service Stations*
- ***NEC Article 515,*** *Bulk Storage Plants*
- ***NEC Article 516,*** *Spray Application, Dipping, and Coating*
- ***NEC Article 517,*** *Healthcare Facilities*


S410 FAN RELAY
FIRE
PUSH IN
PULL DOWN
SILENT KNIGHT
RESET
SILENCE
SILENT KNIGHT
Model SK-5208

760.3(D) Corrosive, Damp, or Wet Locations.

Where installed in corrosive, damp, or wet location Sections 110.11, 300.6, and 310.10(G), shall apply.

110.11 Deteriorating Agents. Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

Equipment not identified for outdoor use and equipment identified only for indoor use, such as “dry locations,” “indoor use only,” “damp locations,” or enclosure Types 1, 2, 5, 12, 12K, and/or 13, shall be protected against damage from the weather during construction.

IN SHORT…IT SHALL BE LISTED!!

760.3(D) Corrosive, Damp, or Wet Locations.

300.6 Protection Against Corrosion and Deterioration.

Raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.

(G) Corrosive Conditions. Conductors exposed to oils, greases, vapors, gases, fumes, liquids, or other substances having a deleterious effect on the conductor or insulation shall be of a type suitable for the application.

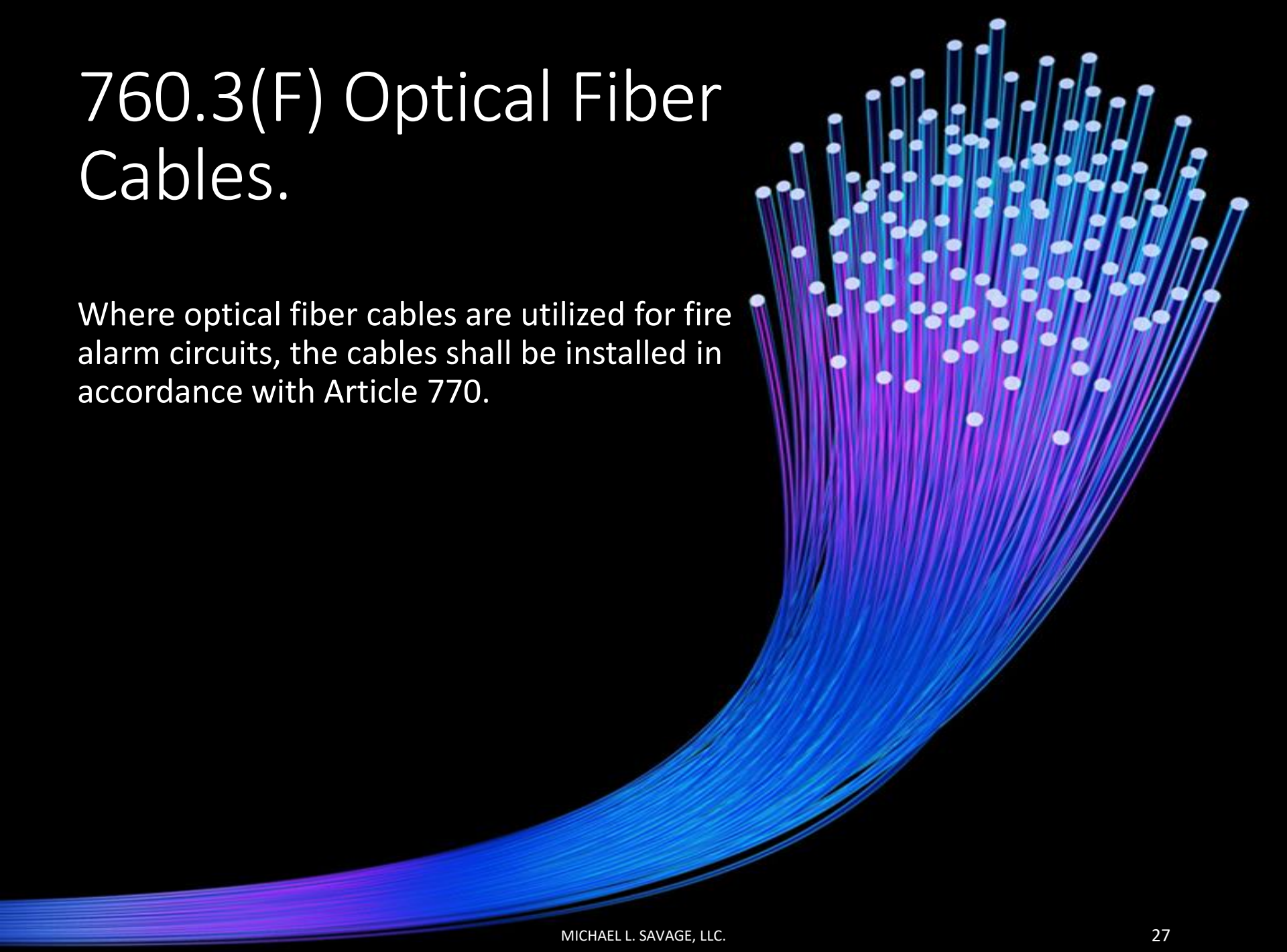
760.3(E) Building Control Circuits.

Article 725, where building control circuits (e.g., elevator capture, fan shutdown) are associated with the fire alarm system.

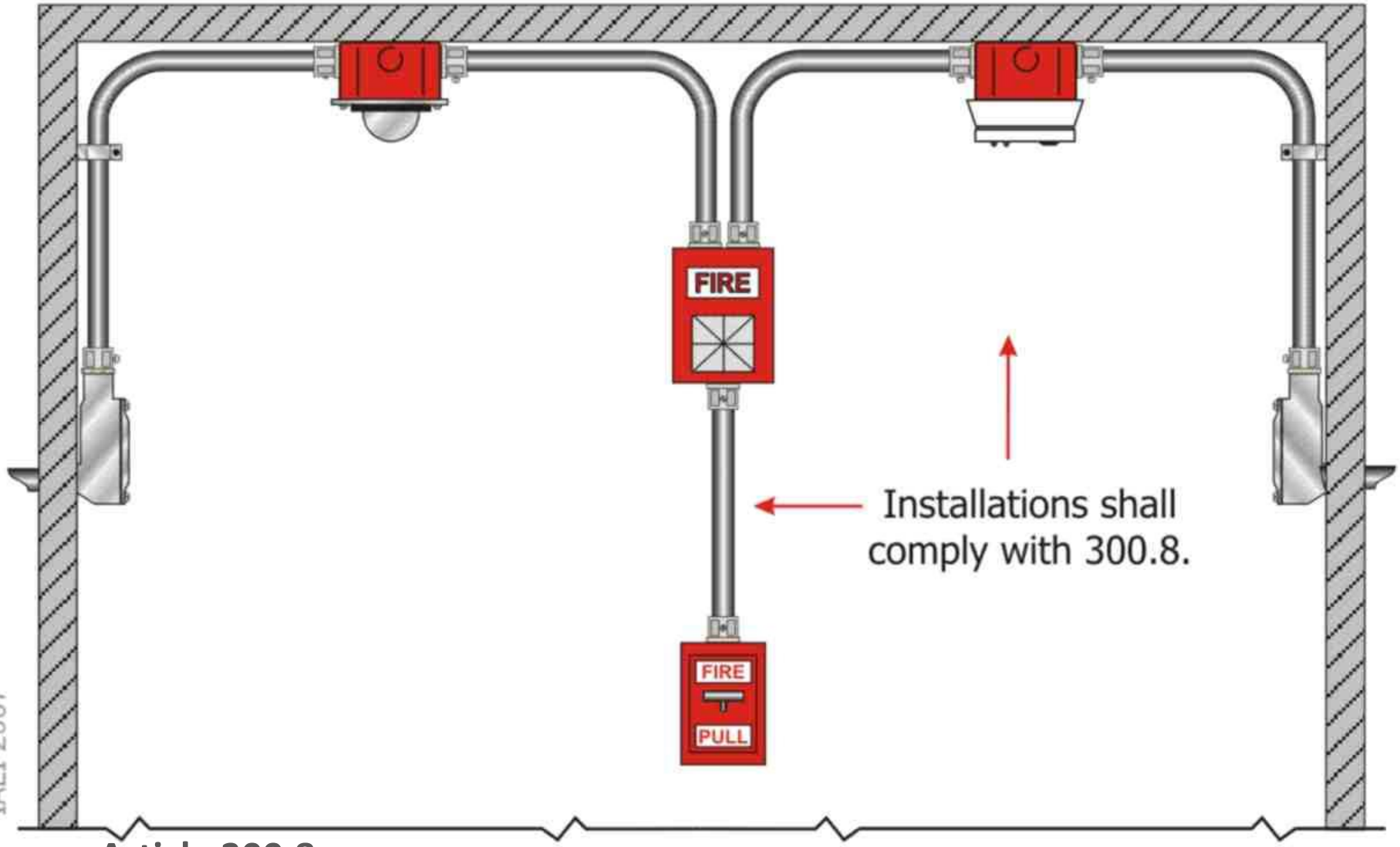
- Wiring in elevator shafts must directly relate to the elevator and be installed in rigid metallic conduit, rigid nonmetallic conduit, EMT, IMC, or up to 6’ of flexible conduit.

760.3(F) Optical Fiber Cables.

Where optical fiber cables are utilized for fire alarm circuits, the cables shall be installed in accordance with Article 770.

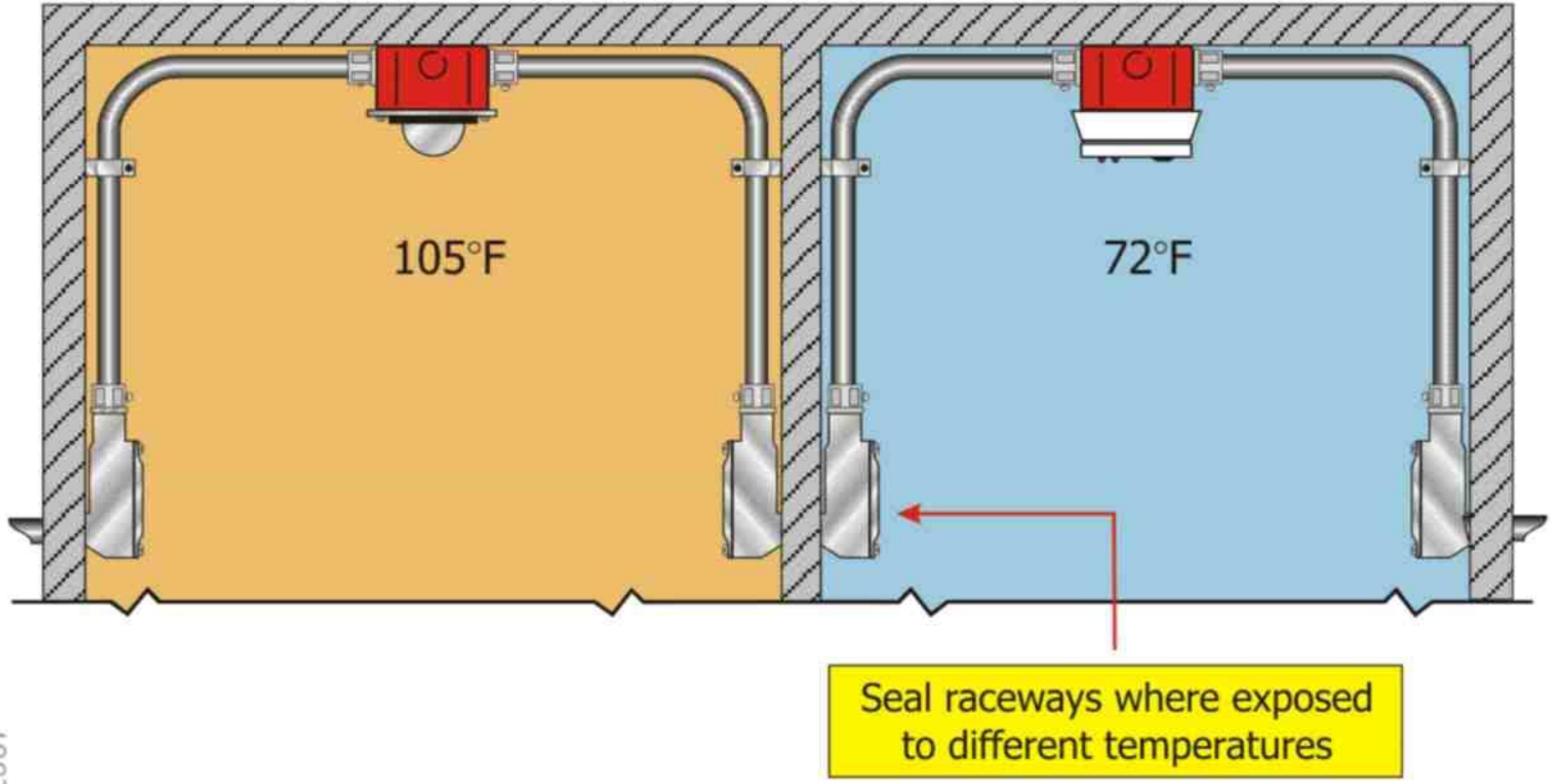


760.3(G) Installation of Conductors with Other Systems



Article 300.8:
Fire alarm conductors are not permitted in the same raceway or cable tray with any foreign systems such as air piping, gas piping, and so forth.

760.46 and 760.130(B) Circuit Wiring Methods



Sealing requirements in 300.7 apply to raceways containing fire alarm circuits.

References to 300.7 have been added to 760.46 and 760.130(B).

760.3(I) Vertical Support for Fire Rated 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 shall be installed in accordance with 300.19.

Table 300.19(A) Spacings for Conductor Supports

Conductor Size	Support of Conductors in Vertical Raceways	Conductors: Aluminum or Copper-Clad Aluminum m	Conductors: Aluminum or Copper-Clad Aluminum ft	Conductors: Copper m	Conductors: Copper ft
18 AWG through 8 AWG	Not greater than	30	100	30	100
6 AWG through 1/0 AWG	Not greater than	60	200	30	100
2/0 AWG through 4/0 AWG	Not greater than	55	180	25	80
Over 4/0 AWG through 350 kcmil	Not greater than	41	135	18	60
Over 350 kcmil through 500 kcmil	Not greater than	36	120	15	50
Over 500 kcmil through 750 kcmil	Not greater than	28	95	12	40
Over 750 kcmil	Not greater than	26	85	11	35

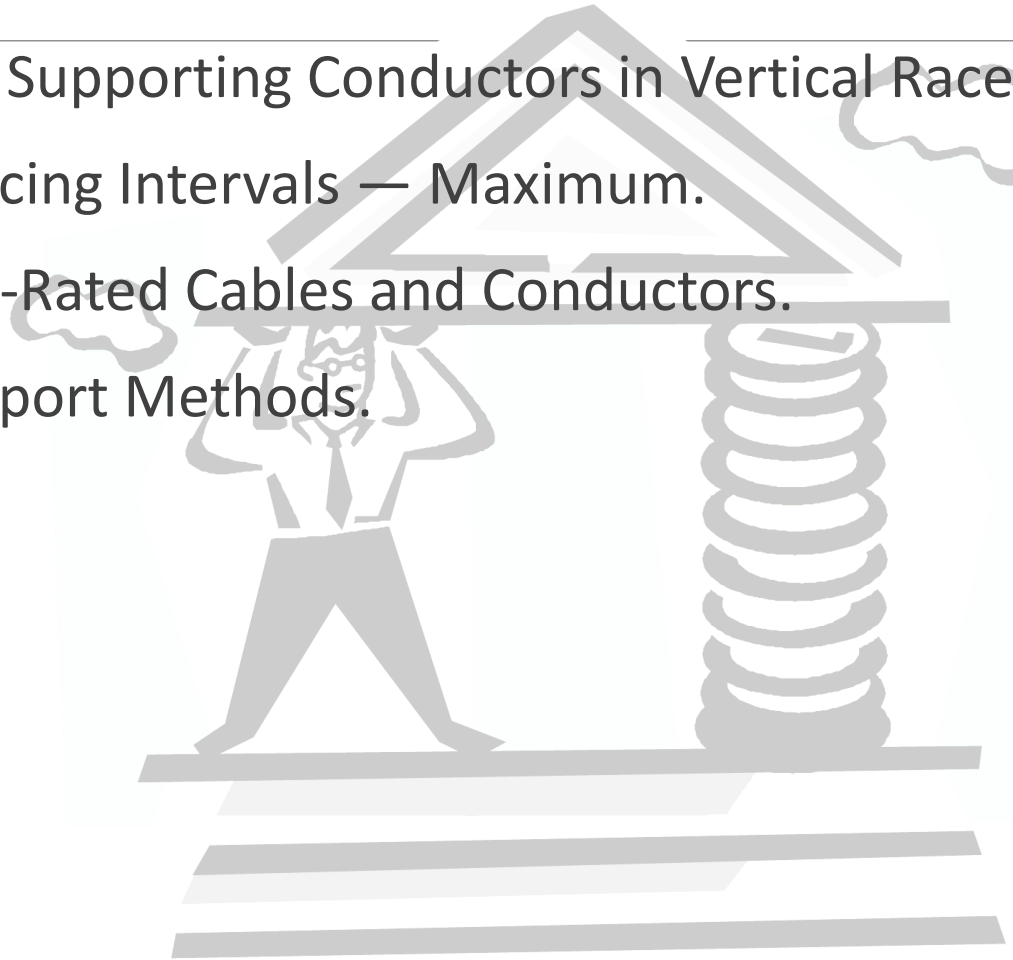
760.3(I) Vertical Support for Fire Rated Cables and Conductors.

300.19 Supporting Conductors in Vertical Raceways includes:

(A) Spacing Intervals — Maximum.

(B) Fire-Rated Cables and Conductors.

(C) Support Methods.



760.3(J) Number and Size of Cables and Conductors in Raceway.

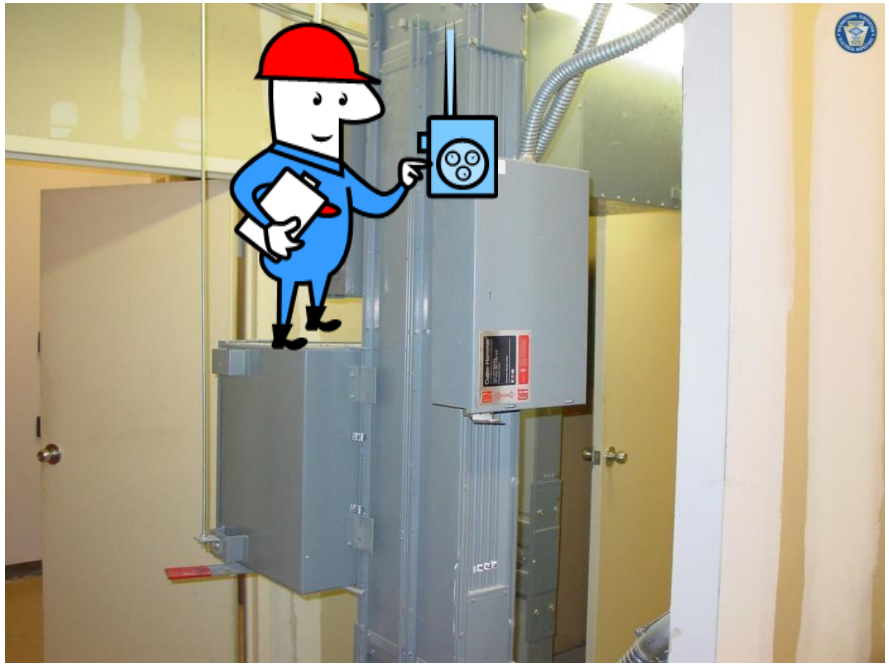
Installations shall comply with 300.17, **Number and Size of Conductors in Raceway.**

The number and size of conductors in any raceway shall not be more than will permit dissipation of the heat and ready installation or withdrawal of the conductors without damage to the conductors or to their insulation.

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

760.21 Access to Electrical Equipment Behind Panels Designed to Allow Access.

Access to electrical equipment shall not be denied by an accumulation of conductors and cables that prevents removal of panels, including suspended ceiling panels.



760.24 Mechanical Execution of Work.

Fire alarm circuits shall be installed in a neat workmanlike manner.

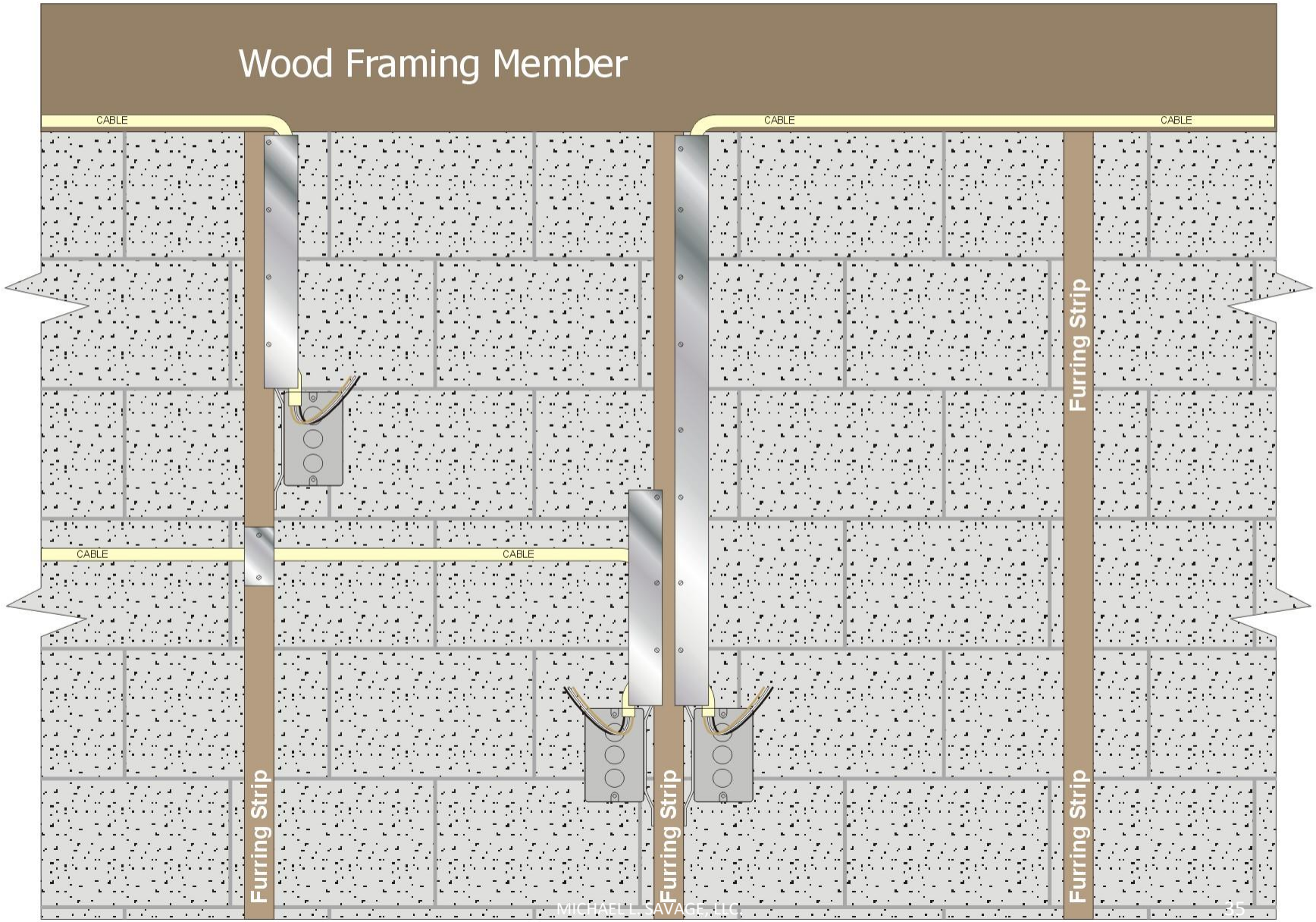
Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use.

Such cables shall be supported by straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the cable.

The installation shall also comply with 300.4(D).

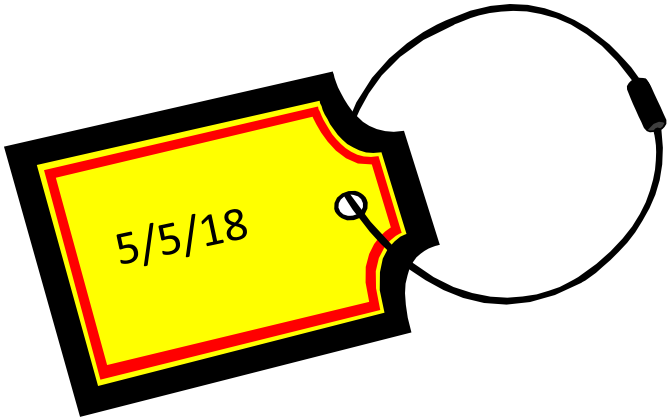
300.4(D) Protection

Cables and raceways parallel to framing members and furring strips

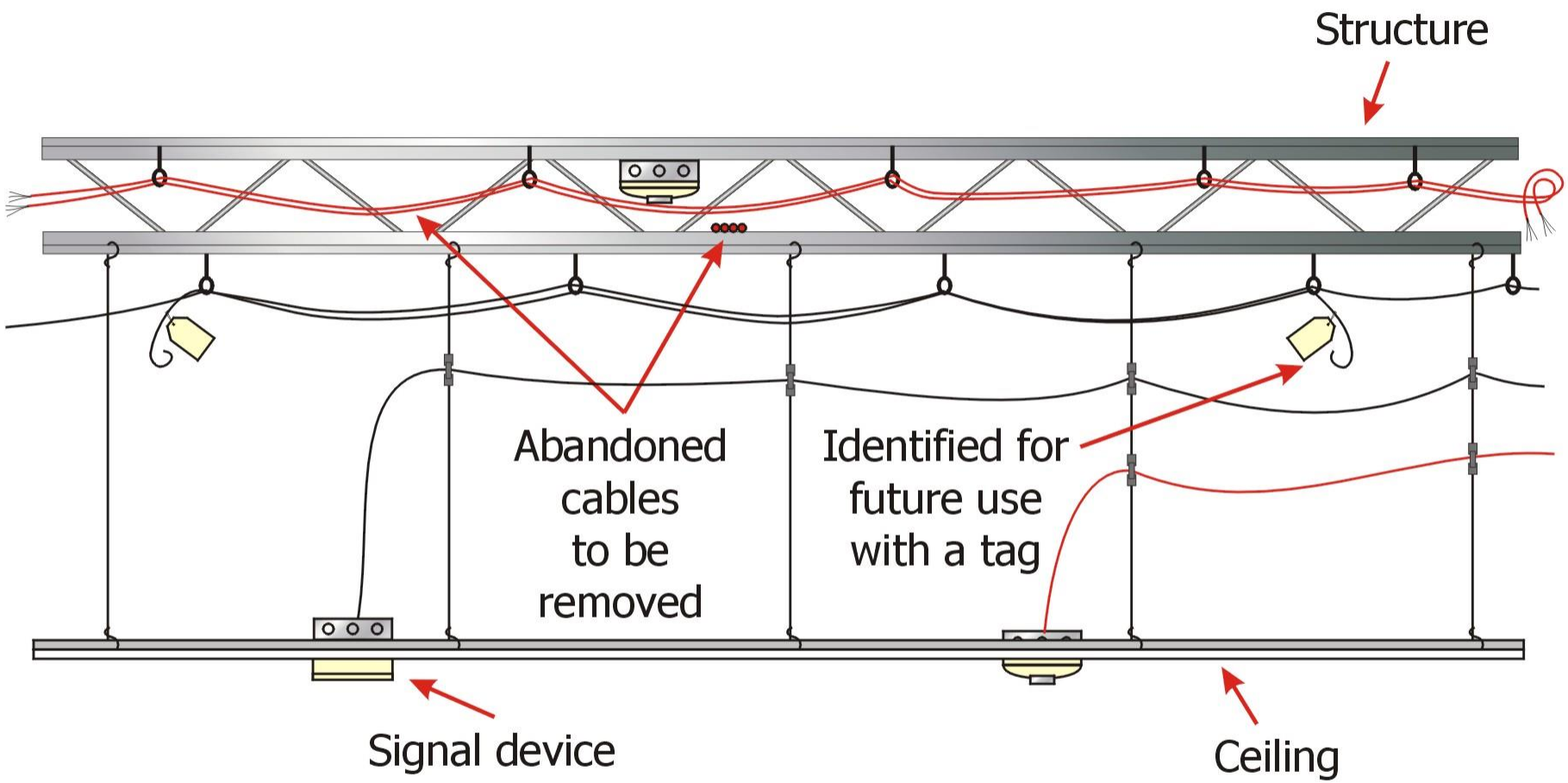


760.25 Abandoned Cables.

The accessible portion of abandoned fire alarm 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.



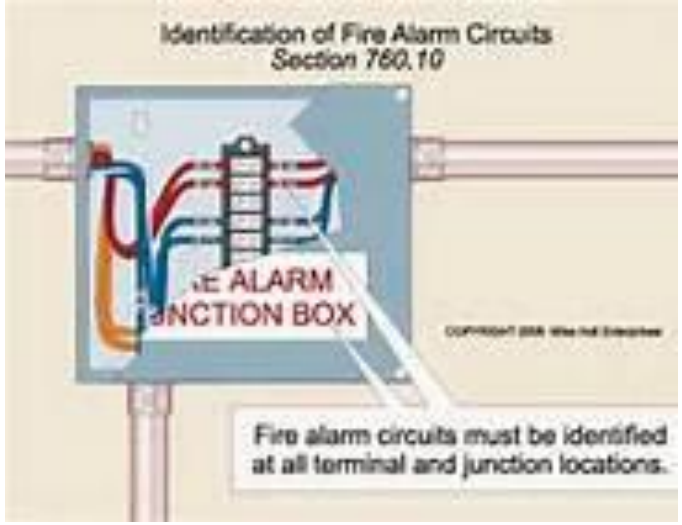
760.25 Abandoned Cables.



Accessible portions of abandoned Class 2, Class 3, and PLTC cable and abandoned fire alarm cables are required to be removed.

760.30 Fire Alarm Circuit Identification.

Fire alarm circuits shall be identified at terminal and junction locations in a manner that helps to prevent unintentional signals on fire alarm system circuit(s) during testing and servicing of other systems.



760.32 Fire Alarm Circuits Extending Beyond One Building.

Power-limited fire alarm circuits that extend beyond one building and run outdoors either shall meet the installation requirements of Parts II, III, and IV of Article 800 or shall meet the installation requirements of Part I of Article 300.

Non–power-limited fire alarm circuits that extend beyond one building and run outdoors shall meet the installation requirements of Part I of Article 300 and the applicable sections of Part I of Article 225.

300.5 Underground Installations. (As Used per 760.32)

(A) Minimum Cover Requirements. Direct-buried cable or conduit or other raceways shall be installed to meet the minimum cover requirements of Table 300.5.

(B) Wet Locations. The interior of enclosures or raceways installed underground shall be considered to be a wet location. Insulated conductors and cables installed in these enclosures or raceways in underground installations shall be listed for use in wet locations and shall comply with 310.10(C). Any connections or splices in an underground installation shall be approved for wet locations.

(C) Underground Cables Under Buildings. Underground cable installed under a building shall be in a raceway.

Exception No. 1: Type MI Cable shall be permitted under a building without installation in a raceway where embedded in concrete, fill, or other masonry in accordance with 332.10(6) or in underground runs where suitably protected against physical damage and corrosive conditions in accordance with 332.10(10).

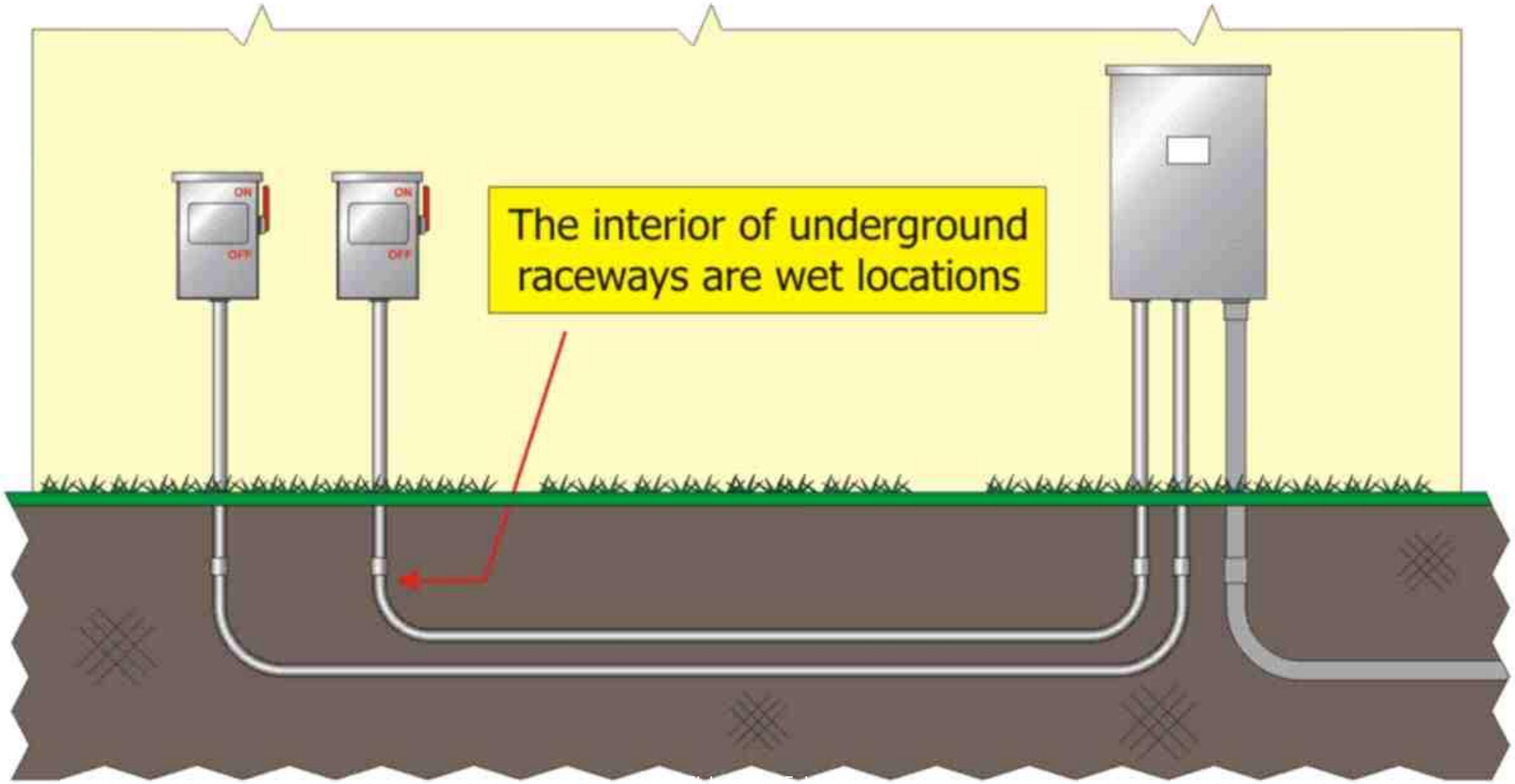
Table 300.5 Minimum Cover Requirements, 0 to 600 Volts, Nominal, Burial in Millimeters (Inches)

Location of Wiring Method or Circuit	Type of Wiring Method or Circuit									
	Column 1 Direct Burial Cables or Conductors		Column 2 Rigid Metal Conduit or Intermediate Metal Conduit		Column 3 Nonmetallic Raceways Listed for Direct Burial Without Concrete Encasement or Other Approved Raceways		Column 4 Residential Branch Circuits Rated 120 Volts or Less with GFCI Protection and Maximum Overcurrent Protection of 20 Amperes		Column 5 Circuits for Control of Irrigation and Landscape Lighting Limited to Not More Than 30 Volts and Installed with Type UF or in Other Identified Cable or Raceway	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
All locations not specified below	600	24	150	6	450	18	300	12	150	6
In trench below 50-mm (2-in.) thick concrete or equivalent	450	18	150	6	300	12	150	6	150	6
Under a building	0 (in raceway or Type MC or Type MI cable identified for direct burial)	0	0	0	0	0	0 (in raceway or Type MC or Type MI cable identified for direct burial))	0	0 (in raceway or Type MC or Type MI cable identified for direct burial))	0
Under minimum of 102-mm (4-in.) thick concrete exterior slab with no vehicular traffic and the slab extending not less than 152 mm (6 in.) beyond the underground installation	450	18	100	4	100	4	150 (direct burial) 100 (in raceway)	6 4	150 (direct burial) 100 (in raceway)	6 4
Under streets, highways, roads, alleys, driveways, and parking lots	600	24	600	24	600	24	600	24	600	24
One- and two-family dwelling driveways and outdoor parking areas, and used only for dwelling-related purposes	450	18	450	18	450	18	300	12	450	18
In or under airport runways, including adjacent areas where trespassing prohibited	450	18	450	18	450	18	450	18	450	18

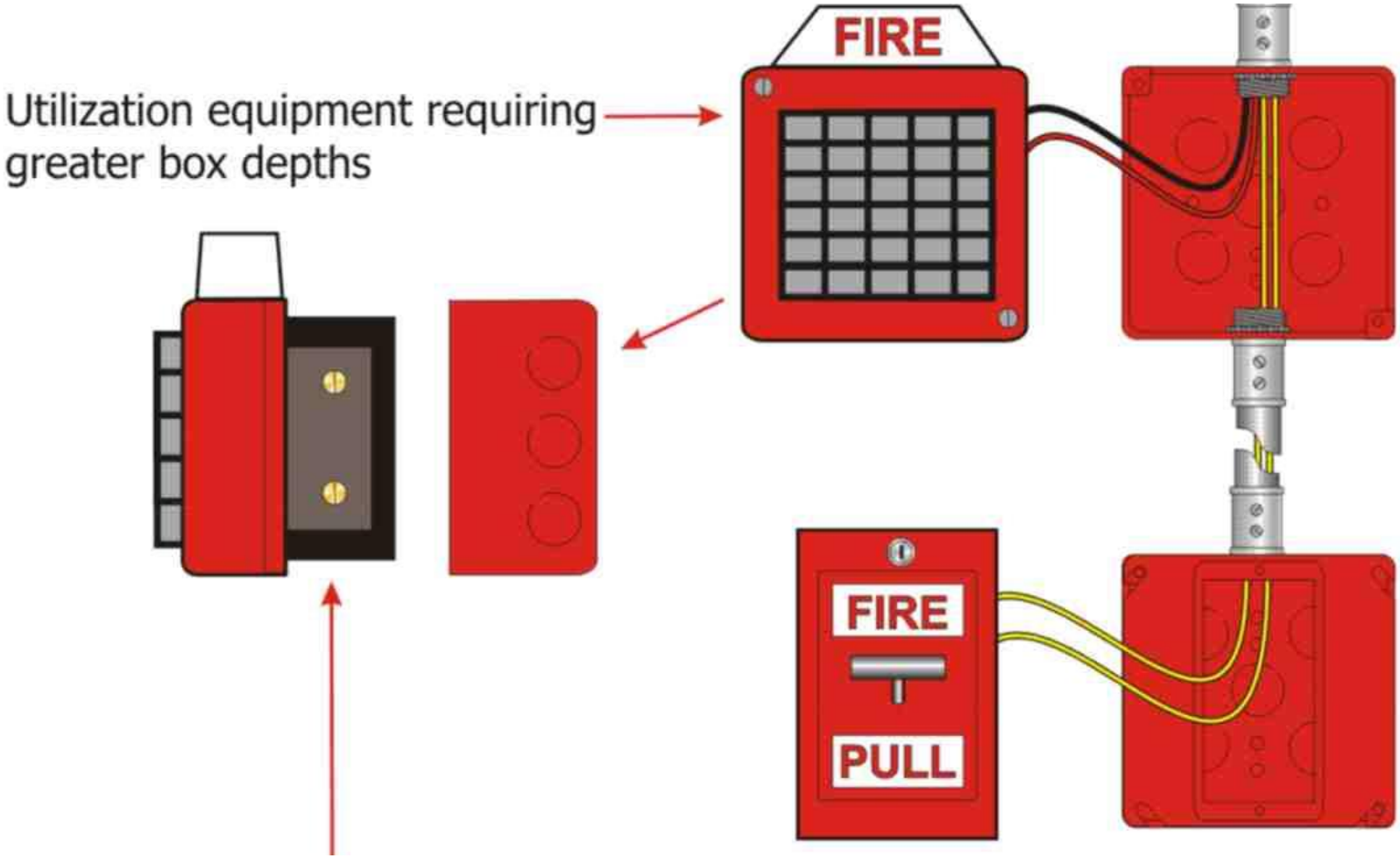
300.5(B) Wet Locations

The interior of enclosures or raceways installed underground shall be considered to be a wet location.

Insulated conductors installed in wet locations are required to be listed for use in wet locations and shall comply with 310.8(C).



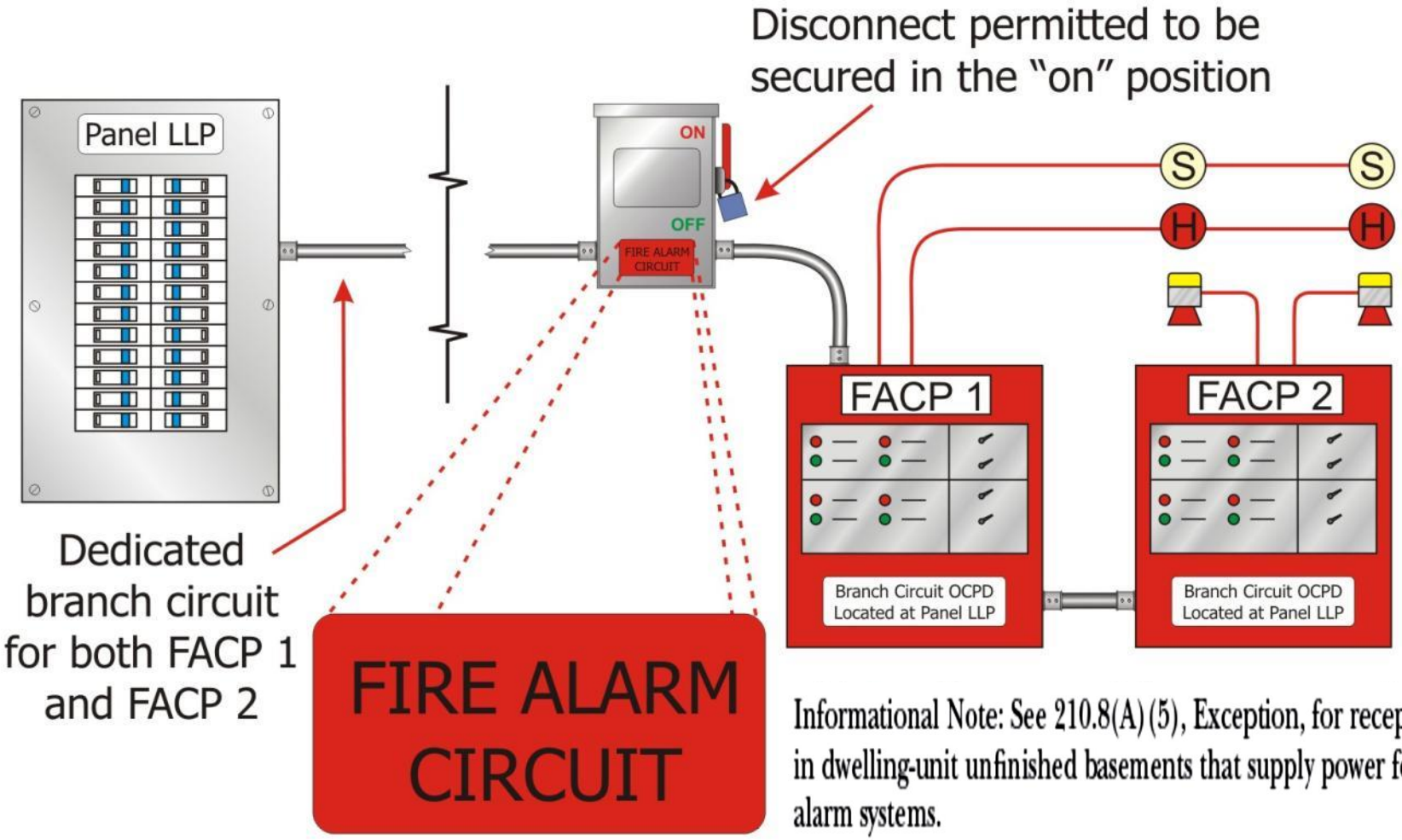
314.21(B) Outlet and Device Boxes with Enclosed Devices or Utilization Equipment.



Outlet and device boxes that enclose devices or utilization equipment shall have a minimum internal depth that accommodates the rearward projection of the equipment and the size of the conductors that supply the equipment.

760.41 NPLFA Circuit Power Source Requirements

Power source for non–power-limited fire alarm (NPLFA) circuits was revised to address new marking and identification requirements and dedicated branch circuit requirements for the fire alarm equipment



Informational Note: See 210.8(A)(5), Exception, for receptacles in dwelling-unit unfinished basements that supply power for fire alarm systems.

760.48 Conductors of Different Circuits in Same Cable, Enclosure, or Raceway.

(A) Class 1 and non–power limited fire alarm circuits shall be permitted to occupy the same cable, enclosure, or raceway without regard to whether the individual circuits are alternating current or direct current, provided all conductors are insulated for the maximum voltage of any conductor in the enclosure or raceway.

(B) Fire Alarm with Power-Supply Circuits.

Power-supply and fire alarm circuit conductors shall be permitted in the same cable, enclosure, or raceway only where connected to the same equipment.

760.121 Power Sources for PLFA Circuits.

(B) Branch Circuit. The branch circuit supplying the fire alarm equipment(s) shall supply no other loads.

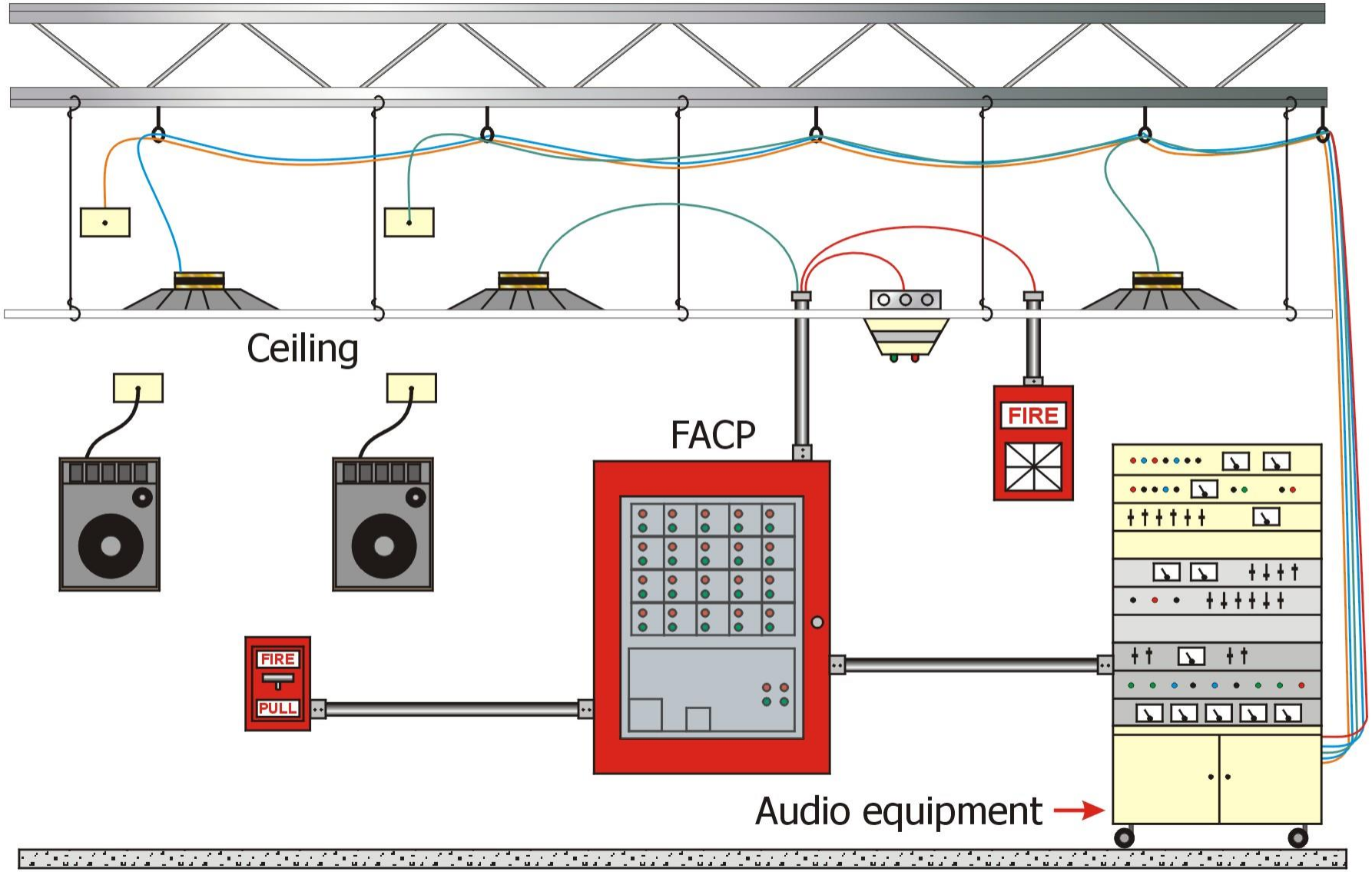
The location of the branch-circuit overcurrent protective device shall be permanently identified at the fire alarm control unit. The circuit disconnecting means shall have red identification, shall be accessible only to qualified personnel, and shall be identified as "**FIRE ALARM CIRCUIT**."

The red identification shall not damage the overcurrent protective devices or obscure the manufacturer's markings. This branch circuit shall not be supplied through ground-fault circuit interrupters or arc-fault circuit interrupters.

760.139(D) Audio System Circuits and PLFA Circuits.

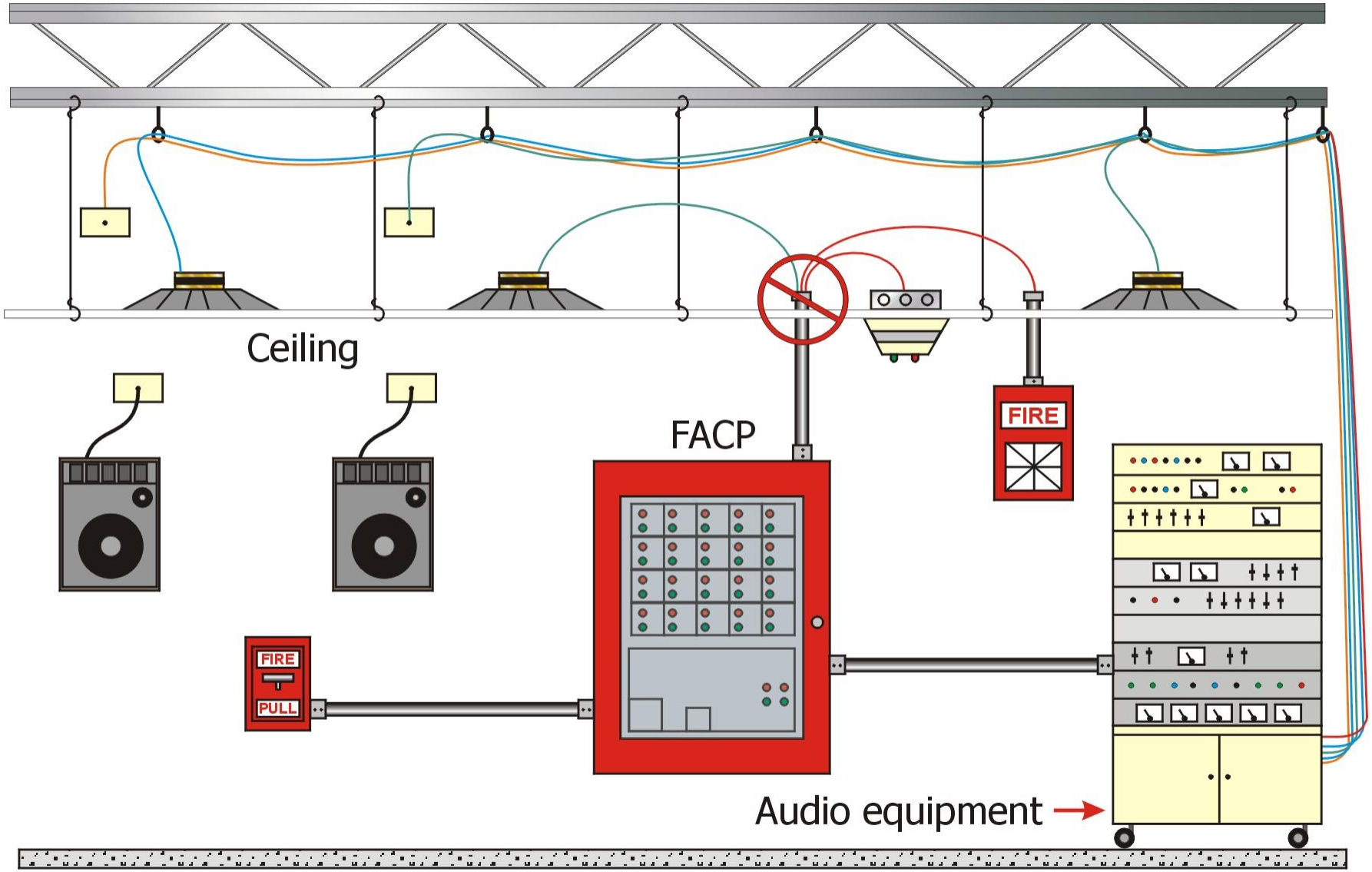
Audio system circuits described in 640.9(C) and installed using Class 2 or Class 3 wiring methods in compliance with 725.133 and 725.154 **shall** not be permitted to be installed in the same cable, cable tray, or raceway with power-limited conductors or cables.

760.139(D) Audio System Circuits and PLFA Circuits.



Audio systems circuits installed using Class 2 or 3 wiring methods specified in 725.54 and 725.61 not permitted in the same raceway or cable with PLFA cables

760.139(D) Audio System Circuits and PLFA Circuits.



Audio systems circuits installed using Class 2 or 3 wiring methods specified in 725.54 and 725.61 not permitted in the same raceway or cable with PLFA cables

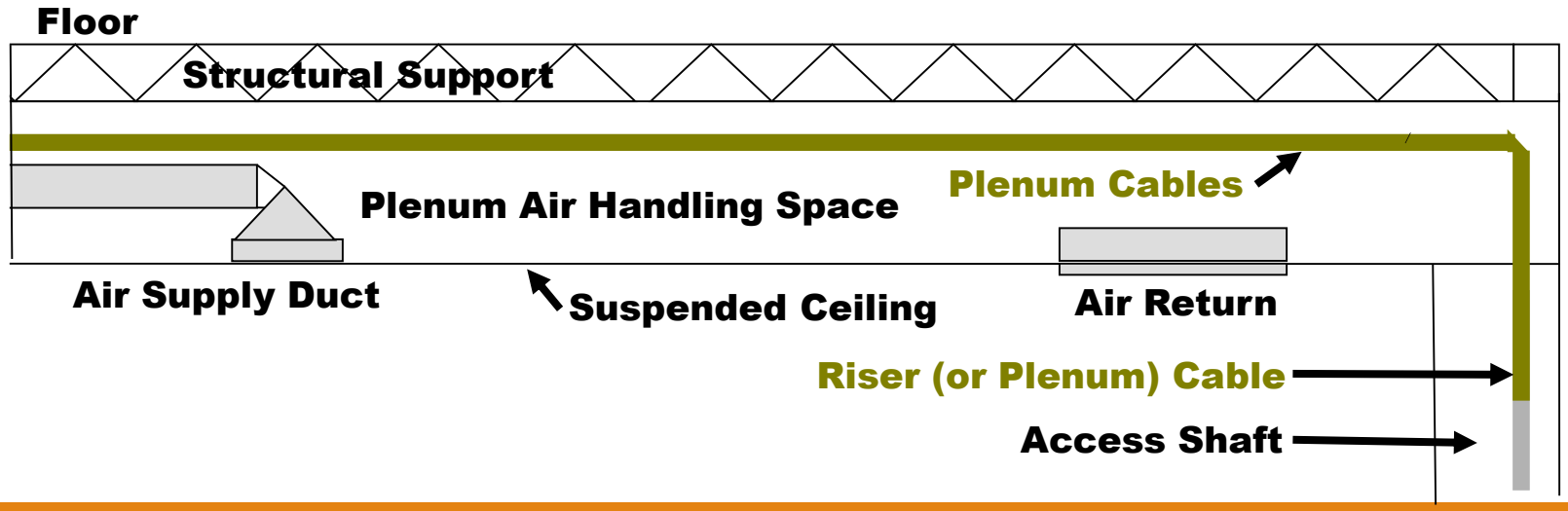
Table 760.154 Applications of Listed PLFA Cables in Buildings

Applications		Cable Type		
		FPLP & FPLP-CI	FPLR & FPLR-CI	FPL & FPL-CI
In fabricated ducts 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 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 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*

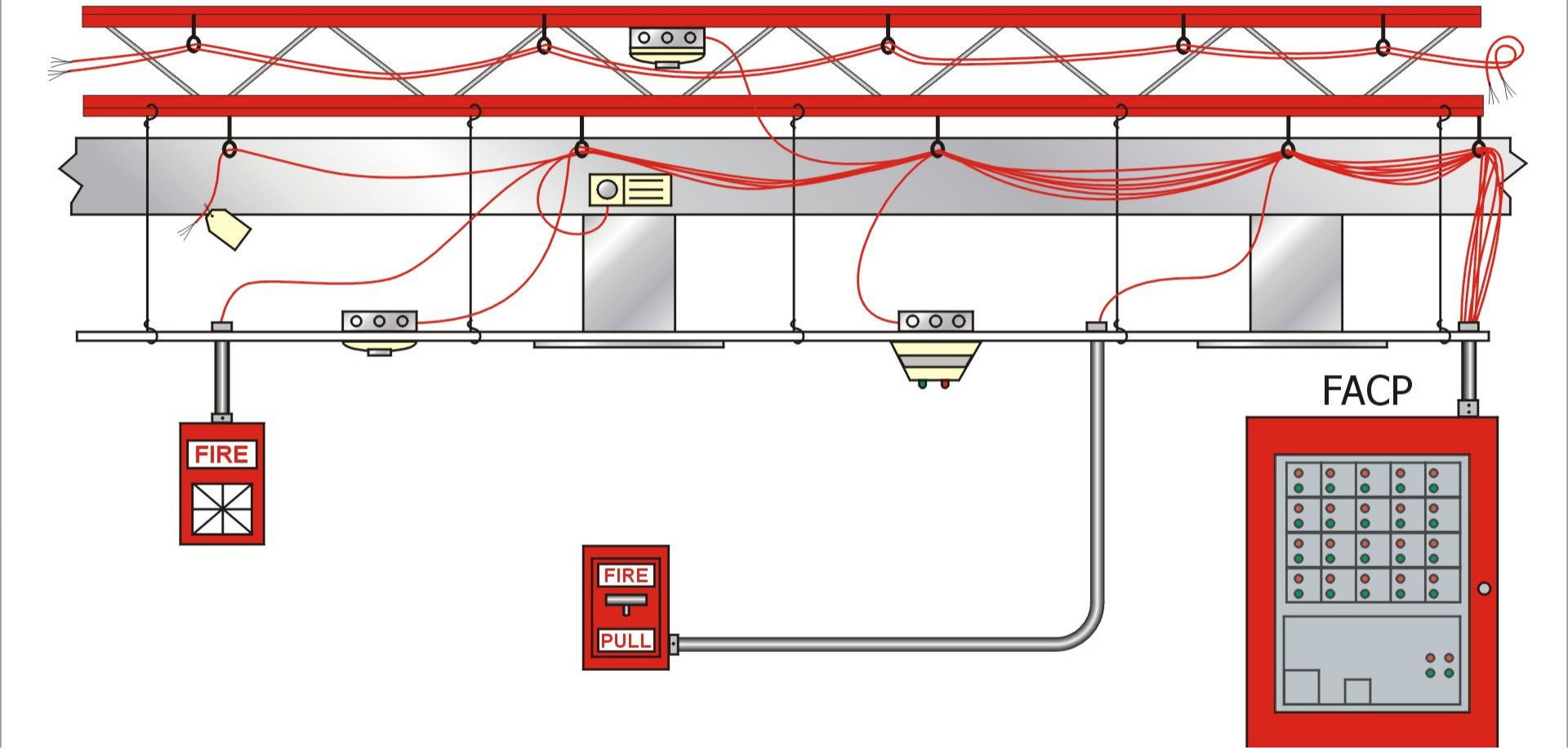
Note:
"N" indicates that the cable type shall not be permitted to be installed in the application.
"Y*" indicates that the cable type shall be permitted to be installed in the application subject to the limitations described in 760.130 through 760.145.

Plenum vs. Riser

- **Plenum**
  - Plenum spaces are defined as any space used as a return passage for environmental air.
  - The wiring is not required to go through conduit
  - Fire resistant and low smoke producing characteristics
  - “Non-Plenum” does not necessarily mean “Riser,” some low-end products are also not riser.



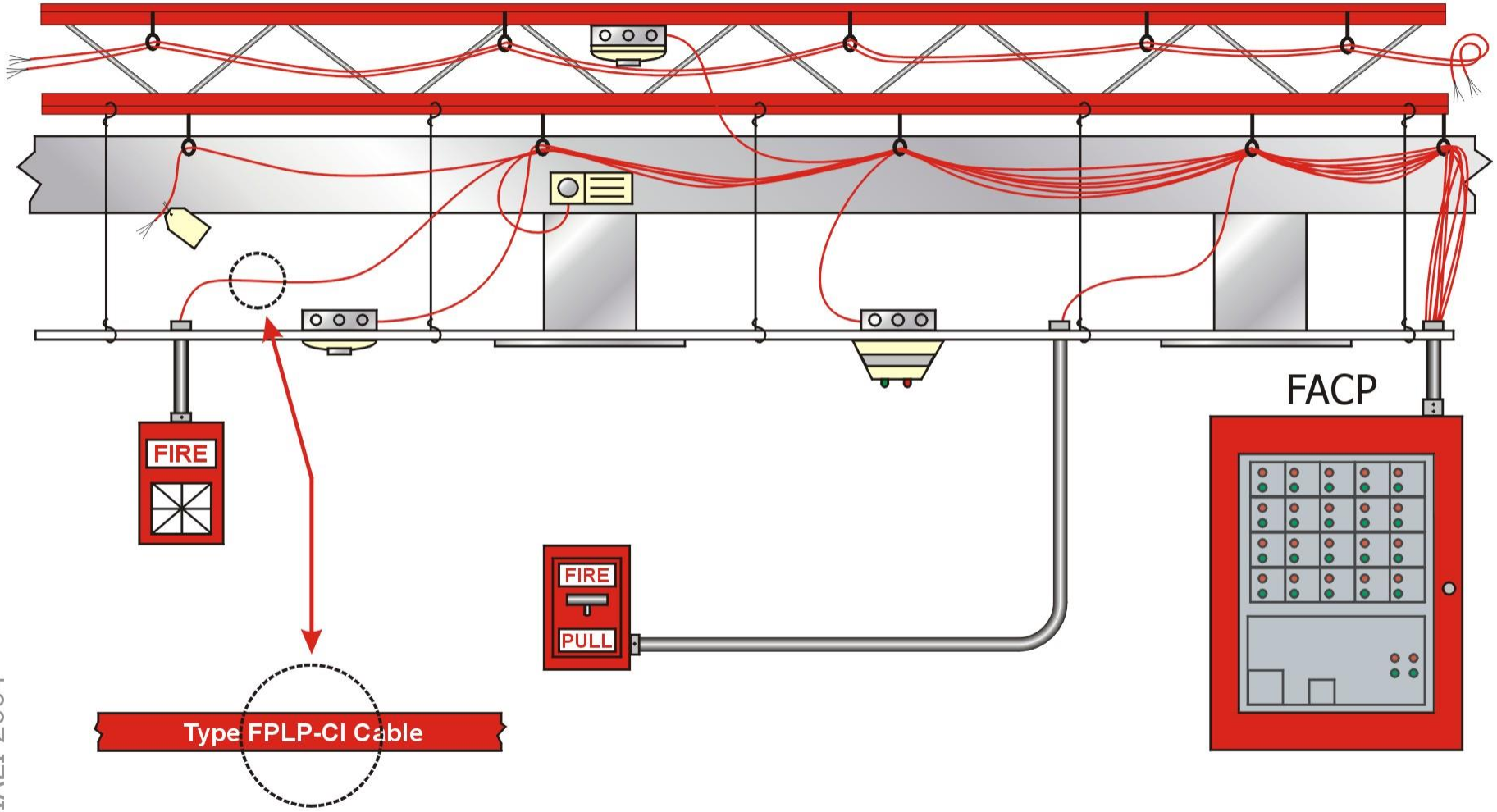
760.176 (F) Fire Alarm Circuit Integrity (CI) Cable or Electrical Circuit Protective System.



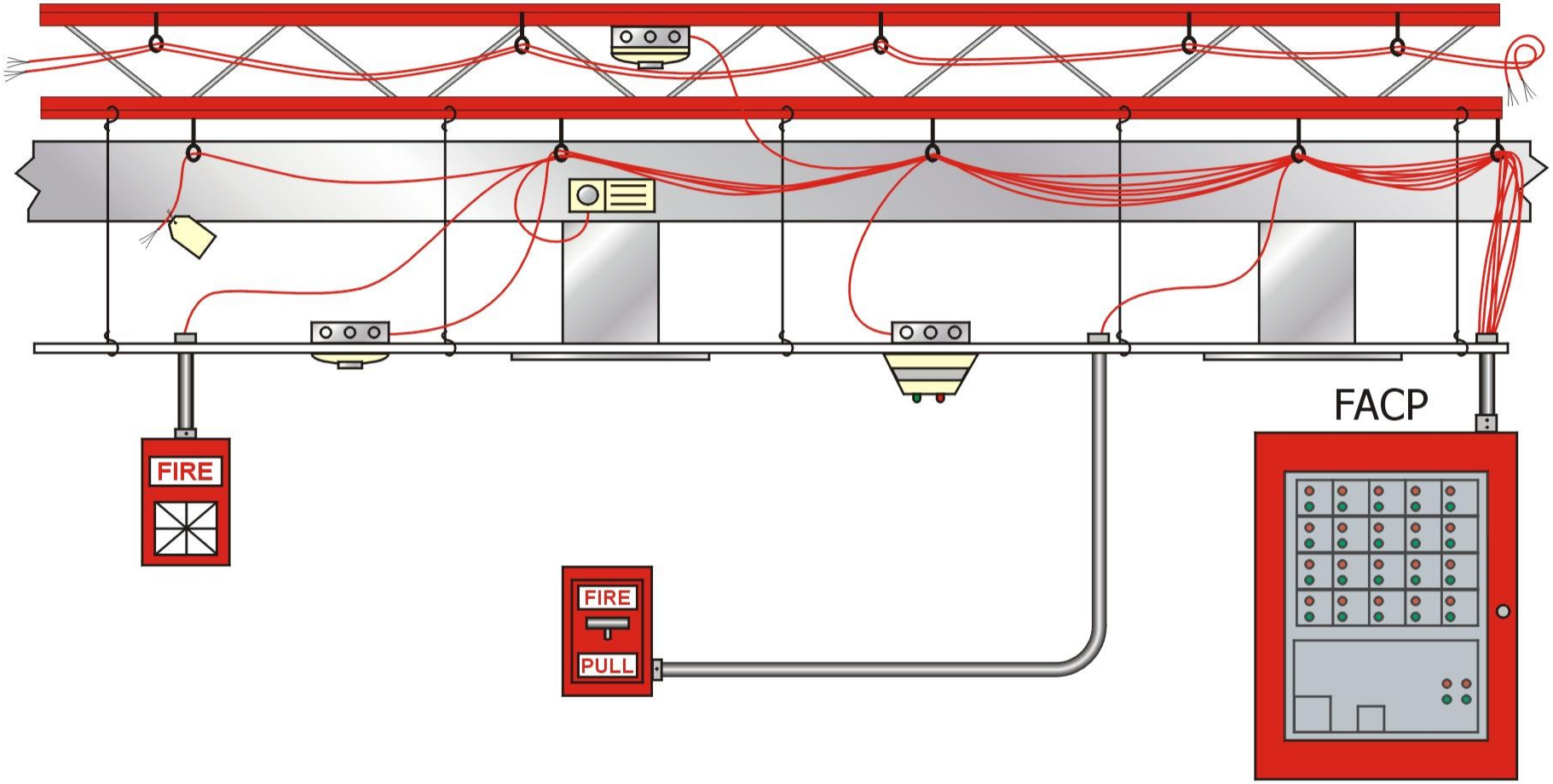
Cables used for survivability of critical circuits shall be listed as circuit integrity (CI) cable. Cables specified in 760.176(C), (D), and (E), and used for circuit integrity shall have the additional classification using the suffix “-CI.”

Cables that are part of a listed electrical circuit protective system shall be considered to meet the requirements of survivability.

760.176 (F) Fire Alarm Circuit Integrity (CI) Cable or Electrical Circuit Protective System.

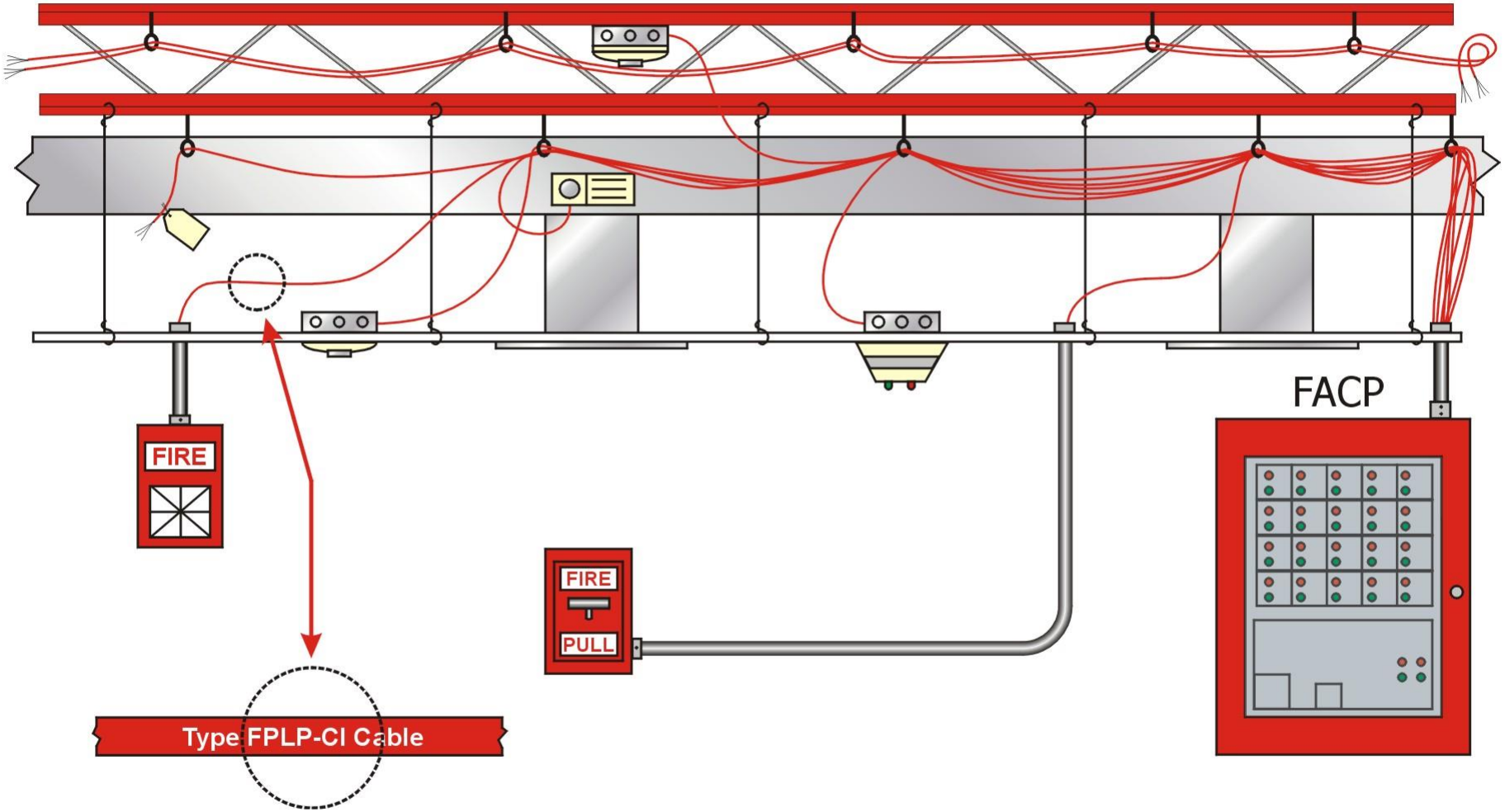


760.176 (G) Fire Alarm Circuit Integrity (CI) Cable or Electrical Circuit Protective System (Multi-conductor).

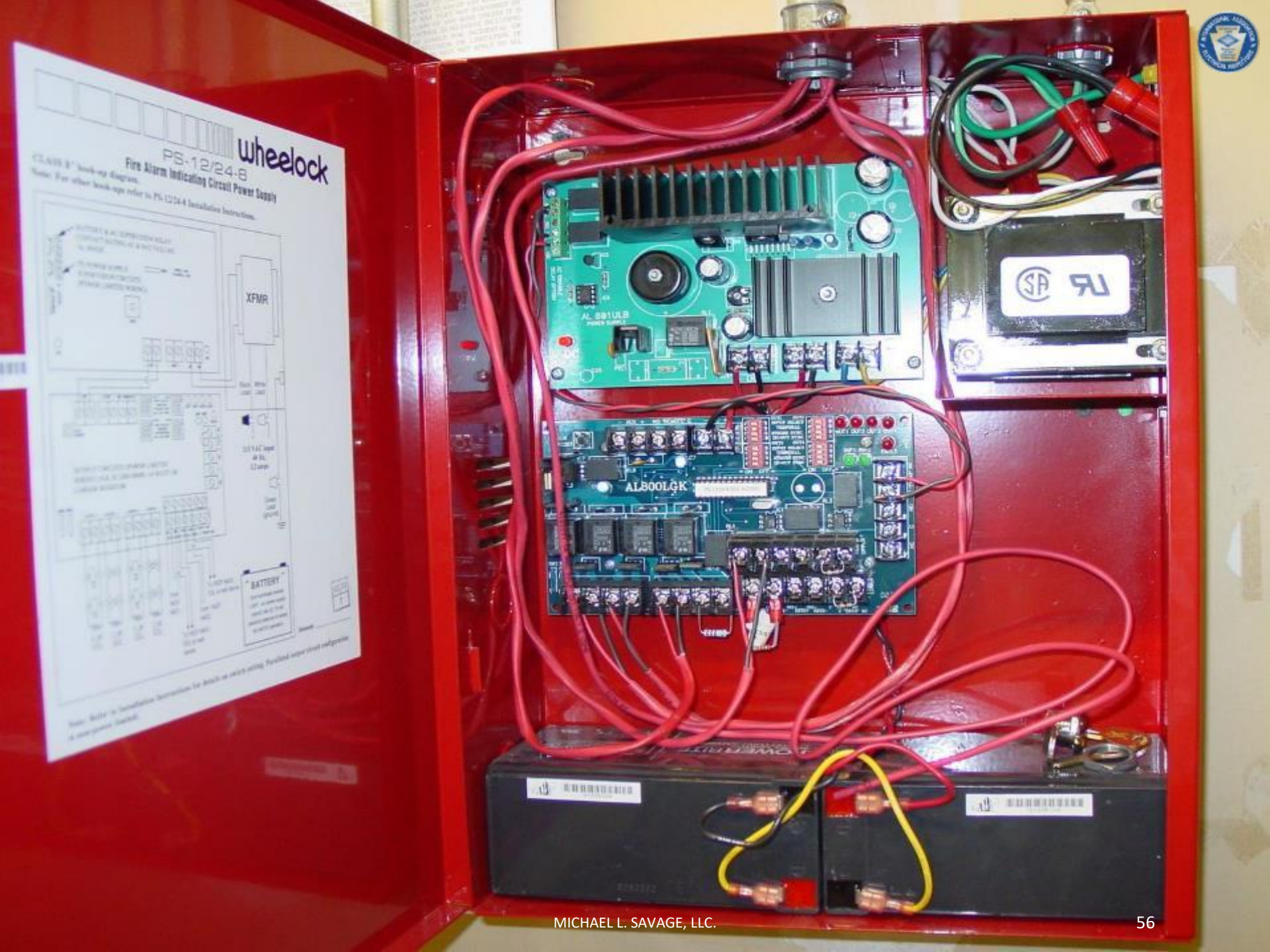


- ✓ Cables that are listed for circuit integrity shall be identified with the suffix “CI” as defined in 760.176(F).
- ✓ Temperature rating shall be marked on the jacket of NPLFA cables that have a temperature rating exceeding 60°C (140°F).
- ✓ The jacket of NPLFA cables shall be marked with the conductor size.

760.176 (G) Fire Alarm Circuit Integrity (CI) Cable or Electrical Circuit Protective System (Multi-conductor).



- ✓ Cables that are listed for circuit integrity shall be identified with the suffix "CI" as defined in 760.176(F).
- ✓ Temperature rating shall be marked on the jacket of NPLFA cables that have a temperature rating exceeding 60°C (140°F).
- ✓ The jacket of NPLFA cables shall be marked with the conductor size.


wheelock
PS-12/24-8
Fire Alarm Indicating Circuit Power Supply
XFMR
BATTERY
AL 801ULB
AL800LGK

Fire Alarm Cable Construction

JACKET

- PVC
- Plenum cables are constructed with low-smoke PVC
- Tubed or Extruded Jacket

SHIELDING

Aluminum Backed Mylar

DRAIN WIRE

Included on all shielded constructions, used to ground the shield.

INSULATION

- PVC
- Polypropylene

LEGEND

These 4 must appear on all cables Nationally Recognized Testing Lab Standard

Footmarking **Mfg.** **Part#** **Size** **Conductors** **Listing Agency** **Mfg. ID** **NEC Rating** **Mfg Date**

NFPA 72 - 2018

National Fire Alarm & Signaling Code

What does NFPA 72 cover….

NFPA 72 covers the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency communications systems (ECS), and their components.

What is it’s purpose….

The purpose of this Code is to define the means of signal initiation, transmission, notification, and annunciation; the levels of performance; and the reliability of the various Types of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment, emergency communications systems, and their components.

Chapter 7 Documentation

The documentation of the design, acceptance, and completion of new systems required under this Code shall comply with the minimum requirements of chapter 7.

This chapter outlines documentation requirements but does not prohibit additional documentation from being provided.

7.2 Minimum Required Documentation.

Where documentation is required by the authority having jurisdiction, the following list shall represent the minimum documentation required for new fire alarm systems, supervising station and shared communication equipment, and emergency communications systems, including new systems and additions or alterations to existing systems:

(1)Written narrative providing intent and system description

(2) Riser diagram

(3) Floor plan layout showing locations of all devices, control equipment, and supervising station and shared communications equipment with each sheet showing the following:

(a) Point of compass (north arrow)

(b) A graphic representation of the scale used

(c) Room use identification

(d) Building features that will affect the placement of initiating devices and notification appliances

(4) Sequence of operation in either an input/output matrix or narrative form

(5) Equipment technical data sheets

7.2 Minimum Required Documentation.

(6) Manufacturers' published instructions, including operation and maintenance instructions

(7) Battery capacity and de-rating calculations (where batteries are provided)

(8) Voltage drop calculations for notification appliance circuits

(9) Mounting height elevation for wall-mounted devices and appliances

(10) Where occupant notification is required, minimum sound pressure levels that must be produced by the audible notification appliances in applicable covered areas

(11) Pathway diagrams between the control unit and the supervising station and shared communications equipment

(12) Completed record of completion in accordance with 7.5.6 and 7.8.2

(13) For software-based systems, a copy of site-specific software, including specific instructions on how to obtain the means of system and software access (password)

(14) Record (as-built) drawings

(15) Records, record retention, and record maintenance in accordance with Section 7.7

(16) Completed record of inspection and testing in accordance with 7.6.6 and 7.8.2

7.2 Minimum Required Documentation.

7.2.2 System design documents shall identify the name and contact information of the system designer.

7.2.3 All fire alarm drawings shall use symbols described in NFPA 170 or other symbols acceptable to the authority having jurisdiction.

7.3 Design (Layout) Documentation.

7.3.1* These requirements of Section 7.3 shall apply only where required by other governing laws, codes, or standards; by other parts of this Code; or by project specifications or drawings.

7.3.2* Where required by governing laws, codes, or standards, or other parts of this Code, design (layout) documents shall be prepared prior to installing new systems.

7.3.3* Where required by governing laws, codes, or standards, or other parts of this Code, preliminary plans shall be created.

7.4 Shop Drawings (Installation Documentation).

7.4.2* Shop drawings shall be drawn to an indicated scale, on sheets of uniform size, with a plan of each floor.

7.4.3 Shop drawings for fire alarm and emergency communications systems shall provide basic information and shall provide the basis for the record (as-built) drawings required in accordance with 7.5.2.

7.4.4 Shop drawings shall include the following information:

(1) Name of protected premises, owner, and occupant (where applicable)

(2) Name of installer or contractor

(3) Location of protected premises

(4) Device legend and symbols in accordance with NFPA 170,

or other symbols acceptable to the authority having jurisdiction

(5) Date of issue and any revision dates

7.5 Completion Documentation.

7.5.2 Before requesting final approval of the installation, if required by the authority having jurisdiction, the installing contractor shall furnish a written statement stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer's published instructions and the appropriate NFPA requirements.

7.5 Completion Documentation.

7.5.3 All systems including new systems and additions or alterations to existing systems shall include the following documentation, which shall be delivered to the owner or the owner's representative upon final acceptance of the system:

(1)*An owner's manual and manufacturer's published instructions

covering all system equipment

(2) Record (as-built) drawings in accordance with 7.5.5

(3) A completed record of completion form in accordance

with 7.5.6

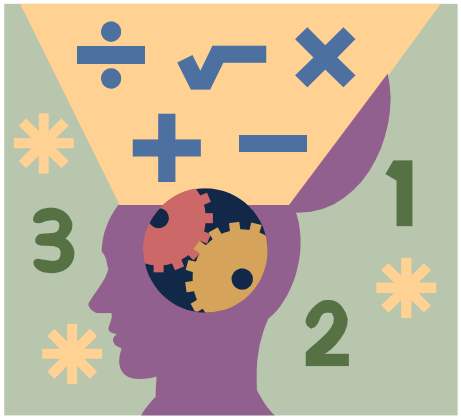
(4) For software-based systems, record copy of the site-specific

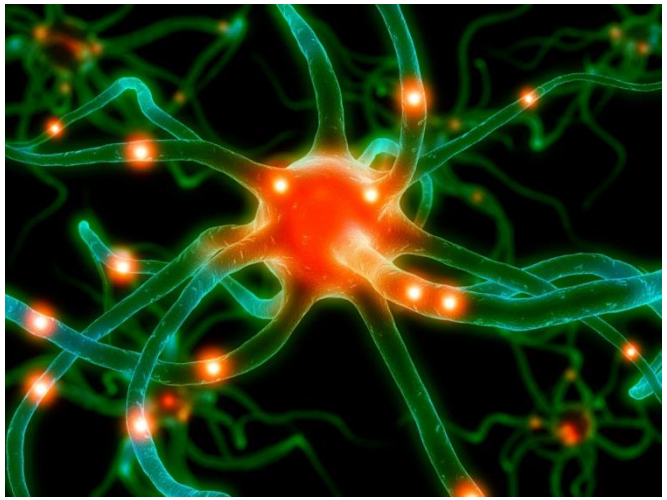
software in accordance with 7.5.7

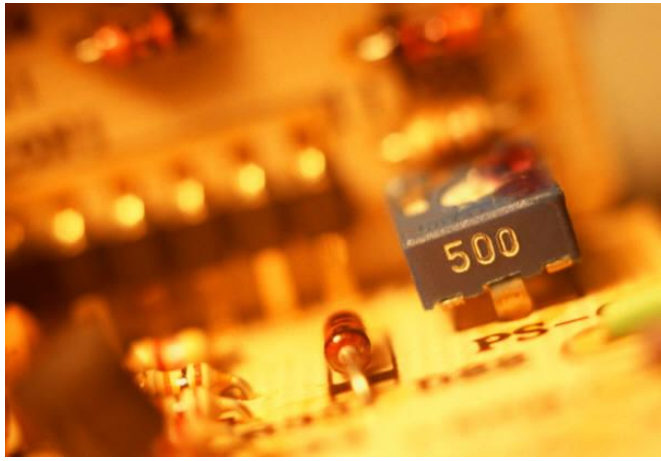
Basic System Components

System control unit (alarm panel)

- Brain of system
- Processes alarm signals from actuating devices and transmits them to the local or other alerting system







Elements of a Control Panel

Requires two Power Sources

Primary (AC)

Secondary (DC)

Elements of a Control Panel

A fire alarm system can have a variety of input devices.

Basic System Components (cont.)

Power supply

- Primary power supply
  - Public electric utility
  - Engine-driven generator
- Secondary power supply
  - Storage battery and charger
  - Engine-driven generator and 4-hour storage battery
  - Multiple engine-driven generators
- Trouble signal power supply

Basic System Components (cont.)

Initiating devices(Inputs): manual pull stations, heat detectors, smoke detectors, flame detectors, waterflow devices, tamper switches, and combination detectors

Initiating Device Circuit (IDC): A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated

Notification appliances: bells, buzzers, horns, recorded voice messages, strobe lights, speakers, and other warning appliances

Auxiliary services

Elements of a Control Panel

Horns

Strobes

Outputs

Outputs

Notification Appliance: A fire alarm system component such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible output, or any combination thereof.

Notification Appliance Circuit: A circuit or path directly connected to a notification appliance.

The Basic System

Primary (AC)

Secondary (DC)

Main Controller

Inputs

Outputs

Signal Initiation/Initiating Devices:

Need to understand stages of fire and what technology works best for each

Design Goals.

The design goal of most fire alarm systems is *life safety*.

Some systems are designed with a secondary purpose of *protecting either property or the activities (mission) within a building*.

The goal of both property and mission protection is the early detection of a fire so that firefighting efforts can begin while the fire is still small and manageable.

Secondary Goal of Systems.

Fire alarm systems with a secondary goal of property protection are commonly used in museums, libraries, storage facilities, and historic buildings in order to minimize damage to the buildings or their contents.

Systems with a secondary goal of mission protection are commonly used where it is essential to avoid business interruptions, such as in hospitals, financial businesses, security control rooms, and telecommunication centers.

Types of Fire Alarm Control Panels

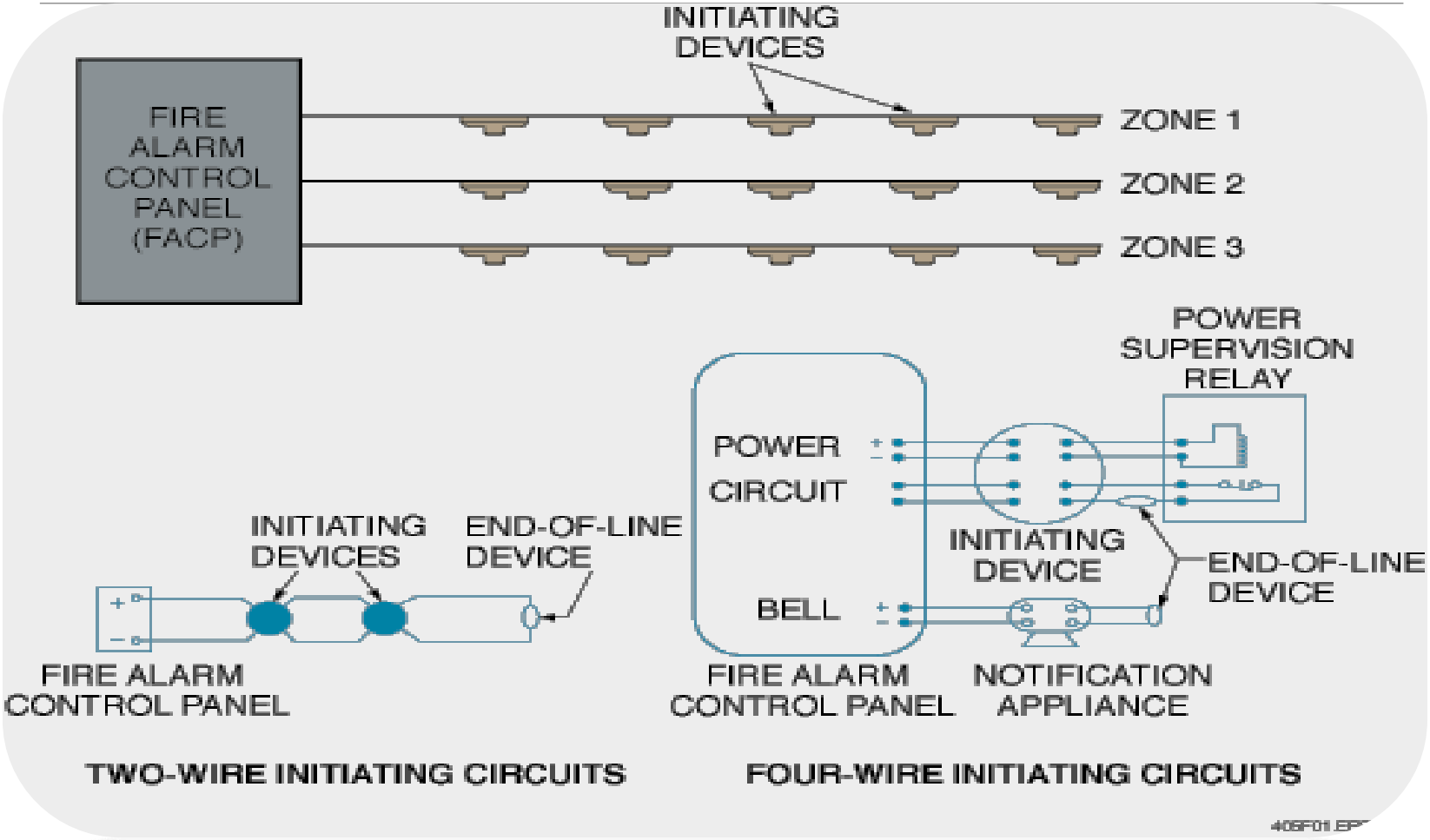
Conventional (hard wired)

- Fixed
- Programmable

Addressable (multiplexed)

Intelligent (analog data transfer)

Conventional “Hard Wired” System



Conventional “Programmable” System

Basic “Designed System”

Components selected by the designer to meet the direct needs of the customer.

Initiating circuits are programmable for fire, waterflow, supervisory service, etc.

Output circuits are programmable for code selection and silenceability.

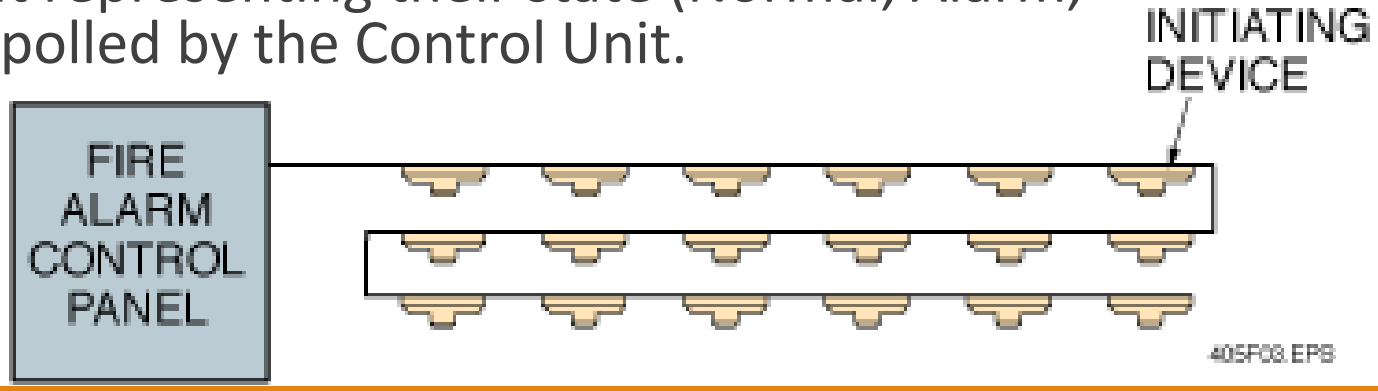
On some systems, input-to-output CIRCUIT (not device) mapping.

Addressable System

Each device (detector, pull station…) has a unique number assigned to it called the address for reporting alarms and troubles.

Employs a Signaling Line Circuit (SLC) Loop along which all addressable input and output devices are connected to the fire alarm control panel.

Addressable devices transmit an electronic message back to the Control Unit representing their state (Normal, Alarm, Trouble) when polled by the Control Unit.



Analog System

Always an Addressable System.

Processes detailed, analog data from detectors about smoke levels.

Can provide sensitivity data for each detector.

Employs Drift Compensation (self calibration) in its detectors.

Drift Compensation

Drift compensation is the process by which an analog addressable control panel automatically adjusts an analog detectors alarm threshold to compensate for contaminants such as dust.

This ensures the detector maintains a consistent sensitivity level, helping to avoid false alarms due to dirty detectors.

Maintenance Alert

Drift compensation occurs until it is nearing a point where it can no longer compensate and remain within U.L. requirements. This point is called “Maintenance Alert”

Some systems handle a maintenance alert condition as a trouble while others flag the condition only, and continue to operate normally.

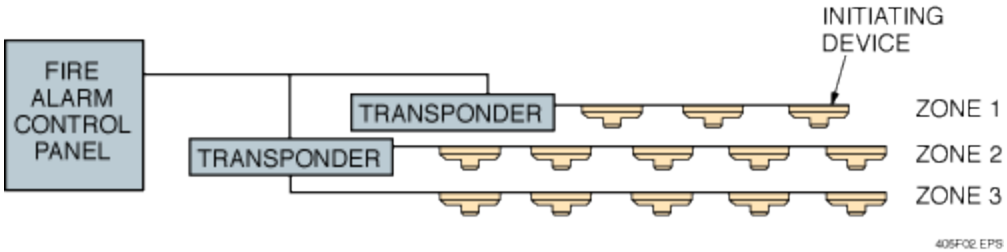
Calibration Trouble

A detector in a maintenance alert condition will eventually go into calibration trouble if not serviced.

A detector in calibration trouble is not functioning correctly and requires service immediately.

Multiplex Systems

Multiplex systems are similar to hardwired systems in that they rely on zones for fire detection. The difference, however, is that multiplexing allows multiple signals from several sources to be sent and received over a single communication line. Each signal can be uniquely identified. This results in reduced control equipment, less wiring infrastructure, and a distributed power supply. *Figure* shows a simplified example of a multiplex system.

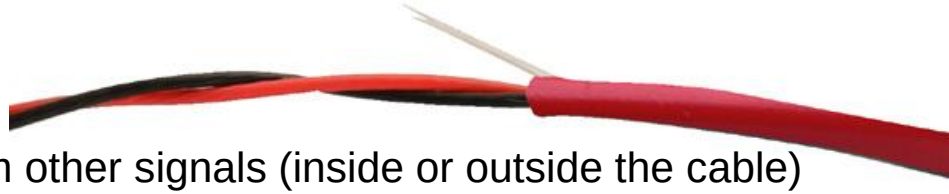


Shielded vs. Unshielded

- **Shielded Cables**
  - Offers excellent protection against RFI & EMI
    - RFI – Radio Frequency Interference
      (such as cell phones, radio towers or garage door openers)
    - EMI – Electro Magnetic Interference
      (caused by electric motors, ballasts, & other high voltage currents)
  - Shielded cables should be used when installing near dimmer panels, light switches, in parallel runs, near neon or fluorescent lights and near power cables

- **Unshielded Cables**
  - Cost effective for areas where interference (EMI) is not a concern

Cabled vs. Straight Lay



- **Cabled**
  - Reduces crosstalk interference from other signals (inside or outside the cable)
  - Also referred to as “twisted” cables
  - Most commonly used in fire alarm systems
  - The majority of products are cabled to cover a wide range of applications and prevent having to stock/manage duplicate sku’s

- **Straight Lay**
  - Cost effective for areas where interference is not a concern
  - Also referred to as “parallel” cables

Stranded vs. Solid

- **Solid**
  - Industry standard for most fire alarm cable
  - Easier to terminate
  - Easier to solder
  - Lower cost
  - Less attenuation / signal loss

- **Stranded**
  - More flexible
  - Reduces potential conductor breakage from repeated flexing

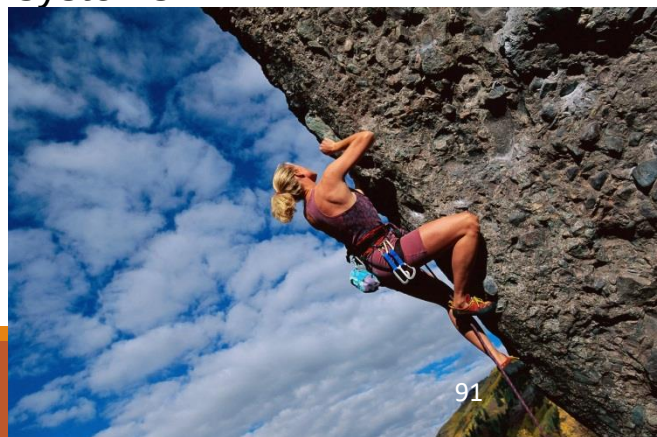
Distance & Capacitance

Distance cable will run

- Voltage drop should be calculated or refer to equipment manufacturer's recommendations
- Knowing the distance the cable will run also helps identify the right gauge size cable to select.
- Larger gauge for longer runs

Capacitance

- The capacity of the insulation to hold an electric charge
- Often, lower capacitance (Picofarrads/foot = pF/ft) translates to a higher performance cable
- May need to meet requirements for specific hardware systems.



Fire alarm system coverage shall include:

- All rooms
- Halls
- Storage areas
- Basements, attics, lofts
- Elevator shafts
- Enclosed stairways
- Dumb waiter shafts, and chutes

Note: this includes sprinkler heads connected to the fire alarm

Manual Alarm-Initiating Devices

General requirements

- Mounting and distribution
- Generally not required in fully sprinklered structures
- Outmoded “broken glass” pull stations

Coded versus noncoded pull stations

Single-action and double-action pull stations

Initiating Devices - Manual Fire Alarm Stations

Manually-operated device used to initiate an alarm signal

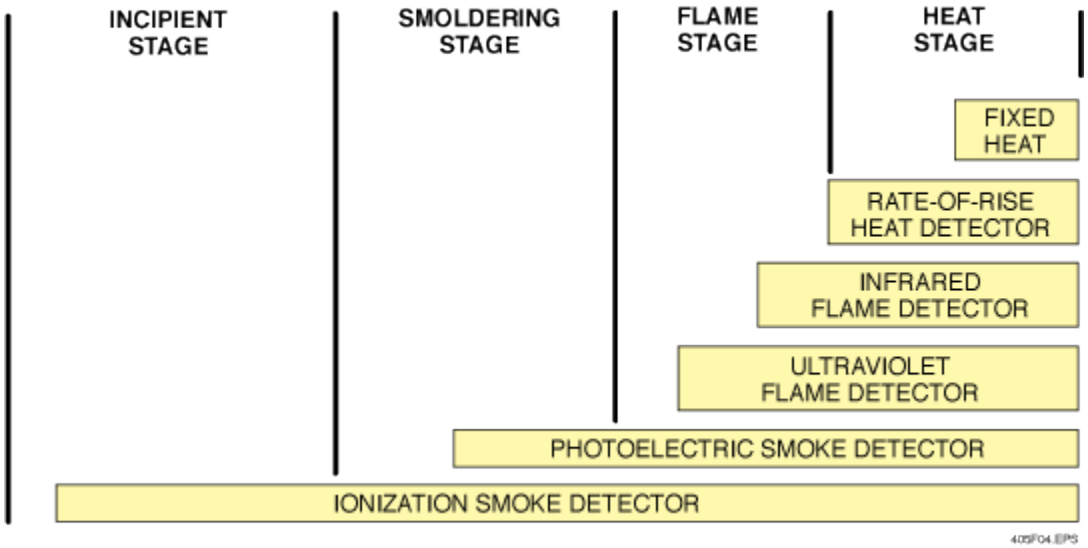
- Single Action Stations require a single operation to activate it. Generally a pulling down action.
- Dual Action Stations require two distinct operations. A set-up and an activating action.

Automatic Alarm-Initiating Devices

Continuously monitor atmosphere

Four basic types

- Heat detectors
- Smoke detectors
- Fire-gas detectors
- Flame detectors



Heat Detectors

Fixed temperature heat detectors

- Fusible links/frangible bulbs
- Continuous line detector
- Bimetallic detector

Rate-of-rise heat detector

- Pneumatic rate-of-rise spot detector
- Pneumatic rate-of-rise line detector
- Rate compensated detector
- Thermoelectric detector

Heat Detectors

Fixed Detectors:

- Alarm when the sensing element reaches a certain set point.
- Two common models have 135 and 200-degrees F range.
- Fixed element is generally a non-restorable type, and when activated, must be replaced.

Rate-of-Rise Detectors:

- Respond when the rate of temperature increase is greater than an allowable limit (15 degrees in 60 secs.) (placement in a stable environment) (e.g.. ovens, heating vents, etc.).
- The Rate-of-Rise element is restorable when conditions return to normal.

Rate Compensation will respond regardless of the rate of temperature rise.

Smoke Detectors

Photoelectric smoke detector

- Projected beam
- Refractory photocell

Ionization smoke detector

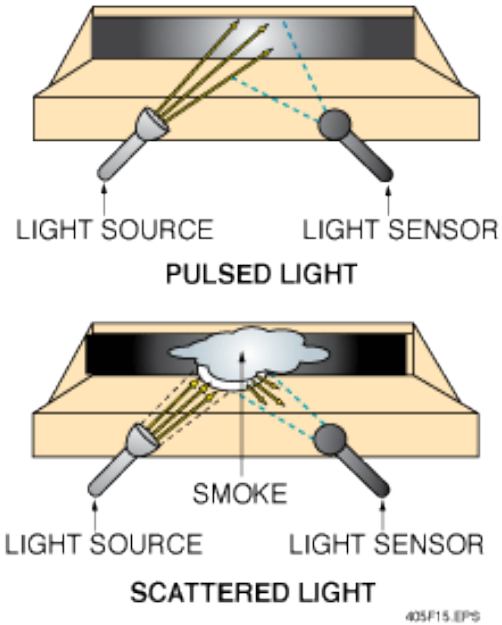
- Dual chamber
- Air-sampling smoke detectors
  - Cloud chamber
  - Second type

Photoelectric detectors are often faster than ionization detectors in sensing smoke from slow, smoldering fires. Ionization detectors are often better than photoelectric detectors at sensing fast, flaming fires.

Photoelectric Smoke Detectors: Light-Scattering Type

Uses a Light-Emitting Diode (LED) that sends a beam of light into a dark chamber- a photo diode sits on the other side of a partition within the chamber

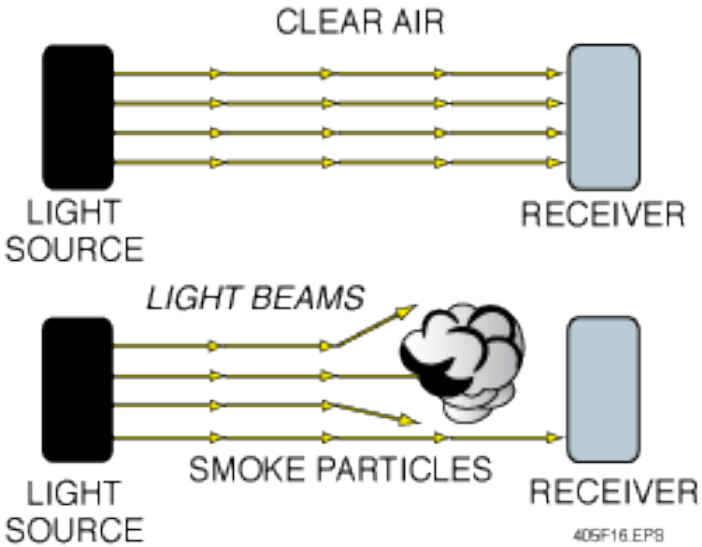
Smoke particles entering the chamber deflect some of the light rays into the photo cell. The photo cell generates a current when exposed to light, and if the current reaches a certain level, the detector alarms.



Photoelectric Smoke Detectors: Light Obscuration Type

In a projected Beam Detector, alarms are generated by diffusing the projected light beam by a specified percentage of obscuration.

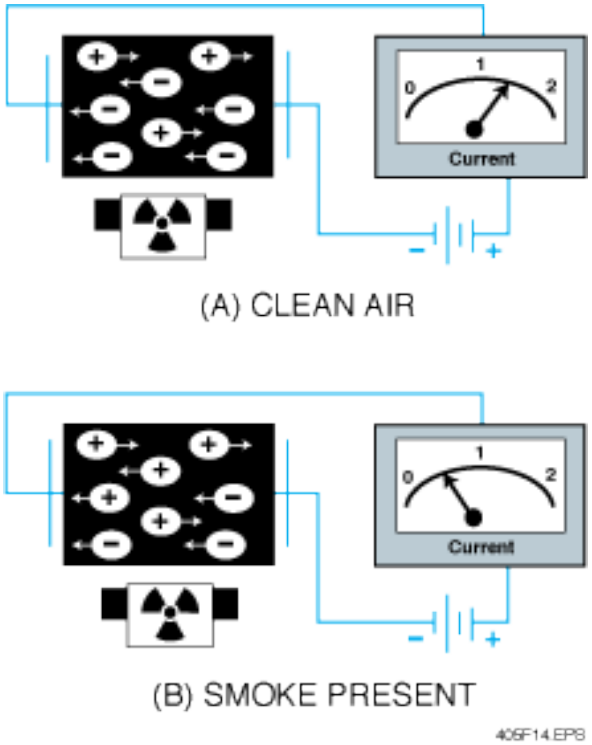
Total beam blockage generally results in a trouble signal.



Ionization Smoke Detectors

Contain a small amount of radioactive material encapsulated in a metal chamber. Ionizing radiation develops a low, but steady electrical current. Smoke particles entering the chamber disrupt the current and trigger the detector's alarm.

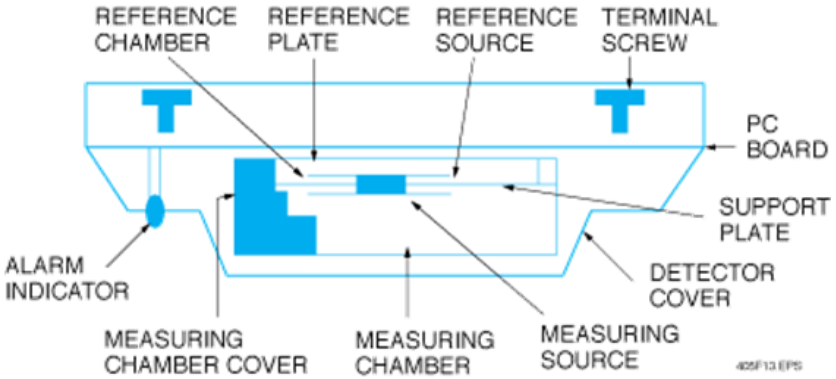
Ion detectors react more quickly to fast flaming fires that give off little smoke.



Smoke Detectors (cont.)

Limitations

- May not provide early warning of a fire developing on another level of a building
- May not detect fire developing on the other side of a closed door
- May not be effective when fire is caused by explosions resulting from careless housekeeping



Types of Flame Detectors

- **Ultraviolet (UV)** uses a solid-state sensing element of silicon carbide, aluminum nitrate, or a gas-filled tube. The UV radiation of a flame causes gas in the element or tube to ionize and become conductive. When sufficient current flow is detected, an alarm is initiated.
- **Infrared (IR)** consists of a filter and lens system that screens out unwanted radiant-energy wavelengths and focuses the incoming energy on light-sensitive components. These flame detectors can respond to the total IR content of the flame alone or to a combination of IR with flame flicker of a specific frequency. They are used indoors and have filtering systems or solar sensing circuits to minimize unwanted alarms from sunlight.

Fire Gas Detectors

Monitors levels of gases released by combustion

- Carbon dioxide
- Carbon monoxide

Faster than heat detectors but slower than smoke detectors

Duct Detectors

Photoelectric detector mounted in housing outside the ductwork that has probes that extend into the duct to sample the air inside the duct.

Primarily used as a smoke control device to control the flow of air in ductwork.

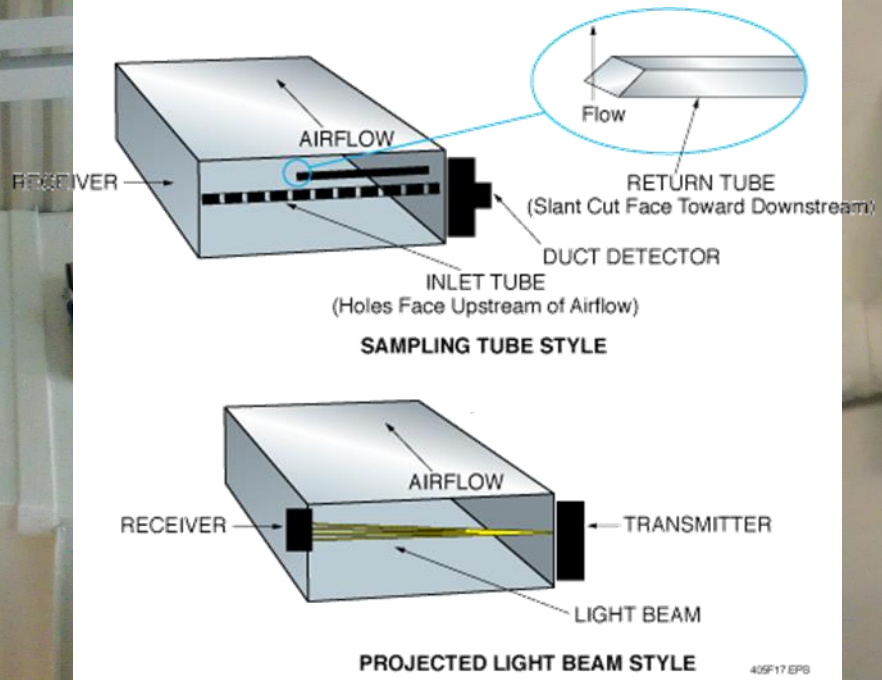
Duct Detectors

NFPA 90A and *NFPA 90B* require that duct detectors be tied into a general fire alarm system if the building contains one. If no separate fire alarm system exists, then remote audio/visual indicators, triggered by the duct detectors, must be provided in normally occupied areas of the building.

Duct detectors that perform functions other than the shutdown of HVAC equipment must be supplied with backup power.

IMC Section 606.2.2 Common supply and return air systems.
Where multiple air-handling systems share common supply or return air ducts or plenums with a combined design capacity greater than 2,000 cfm (0.9 m^3/s), the return air system shall be provided with smoke detectors in accordance with Section 606.2.1.

Duct Detectors



Notification Appliances Types

Audible - Horns, Bells, Sounders, Sirens, Chimes, Speakers

Visual - Strobes

Physical - Bed shakers

Olfactory - Smell

Audible Devices

Bells: Used if they are only for fire, or have a distinctive sound from other bell signaling devices. Often used as an external gong to indicate the flow of water in the sprinkler system.

Horns: Loud and distinctive output. Often used in high-noise environments, such as manufacturing plants.

Audible Devices

Sounders: Electronic or mechanical audible devices, which are capable of producing a variety of tones. Often, the tone is selectable during installation of the device.

Chimes: Soft-toned appliances used where loud noises could be disruptive to other operations. Generally used where qualified personnel are continuously in attendance.

Audible Devices

Sirens: Extremely loud devices generally limited in use to outdoor or heavy industrial areas.

Speakers: Audible devices used in conjunction with voice evacuation messages. Life-Safety speakers are not generally associated with Muzak systems.

Visual Signaling Appliances

VISUAL SIGNALING APPLIANCES ARE USED IN HIGH-NOISE ENVIRONMENTS, IN AREAS OCCUPIED BY HEARING-IMPAIRED INDIVIDUALS, OR IN AREAS WHERE AUDIBLE DEVICES MAY NOT BE DESIRED.

Visual Devices

Strobe

Chime/Strobe

Horn/ Strobe

Speaker/Strobe

Record Keeping

Maintaining Files and Records

- Documents:
  - Inspection reports, forms, and letters
  - Violation notices
  - Summonses
  - Plans review comments, approvals, and drawings
  - Fire reports
  - Investigations
  - Permits and certificates issued

Record Keeping

Maintaining Files and Records (cont.)

- Occupancies:
  - Those that have been issued a permit, certificate, or license
  - Those that contain automatic fire suppression or detection systems
  - Those that conduct hazardous operations or routinely house hazardous materials
- Duration: life of structure
- Public record

Written records

- File for each inspected property
- Cataloging and storage

Documentation

Facilities shall maintain a record of the complete fire alarm tests, inspections and certifications. III

Fire and Life Safety Inspection

Occupancy/ Group _____

Business Name: _____ Telephone: _____

Address: _____

Contact: _____ Telephone: _____

INSPECTION REPORT

Violations requiring corrective action are marked with a ✓ or ≠ in the appropriate box below.
If violations are noted this form must be considered a **Notice of Hazard** and necessary corrections must be made within _____ days of inspection date.

1. Housekeeping (General maintenance & Storage)
   - 304.1 -Inside no dangerous conditions ☐
   - 304.1 & 304.1.2 - Outside no dangerous cond. ☐
2. Commercial Kitchen Hood & Duct System
   - 609.2 - Hood & Duct is required ☐
   - 904.11.6.3 - Cleaning schedule ☐
   - 904.2.1 - Suppression system is required ☐
   - 904.11.6.4 - Inspect & test each 6 months ☐
   - 904.11.5 - K Class port extinguisher required ☐
3. Fire Doors
   - 703.2 - Properly maintained ☐
   - 703.2 - No unapproved hold open devices ☐
   - 703.2.3 - Proper operation ☐
4. Electrical
   - 605.3 - 30" minimum clearance from storage ☐
   - 605.4 & 605.5 - No extension cords/cubs adaptors ☐
   - 605.6 - No open J-boxes, switches, receptacles ☐
5. Fire Protection Systems (Sprinklers & Standpipes)
   - 901.6.2 - Test records available on site ☐
   - 901.6.1 - Annual inspection/testing/maintenance ☐
   - NFPA 13.2-9.1 - FDC plugs & caps are in place ☐
   - 912.3 - FDC access is unobstructed ☐
   - 903.3.1.1 - No non-system components ☐
   - 903.3.1.1 - No storage within 18" of head ☐
   - 901.6.1 - 6 extra heads ☐
   - 901.6.1 - Sprinkler wrench in cabinet ☐
   - 901.6.1 - Control valves locked open ☐
6. Means of Egress - Exit Doors
   - 1011.3 - Doors are unobstructed ☐
   - 1005.2.1 - Proper number for occupancy ☐
   - 1003.3.1.8 - No key or special knowledge required ☐
   - 1003.3.1.9 - Panic hardware installed if required ☐
7. Means of Egress - Exit Way (Aisles, Corridors & Stairs)
   - 1011.3 - No obstructions - clear access ☐
   - 315.2.2 - No flammable/combustible storage ☐
8. Decorative Material - Walls
   - 803.3.2 - Maximum 20% wall surface ☐
   - 805.1.2 - Flame resistant 10% wall surface ☐
9. Emergency Signs & Lighting
   - 1003.2.11 - Emergency egress lights working ☐
   - 1010.3 - Exit signs in place & illuminated ☐
   - 1003.2.10.1 - Exit signs unobstructed ☐
10. Occupancy Load
    - 1003.2.2.5 - Sign posted in all assembly areas ☐
11. Portable Fire Extinguisher - Where required
    - 906.3 - Approved and minimum size 2A, 20B:C ☐
    - 906.3 – Within maximum allowed travel distance ☐
    - 901.6.1 & NFPA 10 - Monthly "quick" checks ☐
    - 901.6.1 & NFPA 10 - Annual maintenance checks ☐
12. Business Address
    - 505.1 - On front clearly viable from street ☐
    - 505.1 - Contrasting color from background ☐
    - 505.1 - Minimum 4" Arabic Letters ☐
13. Fire Drills - Where required
    - 405.2 - Proper frequency and number ☐
    - 405.5 - Records of drills ☐
14. Manual Fire Alarm System
    - 907.2.3 - Required in all E use groups ☐
    - 907.4.4 - Pull station within 5' of exit ☐
    - 907.20.1 - Maintenance ☐
    - 907.20.2- Semi-annual test ☐
    - NFPA 72-7-5.2.1 - Test records avail. for 18 mos. ☐

Other violations & Remarks: _____

Inspected by : _____ Employee No. _____ Date: _____

(OVER)

(last printed 89/2)

Underwriters Laboratories Inc.®

Northbrook, IL Santa Clara, CA
Melville, NY Research Triangle Park, NC
A not-for-profit organization dedicated to public safety and committed to quality service

File No: S99999 CCN: UUFX
Service Center No: 2
Expires: Aug 3, 1993
Issued: Aug 3, 1992

CENTRAL STATION
FIRE ALARM SYSTEM DESCRIPTION
For Certificate Serial No: FC20453931

Protected Property:

A WAREHOUSE
1 INDUSTRIAL PK
PALATINE, IL 60074

Alarm Service Company:

AN ALARM SERVICE CO
333 PFINGSTEN RD
NORTHBROOK, IL 60062-2096

COMMENTS AND CLARIFICATIONS:
THIS CERTIFICATE IS FOR DEMONSTRATION PURPOSES ONLY!!!

SYSTEM DESCRIPTION:
This system is installed and operated in accordance with standard NFPA 71, 1989 edition.
Coverage is PARTIAL.
Area Covered: ENTIRE BUILDING
Authority Having Jurisdiction: PALATINE FPD
Responding Fire Department: PALATINE FPD #23
Local Alarm Annuciation is employed. Local Alarm Indication is employed.

MANUAL FIRE ALARM SERVICE:
- 1 - Coded Stations
- 2 - Non-coded Stations activating 2 transmitters
- 2 - Combination Manual Fire Alarm and Guard Tour Stations

GUARD'S TOUR SUPERVISORY SERVICE:
- 2 - Coded Stations
- 2 - Non-coded Stations activating 2 transmitters
- 2 - Compulsory Stations with 2 transmitters

AUTOMATIC FIRE DETECTION AND ALARM SERVICE:
- 2 - Coded Alarm Signals
- 2 - Coded Trouble Signals
- 2 - Initiating Circuits, Style A
- 2 - Smoke Detectors: 1 Ionization type 1 Photoelectric type
- 2 - Duct Detectors: 1 Ionization type 1 Photoelectric type
- 2 - Heat Detectors: 1 Rate-of-rise type 1 Fixed Temperature type
- 2 - Other: FLAME DETECTORS

Page 1 of 2
This form is to accompany the Certificate!

FIRE & LIFE SAFETY SURVEY

_____ Date_____

_____ Phone_____

_____ Owner/Manager_____

_____ Shift_____ Station _____

____no Sprinkler System ____yes____no Floors_____ Sub-floors_____

Name/Number _____

001 ___
002 ___
003 ___

001 ___
002 ___
003 ___
004 ___

001 ___
002 ___

001 ___
002 ___
003 ___
004 ___

001 ___
002 ___
003 ___
004 ___
005 ___

001 ___
002 ___
003 ___
004 ___
005 ___

001 ___
002 ___
003 ___

008. Extinguishers
- Recharge 001 ___
- Hang 002 ___
- Repair/Test/Recertify 003 ___
- Inadequate 004 ___
- Wrong type 005 ___
- Required 006 ___

009. Fire Doors
- Blocked/Inoperative 001 ___
- No Closing Device 002 ___
- Inadequate 003 ___
- Other 004 ___

010. Chemicals
- Improper storage 001 ___
- No permit 002 ___
- Other 003 ___

011. Explosives/Ammunition
- Improper storage 001 ___
- No permit 002 ___
- Other 003 ___

012. Flammable Liquids
- Improper Storage 001 ___
- No Safety Cans 002 ___
- To close to a Heat Source 003 ___
- Improper Dispensing 004 ___
- Excessive Amounts 005 ___

013. Open Flame Devices
- Open top or sides 001 ___
- Use not to Code 002 ___

014. Painting Spraying
- Improper Venting 001 ___
- Booth not to Code 002 ___
- No Sprinkler Heads 003 ___
- Other 004 ___

015. Fixed Extinguishing systems
- Inadequate coverage 001 ___
- Recertify 002 ___
- Other 003 ___

016. Sprinkler Systems
- Defective Heads 001 ___
- Incomplete coverage 002 ___
- Storage to close to heads 003 ___
- Extra heads/wrench needed 004 ___
- Annual Certification 005 ___
- Other 006 ___

017. Stairs
- Handrails 001 ___
- Blocked 002 ___
- Emergency Lighting 003 ___

018. Stand pipes/Hose cabinets
- Wrong Threads 001 ___
- Recertify/Replace Hose 002 ___
- Repair 003 ___
- Testing 004 ___
- Other 005 ___

019. Housekeeping
- Area/Yard/Building 001 ___
- Improper Disposal 002 ___
- Excessive storage of waste 003 ___

020. Address
- Not Posted 001 ___
- Not Visible/Contrasting 002 ___
- Not 6" Numbers 003 ___

021. Knox Boxes
- Required 001 ___
- Provide Current Key 002 ___
- Other 003 ___

050. Other Violations
- Other 001 ___

FIRE ALARM SYSTEM INSTALLATION

The system shall be installed and maintained per NEC Article 760 and NFPA 72

Plans must be submitted to the AHJ for review and approval

Shall be designed by qualified personnel

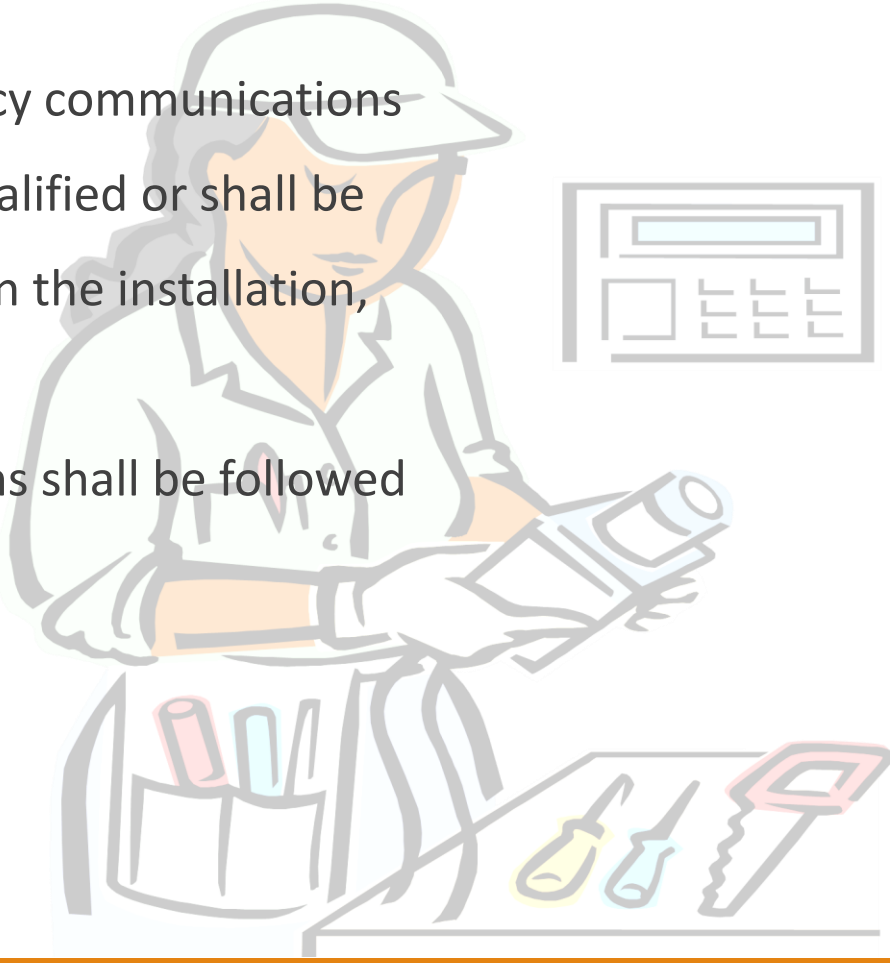
Installed by qualified personnel or installation supervised by qualified personnel…..

The term qualified personnel shows up 34 times in NFPA 72…..

System Installer Qualifications?

10.5.2.1 Fire alarm systems and emergency communications systems installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection, and testing of the systems.

10.5.2.2 State or local licensure regulations shall be followed to determine qualified personnel.



System Installer Qualifications?

10.5.2.3 Personnel shall provide documentation of their qualification by one or more of the following:
(1) Registration, licensing, or certification by a state or local authority
(2) Certification by an organization acceptable to the authority having jurisdiction
(3) Manufacturer's certification for the specific type and brand of system provided
10.5.2.4 System installation trainees shall be under the supervision of a qualified system installer.
10.5.2.5 The system installer shall provide evidence of their qualifications and/or certifications when requested by the authority having jurisdiction.

Fundamentals, Chapter 10

10.6.7.1 Operation on secondary power shall not affect the required performance of a system or supervising station facility, including alarm, supervisory, and trouble signals and indications.

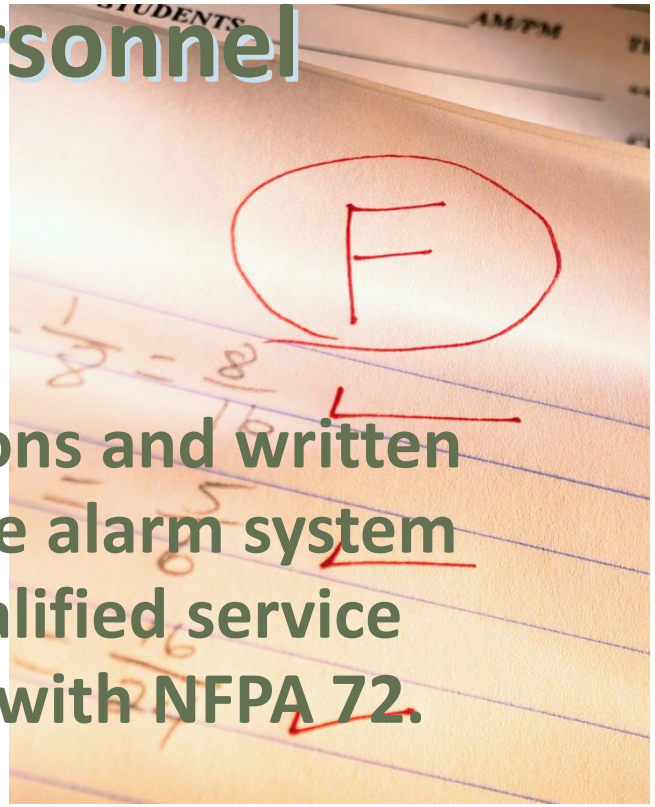
10.6.7.2 Capacity

10.6.7.2.1.1 Battery calculations shall include a 20 percent safety margin to the calculated amp-hour rating

This provides alignment with UL 864 9th edition and the realization that over the life of a battery, it will decay.

Chapter 10, Alarm System Testing

Be tested annually by qualified personnel



- All facilities shall have inspections and written certifications of the complete fire alarm system completed by an approved qualified service representative in accordance with NFPA 72.

14.4. Acceptance Testing.

10.4.1.1 Initial Acceptance Testing.

All new systems shall be inspected and tested in accordance with the requirements of Chapter 14.

The authority having jurisdiction shall be notified prior to the initial acceptance test.

10.4.1.2 Reacceptance Testing.

When an initiating device, notification appliance, or control relay is added, it shall be functionally tested.

When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated.

When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 14.4.3.2, items 2(a) and 2(d).

Table 14.4.3.2 Testing

Component	Initial Acceptance	Periodic Frequency	Method
1. All equipment	X		See Table 14.3.1.
2. Control equipment and transponder			
(a) Functions	X	Annually	Verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
(b) Fuses	X	Annually	Verify rating and supervision.
(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
(e) Primary (main) power supply	X	Annually	Test under maximum load, including all alarm appliances requiring simultaneous operation. Test redundant power supplies separately.
3. Fire alarm control unit trouble signals			
(a) Audible and visual	X	Annually	Verify operation of control unit trouble signals. Verify ring-back feature for systems using a trouble-silencing switch that requires resetting.
(b) Disconnect switches	X	Annually	If control unit has disconnect or isolating switches, verify performance of intended function of each switch. Verify receipt of trouble signal when a supervised function is disconnected.
(c) Ground-fault monitoring circuit	X	Annually	If the system has a ground detection feature, verify the occurrence of ground-fault indication whenever any installation conductor is grounded.
(d) Transmission of signals to off-premises location	X	Annually	Actuate an initiating device and verify receipt of alarm signal at the off-premises location. Create a trouble condition and verify receipt of a trouble signal at the off-premises location. Actuate a supervisory device and verify receipt of a supervisory signal at the off-premises location. If a transmission carrier is capable of operation under a single- or multiple-fault condition, activate an initiating device during such fault condition and verify receipt of an alarm signal and a trouble signal at the off-premises location.

Partial Table Shown

14.4.4 Testing Frequency.

Unless otherwise permitted by other sections of this Code, testing shall be performed in accordance with the schedules in Table 14.4.3.2 or more often if required by the authority having jurisdiction.

14.4.4.1 Devices or equipment that are inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be tested during scheduled shutdowns if approved by the authority having jurisdiction.

Extended intervals shall not exceed 18 months.

14.4.4.2 If automatic testing is performed at least weekly by a remotely monitored fire alarm control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annually.

Testing Table 14.4.3.2

7.	Secondary (standby) power supply[c]	X	Annually	Disconnect all primary (main) power supplies and verify the occurrence of required trouble indication for loss of primary power. Measure or verify the system's standby and alarm current demand and verify the ability of batteries to meet standby and alarm requirements using manufacturer's data. Operate general alarm systems a minimum of 5 minutes and emergency voice communications systems for a minimum of 15 minutes. Reconnect primary (main) power supply at end of test.
8.	Uninterruptible power supply (UPS)	X	Annually	If a UPS system dedicated to the system is used as a required power source, verify by the building owner operation of the UPS system in accordance with NFPA 111.
9.	Battery tests			Prior to conducting any battery testing, verify by the person conducting the test, that all system software stored in volatile memory is protected from loss.
	(a) Lead-acid type			
	(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
	(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
	(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
	(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the battery does not fall below 2.05 volts per cell under load.

10.20 Impairments.

10.20.1 The system owner or the owner's designated representative shall be notified when a system or part thereof is impaired. Impairments to systems shall include out-of-service events.

10.20.2 A record of the impairments shall be maintained by the system owner or the owner's designated representative for a period of 1 year from the date the impairment is corrected.

10.20.3 The supervising station shall report to the authority having jurisdiction any system for which required monitoring has been terminated.

10.20 Impairments.

10.20.4* The service provider shall report to the authority having

jurisdiction any system that is out of service for more than 8 hours.

10.20.5* Where required by the authority having jurisdiction, mitigating measures shall be implemented for the period that the system is impaired.

10.20.6 The system owner or the owner's designated representative and the authority having jurisdiction shall be notified when an impairment period ends.

10.21* Unwanted Alarms. For the purpose of reporting, alarm signals that are not the result of hazardous conditions shall be classified as Unwanted and subclassified as one of the following:

(1) Malicious alarm

(2) Nuisance alarm

(3) Unintentional alarm

(4) Unknown alarm

Single- and Multiple-Station Alarms and Household Fire Alarm Systems – Chapter 29

29.3.8.1* Mild to Severe Hearing Loss.

Notification appliances provided for those with mild to severe hearing loss shall comply with the following:

- (1) An audible notification appliance producing a low frequency alarm signal shall be installed in the following situations:
  - (a) Where required by governing laws, codes, or standards for people with hearing loss
  - (b) Where provided voluntarily for those with hearing loss

Single- and Multiple-Station Alarms and Household Fire Alarm Systems – Chapter 29

- (2)*The low frequency alarm signal output shall comply with the following:
  - (a) The waveform shall have a fundamental frequency of 520 Hz ±10 percent.
  - (b) The minimum sound level at the pillow shall be 75 dBA, or 15 dB above the average ambient sound level, or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater.

29.5.1.1 Required Detection

(1)*In all sleeping rooms and guest rooms

(2)*Outside of each separate dwelling unit sleeping area, within **21 ft** of any door to a sleeping room, the distance measured along a path of travel

(3) On every level of a dwelling unit, including basements

(4) On every level of a residential board and care occupancy (small facility), including basements and excluding crawl spaces and unfinished attics

(5)*In the living area(s) of a guest suite

(6) In the living area(s) of a residential board and care occupancy (small facility)

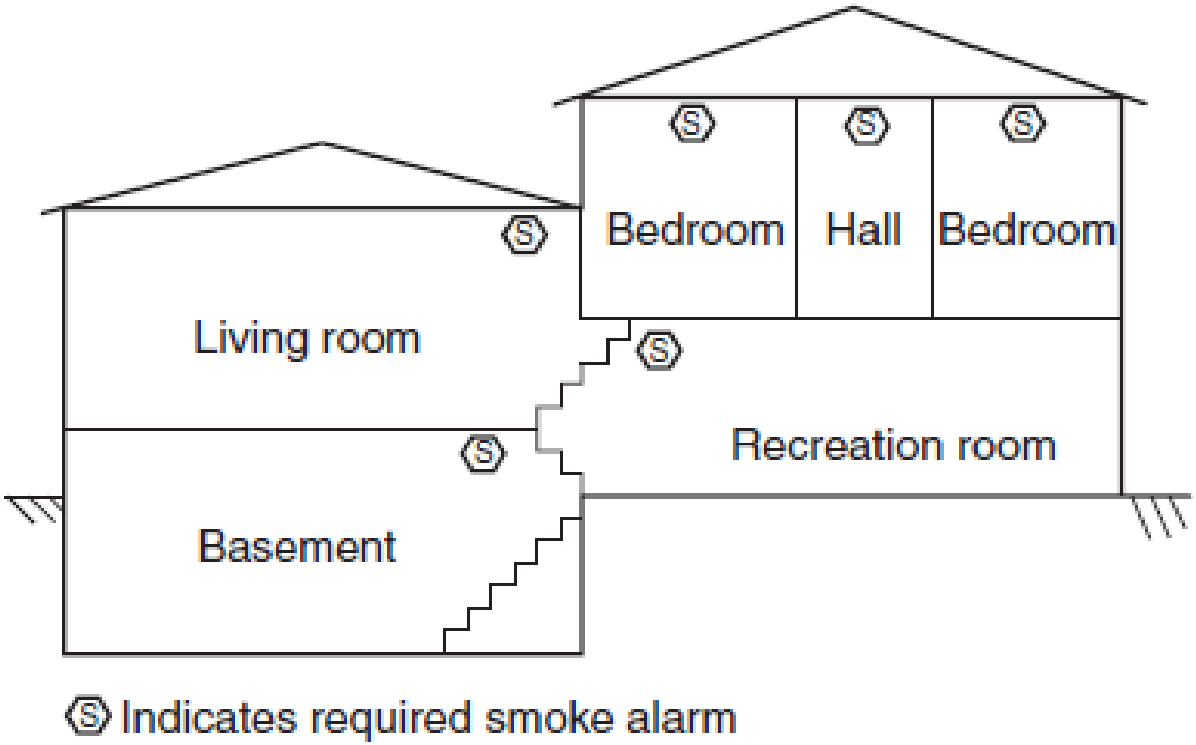


FIGURE A.29.5.1(a) Split Level Arrangement.

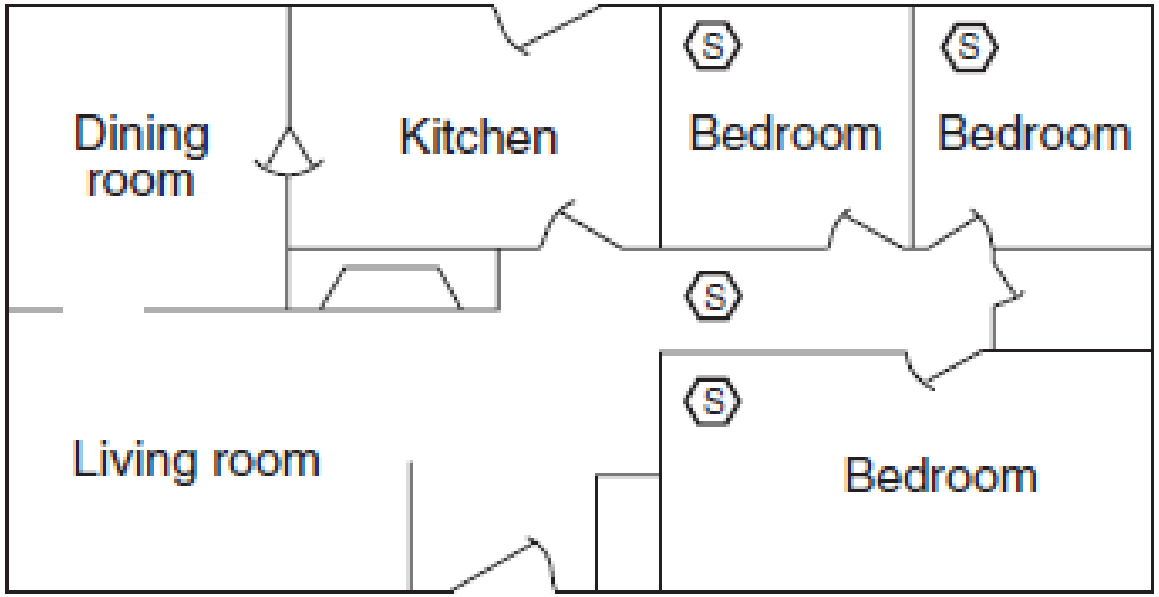


FIGURE A.29.5.1(b) Smoke Alarm Should Be Located Between Sleeping Area and Rest of Dwelling Unit, as Well as in Each Bedroom.

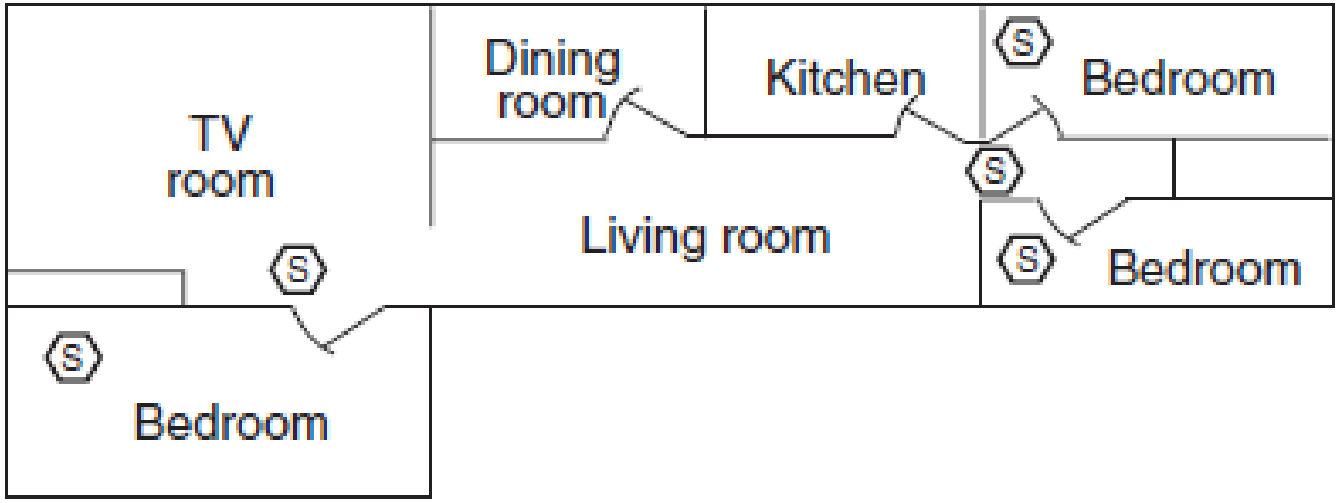


FIGURE A.29.5.1(c) In Dwelling Units with More Than One Sleeping Area, Smoke Alarm Should Be Provided to Protect Each Sleeping Area in Addition to Smoke Alarms Required in Bedrooms.

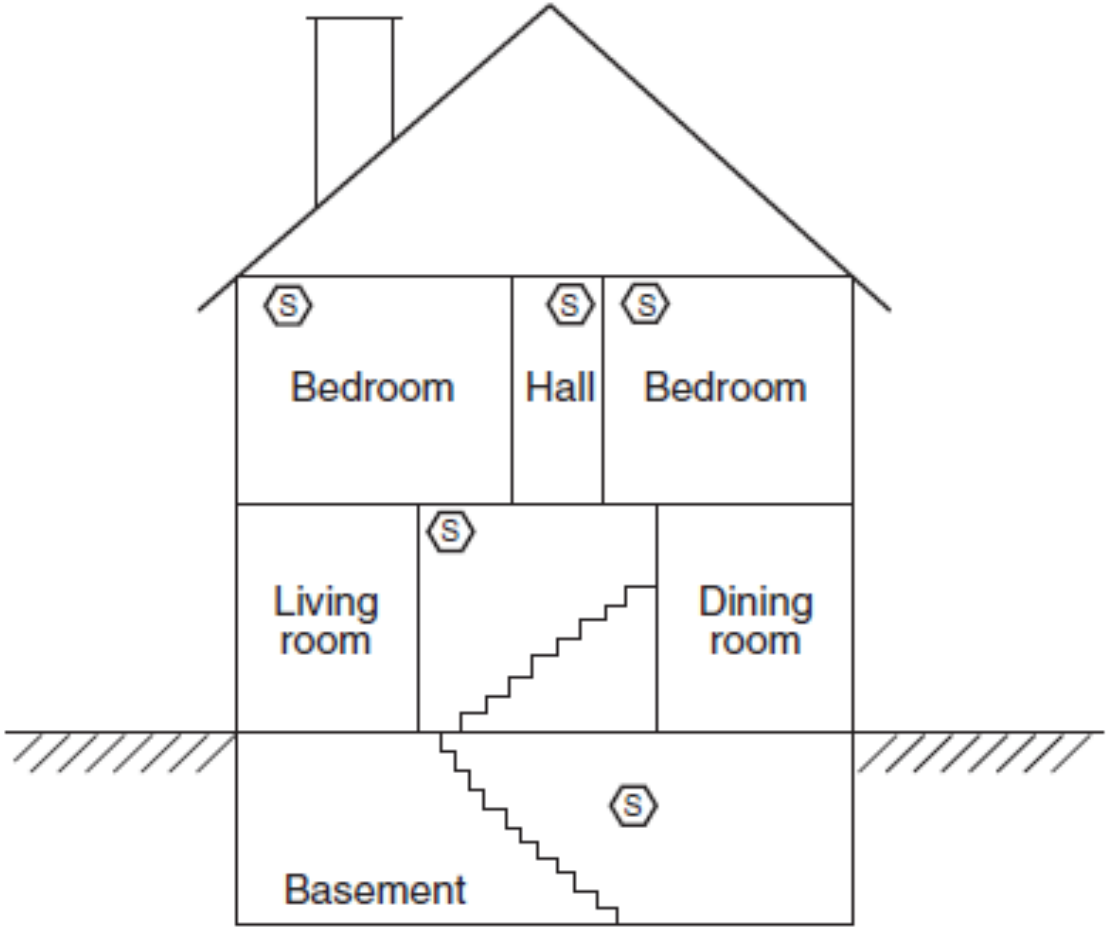


FIGURE A.29.5.1(d) Smoke Alarm Should Be Located on Each Level in Addition to Each Bedroom.

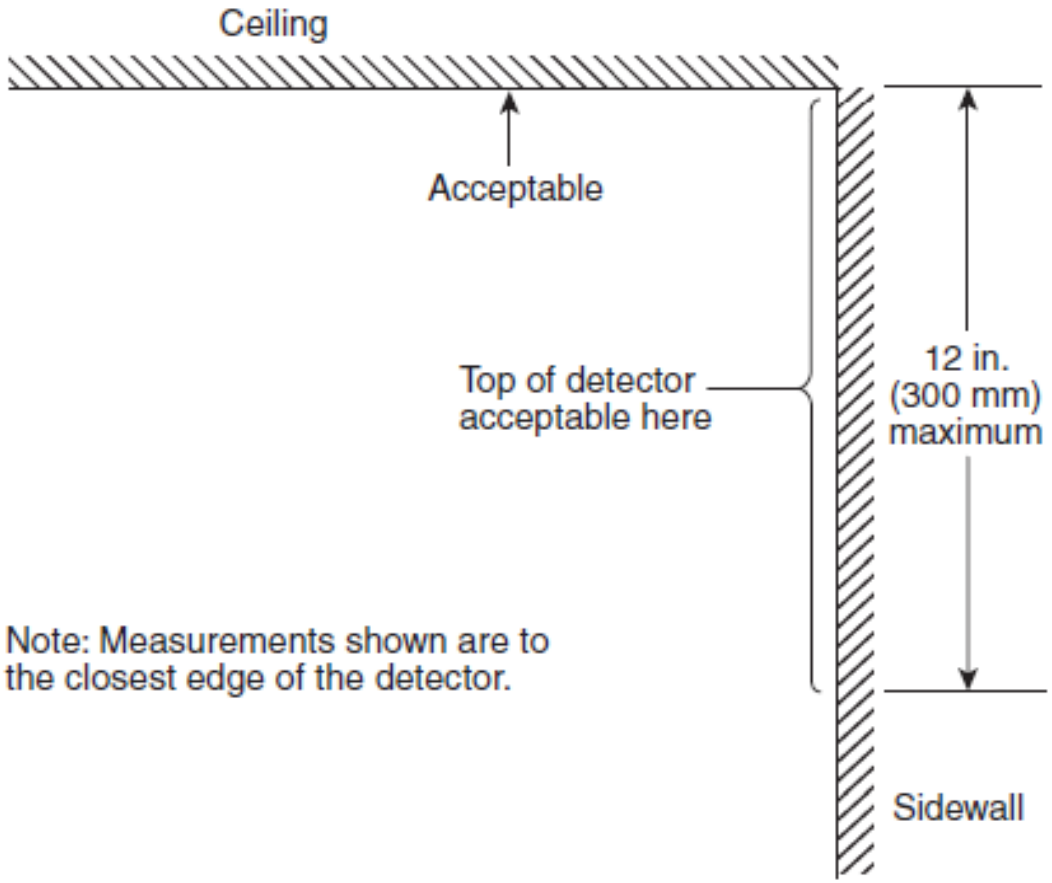


FIGURE A.29.8.3 Example of Proper Mounting for Smoke Alarms and Smoke Detectors.

29.8.3.1 Peaked Ceilings

Smoke alarms or smoke detectors mounted on a peaked ceiling shall be located within 36 in. horizontally of the peak, but not closer than 4 in. vertically to the peak.

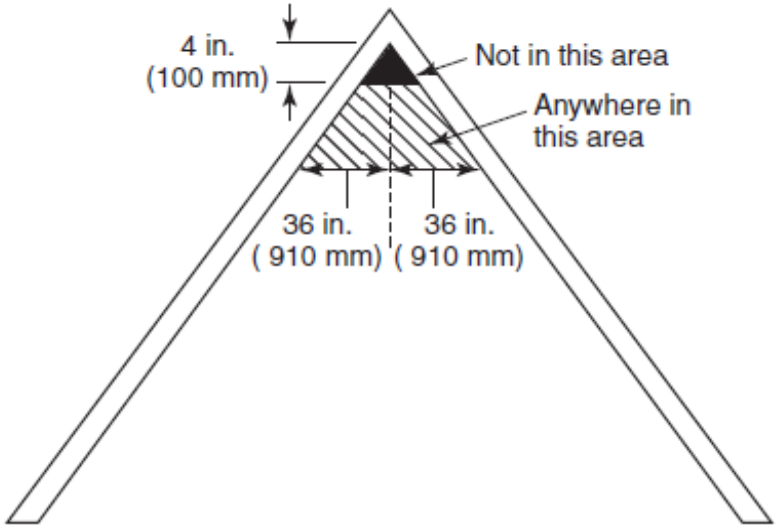


FIGURE A.29.8.3.1 Example of Proper Mounting for Alarms and Detectors with Peaked Ceilings.

29.8.3.2 Sloped Ceilings

Smoke alarms or smoke detectors mounted on a sloped ceiling having a rise greater than 1 ft in 8 ft horizontally shall be located within 36 in. of the high side of the ceiling, but not closer than 4 in. from the adjoining wall surface.

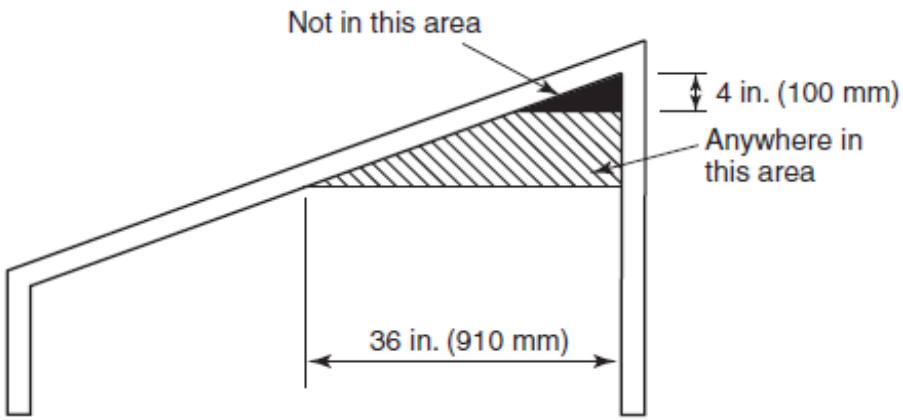


FIGURE A.29.8.3.2 Example of Proper Mounting for Alarms and Detectors with Sloped Ceilings.

29.8.3.3 Wall Mounting.

Smoke alarms or smoke detectors mounted on walls shall be located not farther than 12 in. from the adjoining ceiling surface.

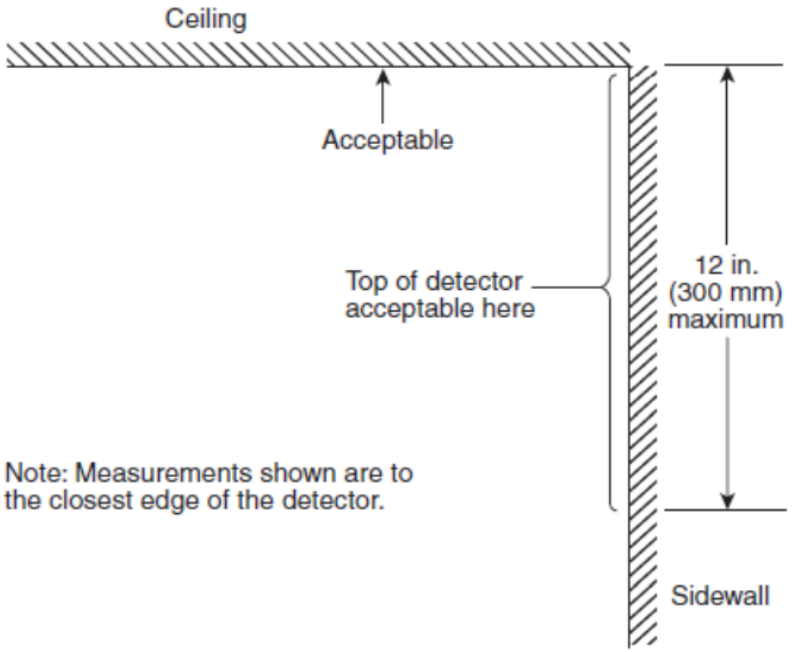


FIGURE A.29.8.3 Example of Proper Mounting for Smoke Alarms and Smoke Detectors.

29.8.3.4 Specific Location Requirements.

(4) Cooking appliances has several requirements including; shall be equipped with an alarm-silencing means or be of the photoelectric type.

(6) Smoke alarms and smoke detectors shall not be installed within a 36 in. horizontal path from a door to a bathroom containing a shower or tub.

(7) Smoke alarms and smoke detectors shall not be installed within a 36 in. horizontal path from the supply registers of a forced air heating or cooling system and shall be installed outside of the direct airflow from those registers.

(8) Smoke alarms and smoke detectors shall not be installed within a 36 in. horizontal path from the tip of the blade of a ceiling-suspended (paddle) fan.

(4) Cooking appliances

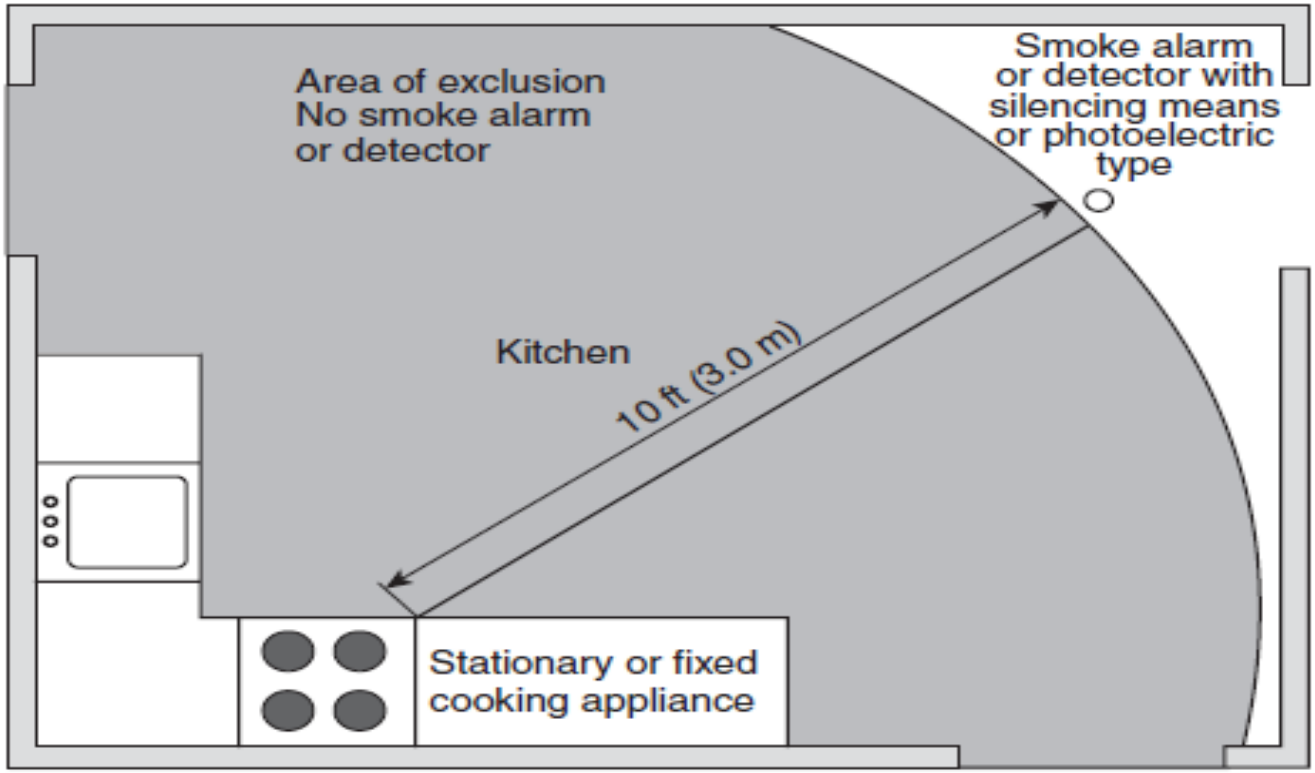


FIGURE A.29.8.3.4(4)(a) Example of Zone of Exclusion (gray area) Within Typical Residential Kitchen.

(4) Cooking appliances

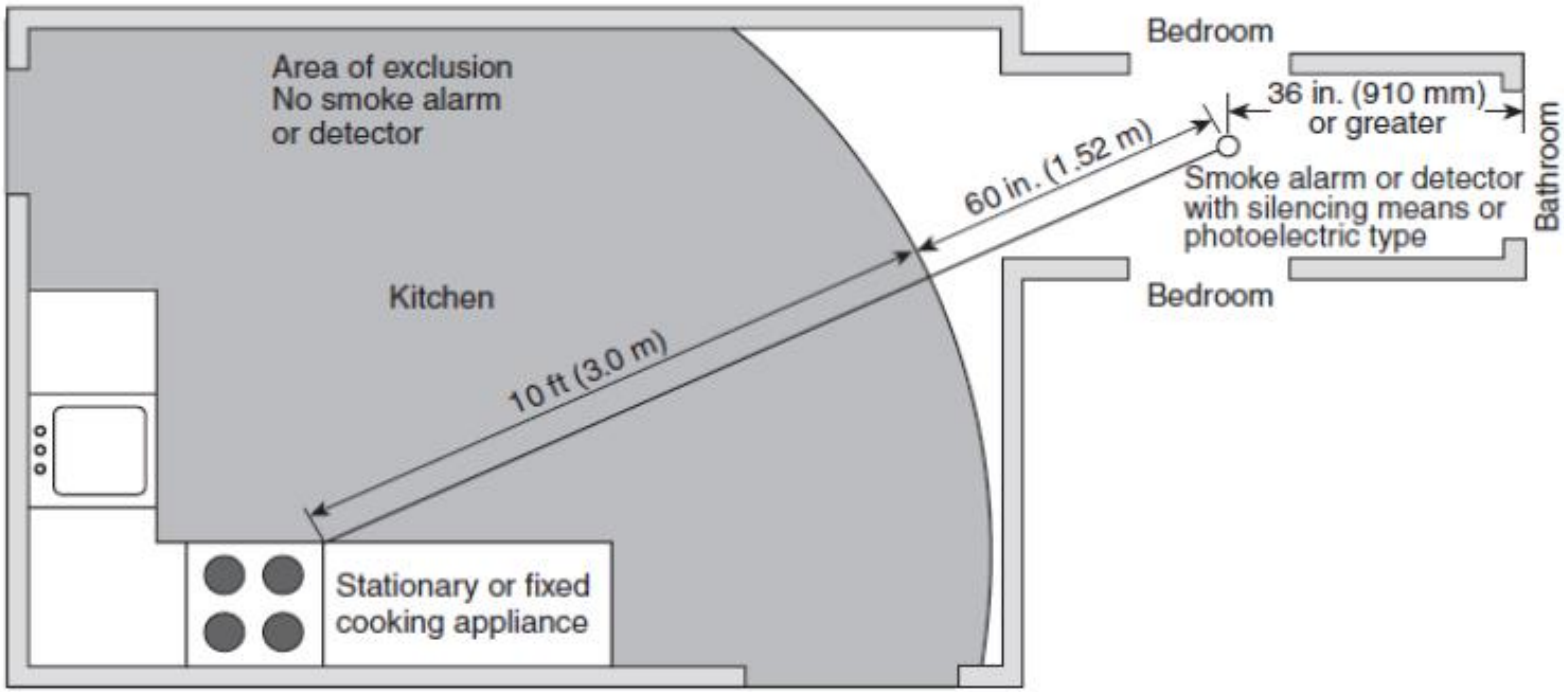


FIGURE A.29.8.3.4(4)(b) Example of Smoke Alarm or Smoke Detector Placement Between 10 ft (3.0 m) and 20 ft (6.1 m) Away in Hallway from Center of Stationary or Fixed Cooking Appliance.

(4) Cooking appliances

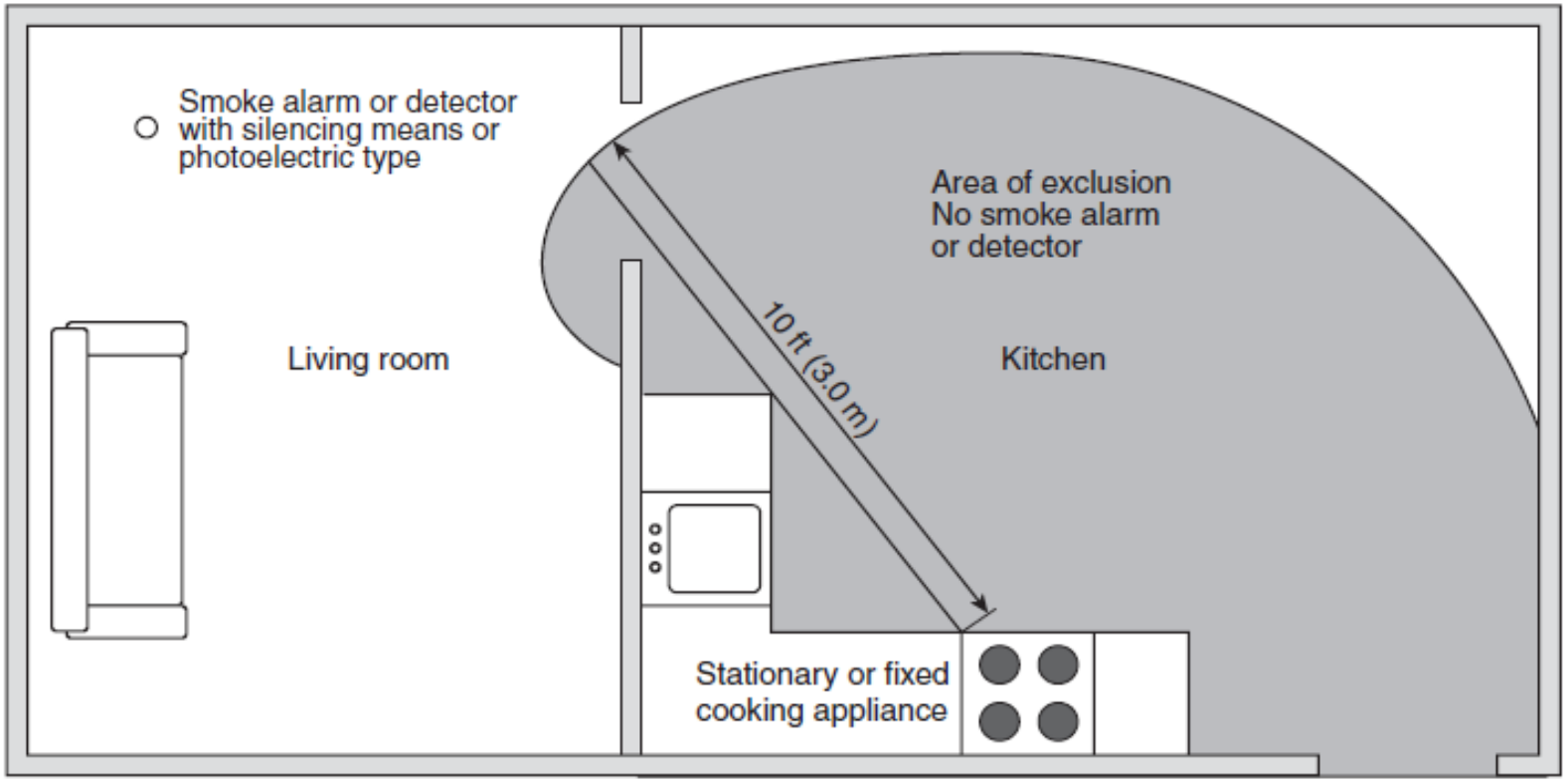


FIGURE A.29.8.3.4(4)(c) Example of Smoke Alarm or Smoke Detector Placement Between 10 ft (3.0 m) and 20 ft (6.1 m) Away in Hallway from Center of Stationary or Fixed Cooking Appliance.

(4) Cooking appliances

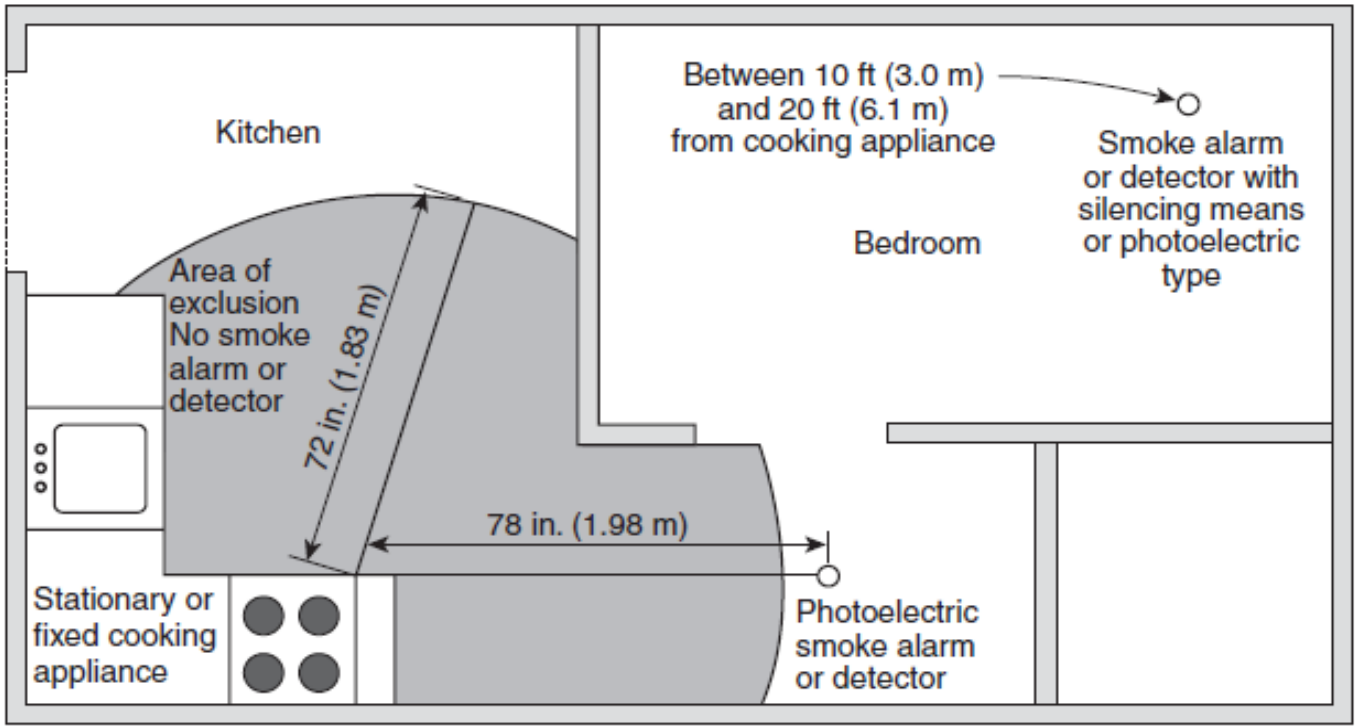


FIGURE A.29.8.3.4(4)(d) Example of Exception Placement of Photoelectric Smoke Alarm or Smoke Detector at 72 in. (1.83 m) from Stationary or Fixed Cooking Appliance.

Installation meets Code?

29.8.3.4 Specific Location Requirements.

(11)*For tray-shaped ceilings (coffered ceiling) smoke alarms and smoke detectors shall be installed on the highest portion of the ceiling or on the sloped portion of the ceiling within 12 in. vertically down from the highest point.

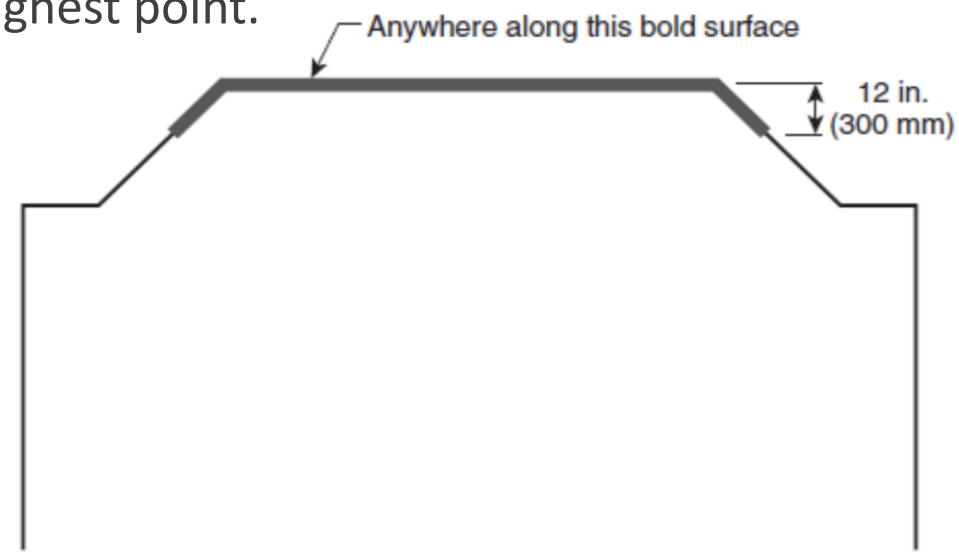
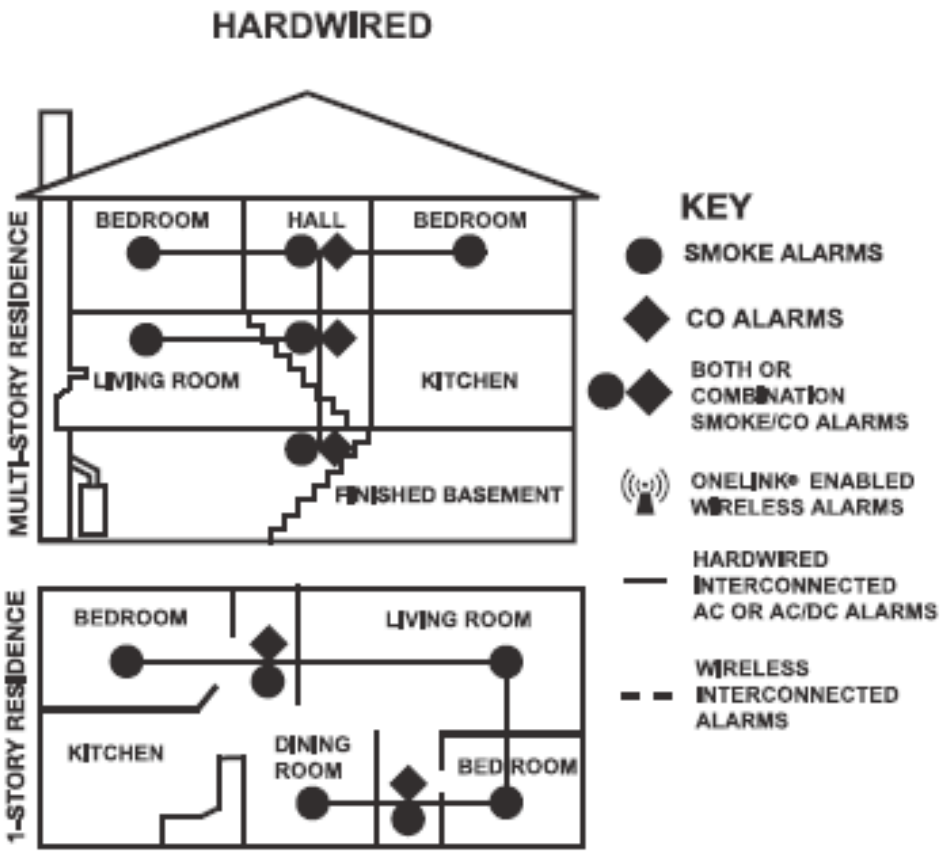


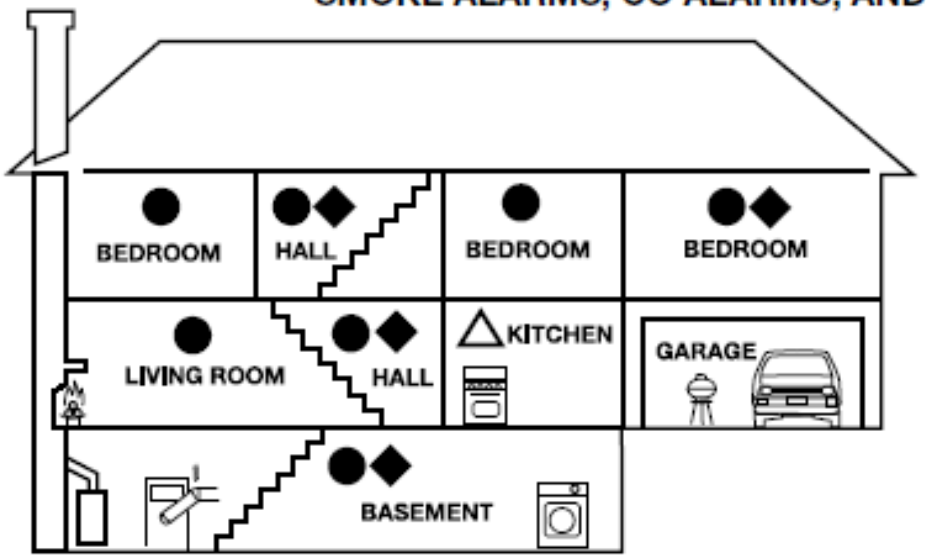
FIGURE A.29.8.3.4(11) Locations Permitted for Smoke Alarms and Smoke Detectors on Tray-Shaped Ceilings.

Manufacturer specs



Recommended Placement

SUGGESTED AREAS FOR INSTALLING SMOKE ALARMS, CO ALARMS, AND COMBO UNITS



In new construction AC and AC/DC smoke alarms MUST be interconnected to meet NFPA recommendations.

KEY:

- ● SMOKE ALARMS
- △ SMOKE ALARM WITH SILENCE FEATURE
- ◆ CO ALARMS
- ●◆ BOTH, OR COMBINATION SMOKE/CO ALARMS

Suggested locations are based on NFPA recommendations (NFPA 72 for Smoke Alarms and NFPA 720 for Carbon Monoxide Alarms). Always refer to national and local codes before beginning any installation.

AVOIDING DEAD AIR SPACES

"Dead air" spaces may prevent smoke from reaching the Smoke/CO Alarm.

To avoid dead air spaces, follow installation recommendations below.

On ceilings, install Smoke/CO Alarms as close to the center of the ceiling as possible. If this is not possible, install the Smoke/CO Alarm at least 4 inches from the wall or corner.

For wall mounting (if allowed by building codes), the top edge of Smoke/CO Alarms should be placed between 4 inches and 12 inches from the wall/ceiling line.

On a peaked, gabled, or cathedral ceiling, install the first Smoke/CO Alarm within 3 feet of the peak of the ceiling, measured horizontally. Additional Smoke/CO Alarms may be required depending on the length, angle, etc. of the ceiling's slope.

Refer to NFPA 72 for details on requirements for sloped or peaked ceilings.

IRC SECTION R315 CARBON MONOXIDE ALARMS

R315.2.1 New construction. For new construction, carbon monoxide alarms shall be provided in dwelling units where either or both of the following conditions exist.

1. The dwelling unit contains a fuel-fired appliance.

2. The dwelling unit has an attached garage with an opening that communicates with the dwelling unit.

R315.3 Location. Carbon monoxide alarms in dwelling units shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms. Where a fuel-burning appliance is located within a bedroom or its attached bathroom, a carbon monoxide alarm shall be installed within the bedroom.

What is the specific gravity of different gases?

Carbon monoxide – CO, SPG of 0.9667

Oxygen - O_2, SPG of 1.1044

Air[1)], SPG of 1.000

CO is Lighter Than Air!!!

Getting the Right Height

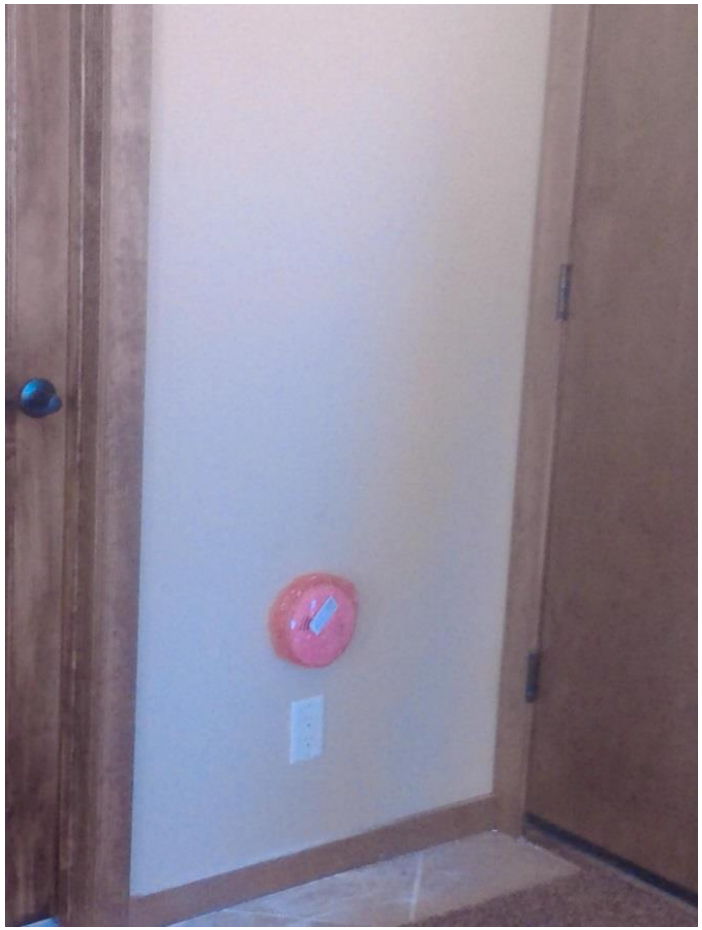
According to information from one of our manufacturers, you can install a CO alarm at any height in your home.

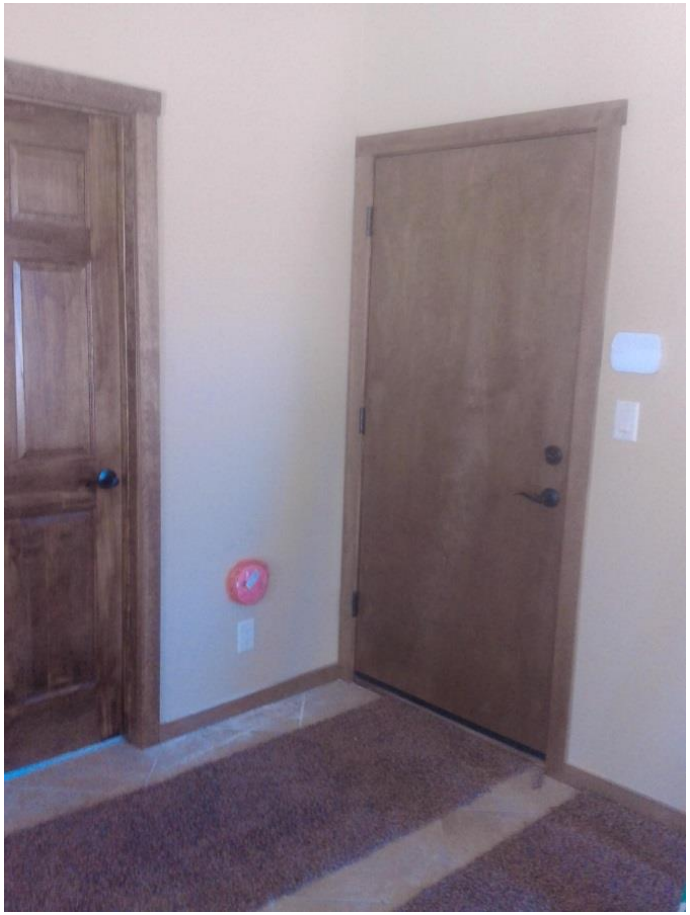
The reason is that the molecular weight of air is almost identical to the weight of carbon monoxide. Air is typically composed of 78% nitrogen and 21% oxygen. Nitrogen has a specific weight of 28.013 while carbon monoxide is almost identical 28.011. CO mixes with Air as their weights are approximately the same.

Also remember that a minimum of 3 carbon monoxide alarms are recommended for a two story home, one on each level near the stairwells.

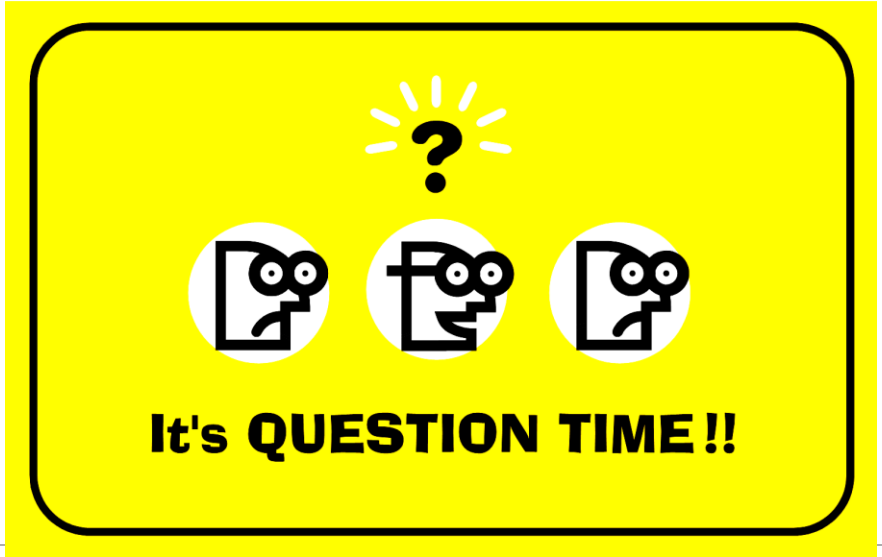
Put one inside each bedroom if you close bedroom doors at night.

What’s Wrong with this?





This Concludes The Program.



Questions?

This Concludes Our Presentation-

Fire Alarm Installation Seminar

THANK YOU FOR YOUR TIME!

For Other Training Opportunities Visit Us At:
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