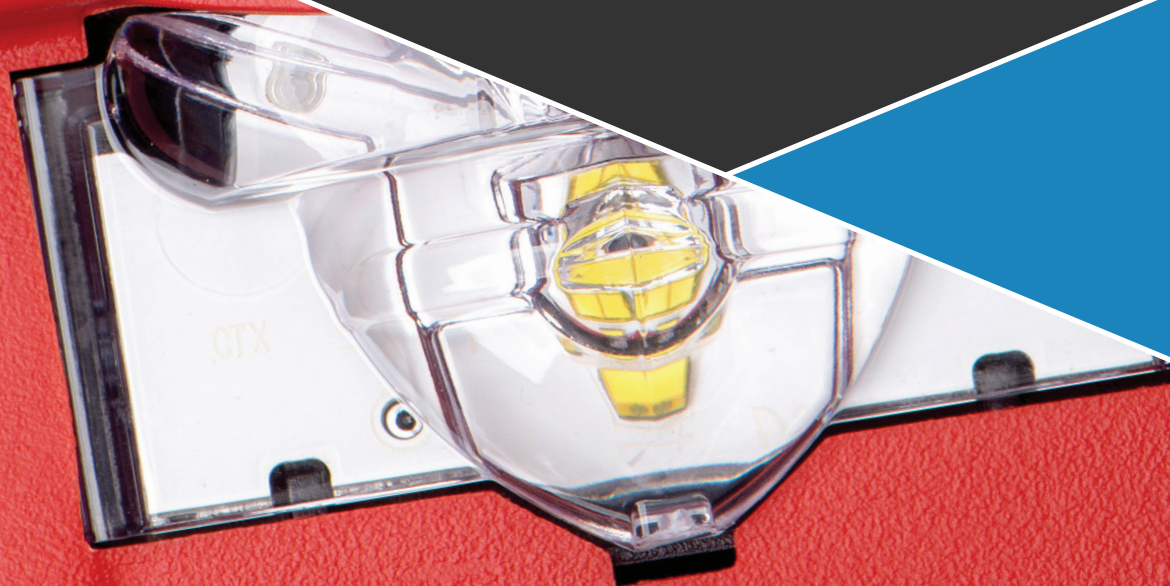


FIRE ALARM SYSTEMS

3 VIRTUAL TRAINING

Part 3: Communications, Circuits & Pathways, & Understanding Design & Placement



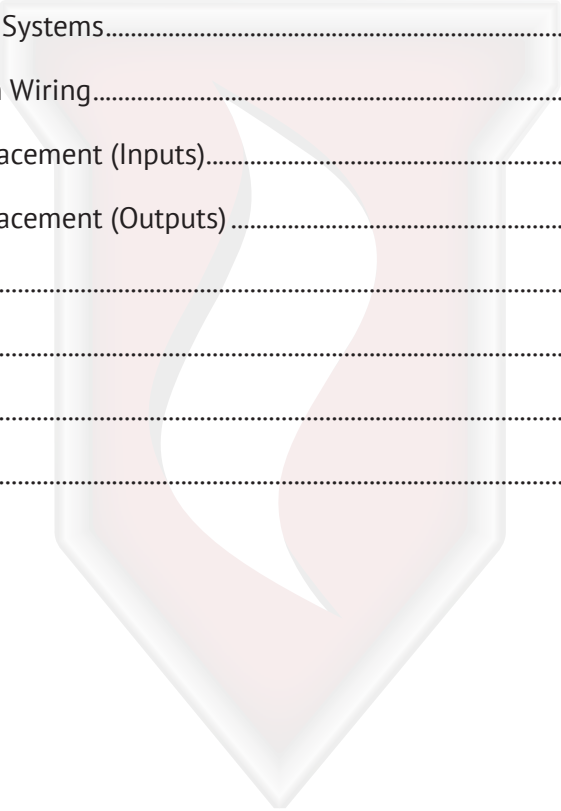
FED[®]

LEARNING CENTER



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#NFPA96
#NFPA17A #NFPA10
#GenerationTrained



What is the FED Learning Center?

The FED Learning Center is an educational platform supporting training and developmental needs of the Fire and Life Safety industry.

In late 2017, Fire and Life Safety industry leaders came together to address challenges in employee hiring, retention, and training. Specific focus was given to the need for technical training, as it relates to the field technician responsible for maintenance, inspection, and repair in fire suppression applications. Continued research and planning, by BHC, resulted in the development of the FED Learning Center. The plan was officially announced in the spring of 2018, with courses held later that summer.

The FED Learning Center was created to fulfill the need for educational opportunities on a variety of topics affecting the Fire and Life Safety industry. To strengthen the educational value the program provides, several industry experts have participated in developing the facilities and content, including many Engineers, Product Specialists, Code Professionals, and Facility Experts. Additionally, great care has been given to Instructional Design so that learners of all types benefit from the courses offered within the program.

Our Work Saves Lives

What We Believe?

Our **POSITION** is simple. We believe that the better educated we are as a community of fire and life safety professionals, the safer we all are. Understanding safety is a **CHALLENGE** and keeping others safe is a **CALLING**. So the team at the FED Learning Center is committed to doing everything within our reach to promote and provide educational opportunities that support the needs of those who hear the calling and have accepted the challenge.

Our **VISION** is to provide an industry-specific, educational platform for all members of the Fire and Life Safety community, because we are on a **MISSION** to educate as many people as possible on what it takes to protect the world from safety hazards, in accordance with codes and NFPA standards.

We accept the **CORPORATE RESPONSIBILITY** necessary to provide a professional, non-political environment, where the "business" of fire protection is put aside, allowing 100% of the focus to be on gaining knowledge and developing skills. And we proudly wear the **SOCIAL IMPACT** we are making like a badge of honor, as we do our part in increasing the number of properly trained professionals in the field.

We all share the **GOAL** of protecting people and property, but every-day hazards change, technology develops, and the way we interact in the world evolves. The work we do saves lives, so we must all make the **COMMITMENT** to develop and evolve too.

Hear the Calling
Take the Challenge
Get Trained
Stay Trained



The Student Experience

Feel Your Vibe: You're in charge of the vibe you want to experience during training. Do you want to send one person to a general session course? How about sending a small group to create comradery amongst the team? On the other hand, what about a private session to combine technical training and teamwork? You are in charge, so you choose! Luckily, the more you send, the greater the discount!

Find Your Venue: If being at an FED Learning Center campus is important to you, select from one of our four campuses spanning the East Coast and the Midwest. Alternatively, off-site sessions may be better for your travel time.

Select Your Course: Our course catalog is always growing. Determine what your instructional needs are now and select from the courses available. Every effort is made to offer multiple product disciplines within a course week, so those who want to stay for multiple courses can do so.

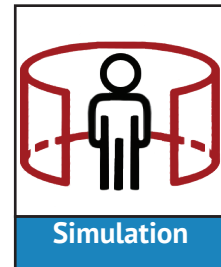
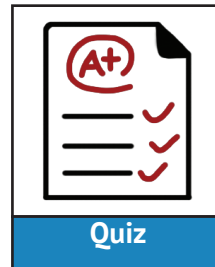
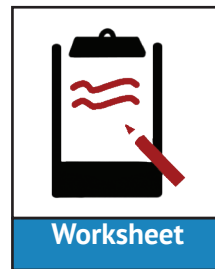
Secure Your Seats: When you're ready, log on to www.FEDLearningCenter.com and secure your seats through our super-simple registration process. Once registered, you will receive a confirmation email, receipt, calendar reminders, and course details for later reference. Don't worry if the venue you are looking for is full, put yourself on the wait list, and we'll do our best to get you in the course or create another course that matches your needs.

*“Tell me and I forget,
teach me and I remember,
involve me and I learn.”*

~ Benjamin Franklin

Instructional Design Variety

No two students learn the exact same way, so at the FED Learning Center, great care is given to ensure the instructional design offers something for everyone. It's our intent to offer a variety of styles and methods in course instruction, ensuring that all students have the opportunity to learn.



Course Objectives

Upon completion of this course, you will have learned:

- The role technicians play in the Fire and Life Safety industry.
- The main reference book required in the Fire Alarm industry.
- How to read NFPA codes.
- Key NFPA definitions.
- Fire Alarm Industry reference books.
- Who is an AHJ.
- The history of Fire Alarm Systems.
- Basic Fire Alarm System Components and their functionality.
- A deep dive into NFPA 72, Chapter 14, Inspection, Testing & Maintenance.
- Emergency control functions.
- The importance of Emergency Communication Systems.
- Circuits and Pathways System wiring.
- Understanding the design and placement for Input and Output Devices.
- The different type of Fire Alarm Circuits.
- The way Fire Alarm Systems communicate to a Central Station.
- The dangers of Carbon Monoxide poisoning.



FIRE ALARM SYSTEMS: **EMERGENCY CONTROLS**

PULL HANDL

THEN



PULL DOWN
LEVER

7136

FIRE ALARM STATION

Emergency Control Functions

- Building, fire, and emergency control elements or systems that are initiated by the fire alarm or signaling system and either increase the level of life safety for occupants or control the spread of the harmful effects of fire or other dangerous products 3.3.101.
- Emergency Control Functions are designated through the Fire Alarm Control Panel or ECS Panel.

Common functions controlled by the fire panel:

- Elevator capture.
- Air handling shutdown.
- Smoke damper control.
- Closure of fire doors.
- Equipment shutdown.
- Smoke control.



Elevator Recall

- Elevator recall is used to stop the function of the elevator operation and bring the elevator to the appropriate floor:
 - Primary level.
 - Alternate level.
 - Fireman's helmet.
- Elevator shunt is an immediate shutdown and is usually required if the shafts are covered with a sprinkler system/head.



1

Duct Detectors

- Devices used to shut down HVAC systems:
 - Installed in duct work (uses sampling tubes).
 - Requires a Photo-R (R = Resettable).
 - Housing for a relay (relay interrupts power).

Fire Doors

- Door holders are used to close interior doors to help stop the fire from spreading to other areas of the building:
 - Allow doors to release (using magnetic door holders).
 - Hydraulic door closer (forces doors to close).
 - Smoke Detector (has a relay built in).



EMERGENCY COMMUNICATION SYSTEMS



MS-9200UDLS
ADDRESSABLE
FIRE ALARM CONTROL PANEL

Emergency Communication System

- A system for the protection of life, by indicating the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action 3.3.97*:

Terminology

- ECS – Emergency Communication System.
- MNS – Mass Notification System.
- LOC – Local Operating Console.
- ACU – Autonomous Control Unit.
- UFC – Unified Facilities Criteria.
- DOD – Department of Defense.



NFPA 72 - 2010

- National Fire and Signaling Code:
 - NFPA changed the name in 2010.
 - Systems used more than just fire hazards.
 - Bomb threats, active shooters, chemical.
(ECS messages can be higher than fire.)

Risk Analysis

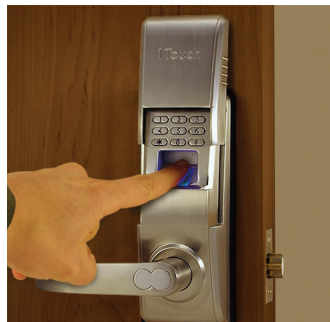
- To be designed for each facility.
- Basis for emergency response plan.
- Consider fire and non-fire emergencies.
- NFPA 72 2010, New Chapter 24.
- Emergency Communications Systems (ECS).

Stakeholders

- Any individual, group, or organization that might affect, be affected by, or perceive itself to be affected by the risk 3.3.295:
 - Building owner.
 - Insurance company.
 - AHJ.
 - Fire alarm technician.
 - Lawyers.

In-Building Fire Emergency Voice/Alarm Communications System (EVACS)

- Dedicated manual or automatic equipment for originating and distributing voice instructions as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building 3.3.97.1.2.
- Controls shall be located or secured to allow access only by trained and authorized personnel 24.4.5.2.
- Requires 24 hours standby time.
- Requires 15 minutes in alarm condition.



1



In-Building Fire Emergency Microphone

- Used to broadcast live messages.
- Will override a recorded message.

Notification Appliances

- The fire portion of the lens strobe is clear and marked FIRE, however the ECS strobe can be a different color, depending on the application. Example: Blue, Green, or Amber.



1

Outdoor Speakers

- Giant loud speakers:
 - Used with ECS systems.
 - Used in schools, stadiums.
 - Notify people of situations.



2

Q: What does the acronym ECS stand for?

A: Emergency Communication Systems

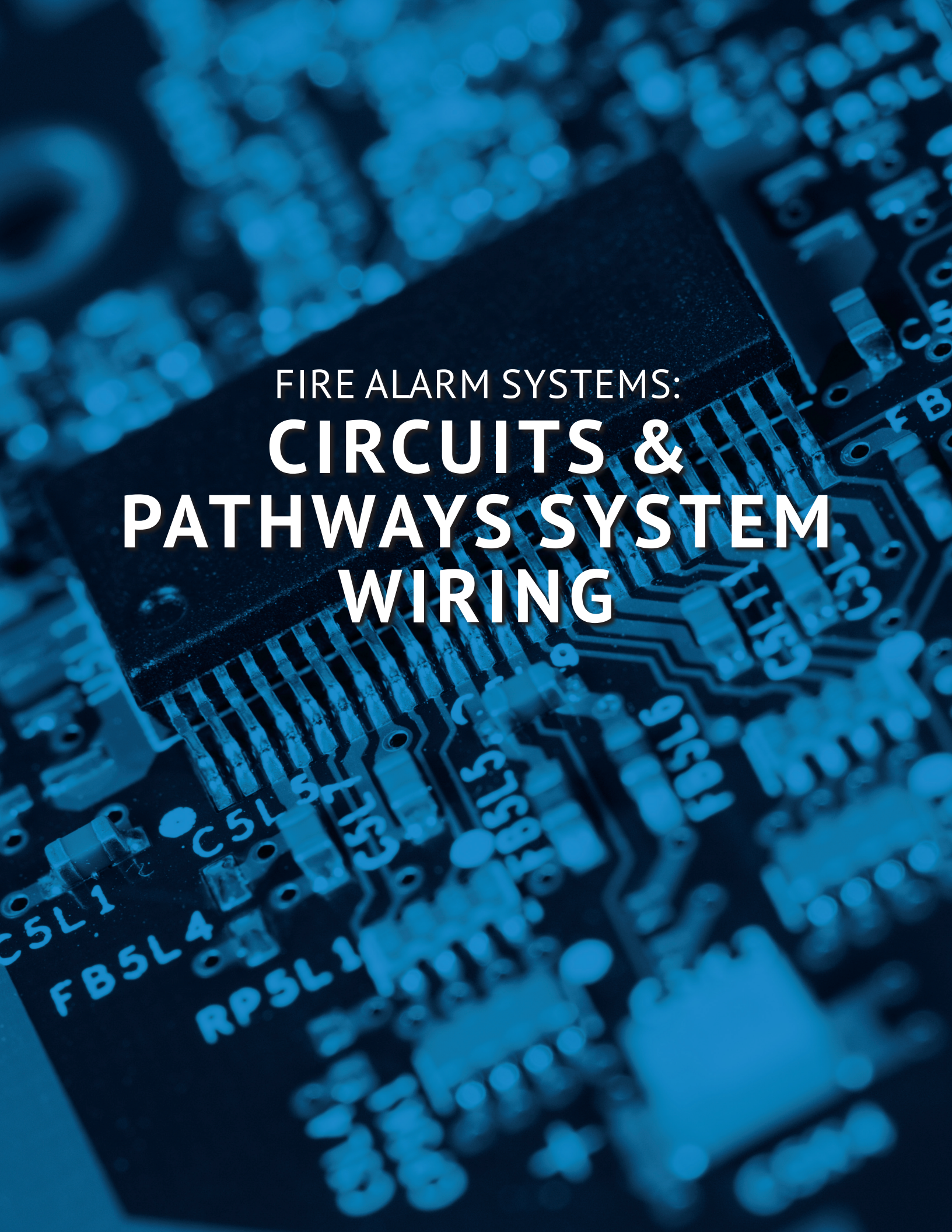
Q: What new chapter did NFPA 72 add for ECS in the 2010 Edition?

A: Chapter 24

Q: True/False: ECS messages can be higher alert priority than fire, depending on the risk analysis?

A: True

KNOWLEDGE CHECK



FIRE ALARM SYSTEMS:
**CIRCUITS &
PATHWAYS SYSTEM
WIRING**

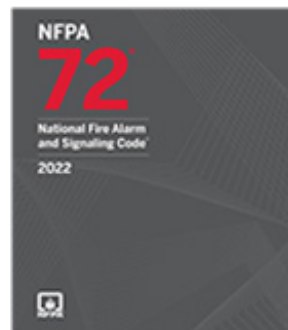
Fire Alarm Circuits and Pathways

NFPA 72 2022, Chapter 12.3 *Pathway Class Designations*. The AHJ or system designer determines the class based on site-specific design for the conditions.

- Pathways shall be designated based on the performance characteristics:
 - Class A.
 - Class B.
 - Class C.
 - Class D.
 - Class E.
 - Class X.

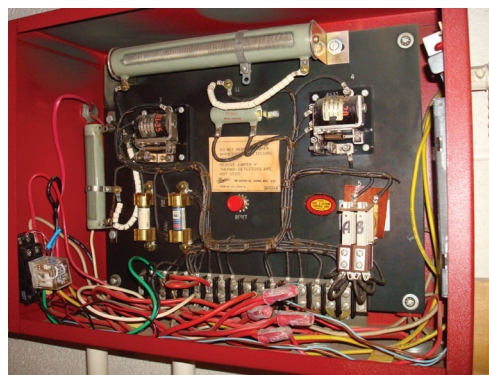
- Class A and Class B are typical for fire alarm systems.
- Class C would be communication circuits that “poll”.
- Class D would be fail-safe circuits, like door holders.
- Class E does not require supervision.
- Class N would be modern networks.
- Class X is the new way to describe Class A Style 7.

- Most common: Class A, B, and X (Class A Style 7).
- Similarities.
 - Conditions that affect the intended operation of the path are annunciated as a trouble signal.
 - Operational capability is maintained during the application of a single ground fault.
 - A single ground fault condition shall result in the annunciation of a trouble signal.



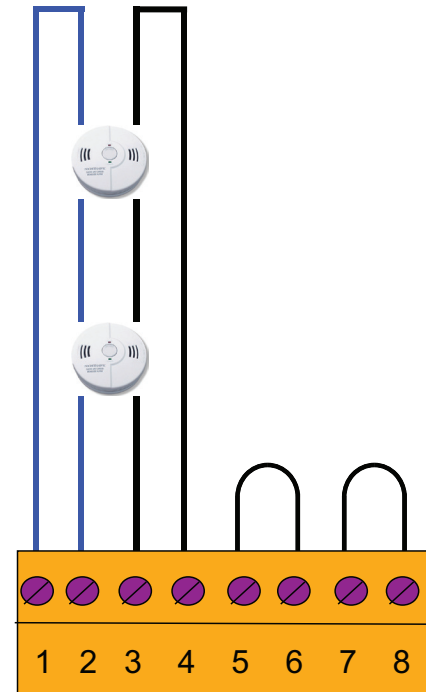
Conventional & Addressable Panel Wiring

- Initiating Device Circuit (IDC) or Signaling Line Circuit (SLC):
 - Class A.
 - Includes a redundant path.
 - Operational past a single open.
 - Class B.
 - No redundant path.
 - Operation stops at a single open.
 - Class X.
 - Class A plus, operational past a single short.



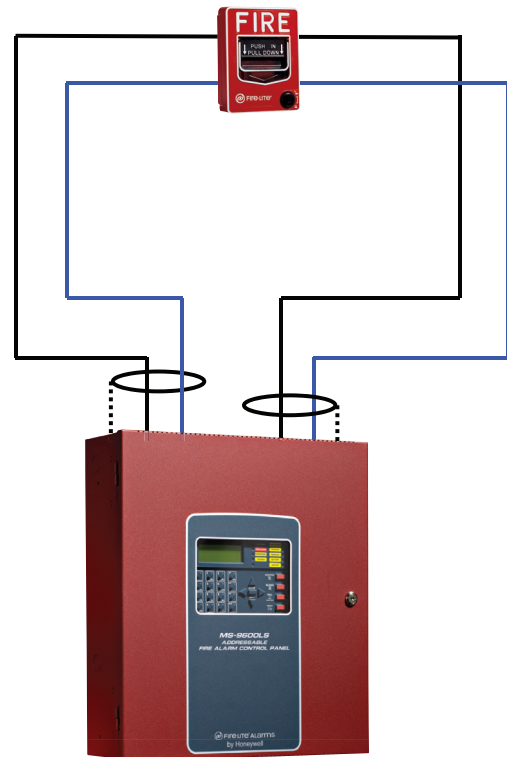
Class A Conventional Wiring

- 4-wire circuit.
- Wiring returns to the FACP.
- No T-tapping allowed.
- Devices on either side of a break can initiate an alarm.
- Unused circuits must have jumpers.



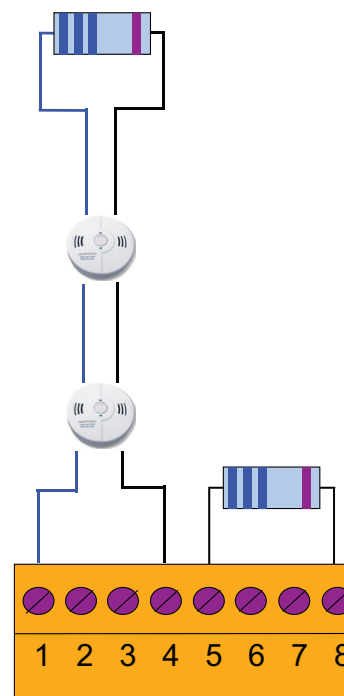
Class A Addressable Wiring

- Signaling Line Circuit:
 - 4-wire circuit.
 - No EOLR or Device.
 - T-tapping is not allowed.
 - Devices on either side of a break will activate.
 - Follow Manufacturer's recommendations.
 - Wire length.
 - Total resistance.
 - Device load.
 - Shielding.



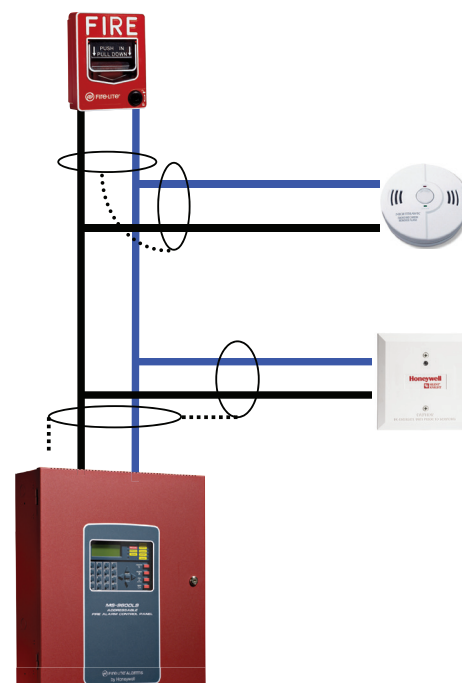
Class B Conventional Wiring

- 2-wire circuit.
- Requires EOLR.
- No T-tapping allowed.
- Devices beyond a break cannot initiate an alarm.
- Unused circuits must have EOLR.



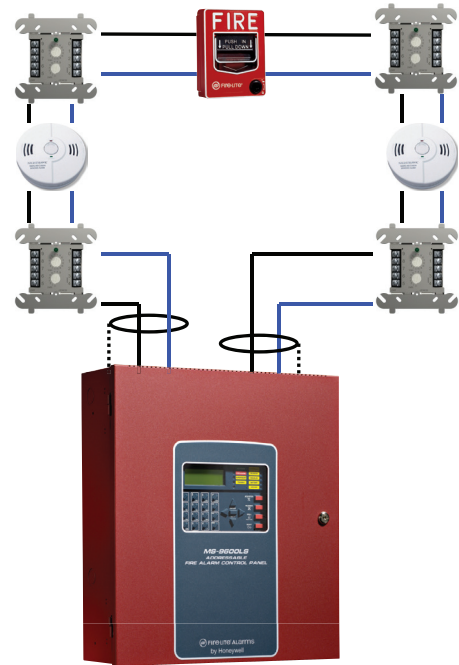
Class B Addressable Wiring

- Signaling Line Circuit:
 - 2-wire circuit.
 - Each device is powered from the SLC.
 - No EOLR required.
 - T-tapping is allowed.
 - Each device has a unique address so a location can be assigned (005 – Front Lobby).
 - Each manufacturer has its own way to address the devices.



Class X Addressable Wiring

- Class X Signaling Line Circuit:
 - Similar to Class A.
 - Each section of devices is protected from short circuits by isolators.
 - Follow manufacturer's recommendations.
 - Wire length.
 - Total resistance.
 - Device load.
 - Shielding.



Isolator Module

Isolator modules are mostly used on a SLC to prevent the entire fire alarm system from going into a complete failure. You must use the correct manufacture ISO to work correctly.

- Works like an automatic switch:
 - Opens upon a short.
 - Opens if voltage drops on the SLC.
 - Every device can be protected.
 - Protects SLC from total failure.
 - Follow manufacturer's recommendations.

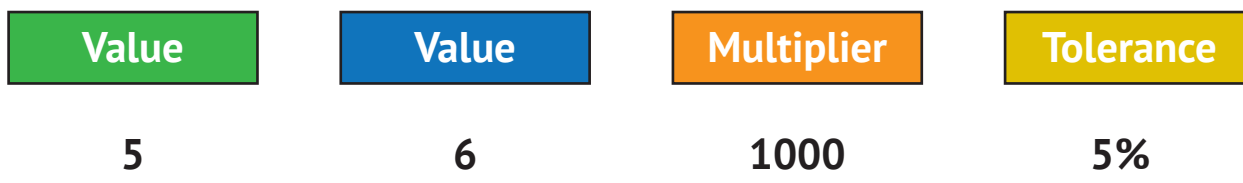
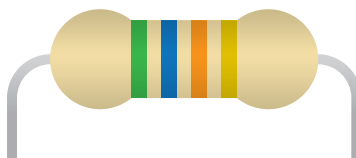


4-Band Resistor

- Band Values:
 - 1st Digit 0–9.
 - 2nd Digit 0–9.
 - 3rd Multiplier.
 - 4th Tolerance.

	1	2	3	4
BLACK		0	NO ZEROS	
BROWN	1	1	0	1
RED	2	2	00	2
ORANGE	3	3	000	
YELLOW	4	4	0000	
GREEN	5	5	00000	5
BLUE	6	6	000000	6
VIOLET	7	7		7
GRAY	8	8		
WHITE	9	9		
GOLD			x.1	±5%
SILVER			x.01	±10%
	VALUE	VALUE	MULTIPLIER	TOLERANCE

56000 ohm value or 56 K



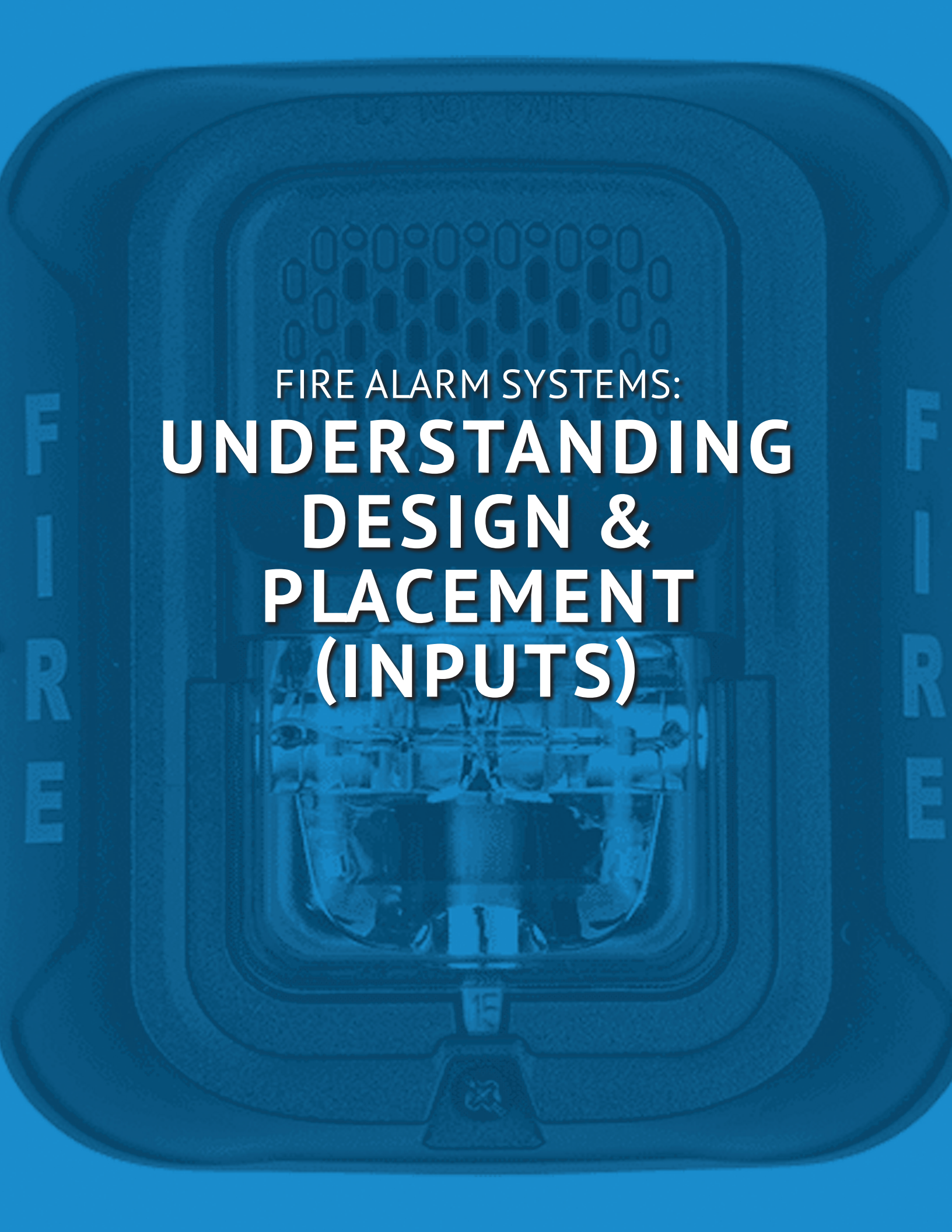
Q: Name 3 common classes of wiring used on a fire alarm system.

A: Class A, B, & X

Q: Which class of wiring has a redundant path and returns to the panel in a different conduit?

A: Class A & X

KNOWLEDGE CHECK



FIRE ALARM SYSTEMS:
**UNDERSTANDING
DESIGN &
PLACEMENT
(INPUTS)**

System Designer

- Plans and specifications shall be developed in accordance with this code by persons who are experienced in the design, application, installation, and testing of the systems 10.5.1.1.

Modes of Operation

- Private Operating Mode.
 - Audible or visual signaling only to those persons directly concerned with the implementation and direction of emergency action initiation and procedure in the area protected by the fire alarm system 3.3.201.1.
- Public Operating Mode.
 - Audible or visual signaling to occupants or inhabitants of the area protected by the fire alarm system 3.3.201.2.



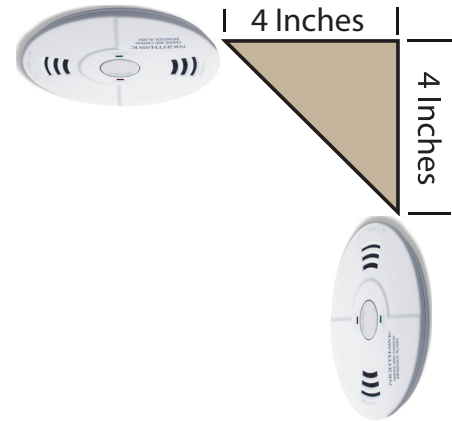
Smoke Detector Placement

If the specifications call for total coverage, NFPA calls for smoke detection in any area that might contain or used to store combustible materials. Some exceptions to this are called out in NFPA 72 2022.

- Total (complete) Coverage.
 - Where required by other governing laws, codes, or standards, and unless otherwise modified by 17.5.3.1.1 through 17.5.3.1.5, total coverage of a building or a portion thereof, shall include all rooms, halls, storage areas, basements, attics, lofts, spaces above suspended ceilings, and other subdivisions and accessible spaces 17.5.3.1.
- Partial or Selective Coverage.
 - Where other governing laws, codes, or standards require the protection of selected areas only, the specified areas shall be protected in accordance with this Code 17.5.3.2.

Smoke Detector Placement (Cont.)

- Detectors shall not be installed less than 4" from a corner.
- Wall mounted detectors shall not be less than 12" from the ceiling.



Smoke Detector Placement – High Ceilings

- Considerations:
 - Accessibility for maintenance and testing.
 - Stratification – smoke stops rising when it reaches the temperature of the surrounding air.
 - Dissipation – smoke can dissipate before it reaches the detector.

Projected Beam Placement

- Generally installed with the beam parallel to the ceiling.
(Spacing as per manufacturer's recommendations.)
- May be installed below the ceiling level to overcome the stratification.
- May be installed vertically or at angles needed for protection.
(Air shaft, stairwell, ramp walkways, and corridors.)



Duct Detector Placement

- Installed in straight areas between 6 and 10 duct widths from any return, bends, or connections.
- May be mounted on supply or return ducts.
- When the duct detector is not visible, a remote alarm or supervisory indication shall be provided.



RTS151KEY Placement

- Remotely test and reset duct detectors from an accessible location.
- 2-wire duct detectors the LED is only red.
- 4-wire duct detectors the LED is a multi-color green and red that alternates (red LED means alarm, green LED indicates power).

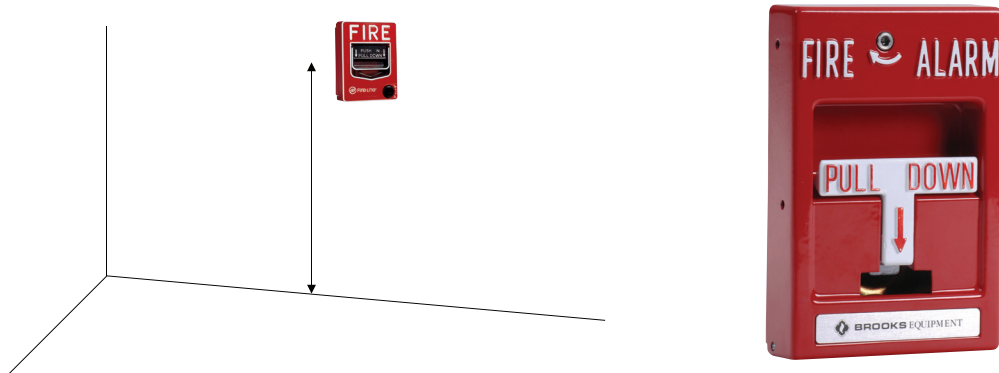


Heat Detector Placement

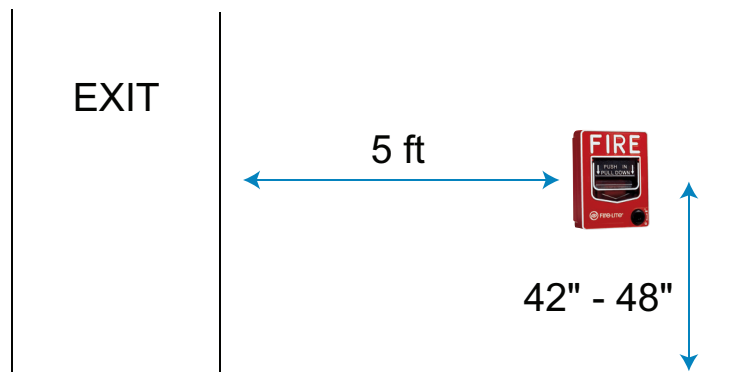
- On a smooth ceiling, the distance between detectors shall not exceed the listed spacing, and there shall be detectors within $\frac{1}{2}$ of the listed spacing from all walls and partitions.
- All points shall have a detector within a distance equal to 70% of the listed spacing.
- Detectors on irregular shaped ceilings may be spaced greater than the listed spacing, provided all points on the ceiling are within 70% of the detectors rated spacing

Manual Fire Alarm Box Placement

- The operable part of a manually actuated alarm-initiating device shall be not less than 42 in (1.07 m) and not more than 48 in (1.22 m) from the finished floor 17.15.6.



- Manual fire alarm boxes shall be installed so that they are conspicuous, unobstructed, and accessible. 17.15.9.2.
- Manual fire alarm boxes shall be located within 5 ft (1.5 m) of each exit doorway on each floor 17.15.9.4.
- Additional manual fire alarm boxes shall be provided so that the travel distance to the nearest manual fire alarm box will not exceed 200 ft (61 m), measured horizontally on the same floor 17.15.9.5.
- Manual fire alarm boxes shall be mounted on both sides of grouped opening over 40 ft (12.2 m) in width and within 5 ft (1.5 m) of each side of the grouped opening 17.15.9.6.



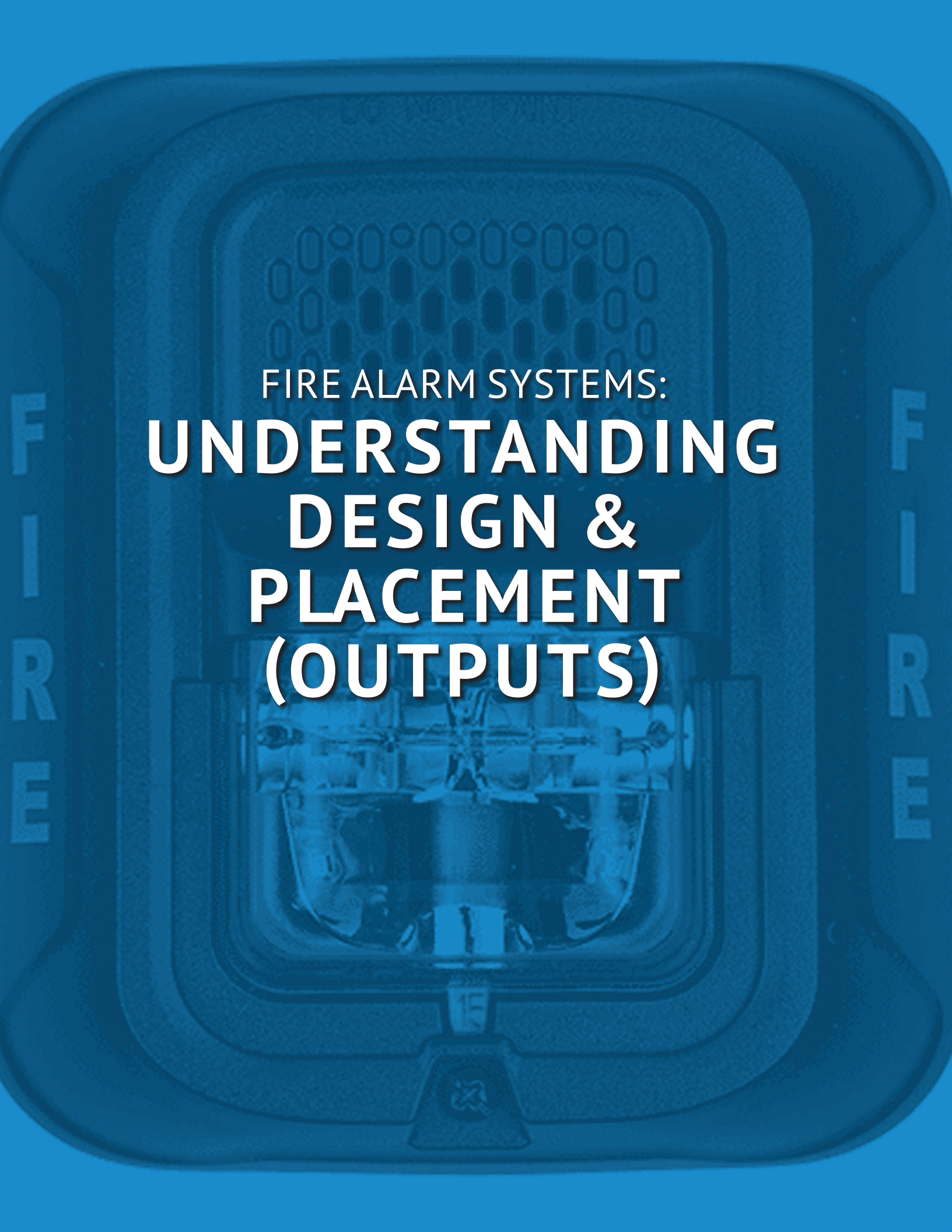
Q: What are the two different modes of operation for fire alarm monitoring?

A: Private and Public

Q: What device would you use in place of smoke detectors in a high ceiling?

A: Beam Detector

KNOWLEDGE CHECK



FIRE ALARM SYSTEMS:
**UNDERSTANDING
DESIGN &
PLACEMENT
(OUTPUTS)**

Audible Requirements

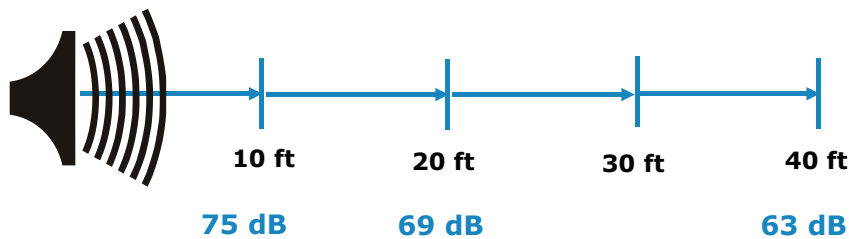
- Public Mode:
 - 15 dB above average ambient sound level or 5 dB above maximum.
- Private Mode:
 - 10 dB above average ambient sound level or 5 dB above maximum.

Ambient Sound

- Ambient sound level (dB):
 - Background noise, existing or present on all sides.
- Decibel (dBA):
 - A unit for expressing the relative intensity of sounds.
 - 1 dBA – Faintest audible sound.
 - 60 dBA – Typical conversation.
 - 80 dBA – Alarm clock.
 - 130 dBA – Painful (Possible damage).

Audible Notification Appliances

- The Sound Pressure Level drops 6 dB each time the distance from the source is doubled.



NFPA 72(2022)Table A.18.4.4

This table is an example of what the noise level would be in these situations. Should always use a dB meter to make sure you are within code.

Business Occupancies	54 dBA
Educational Occupancies	45 dBA
Industrial Occupancies	88 dBA
Institutional Occupancies	50 dBA
Mercantile Occupancies	40 dBA
Mechanical Rooms	91 dBA
Piers and Water-Surrounded Structures	40 dBA
Places of Assembly	60 dBA
Residential Occupancies	35 dBA
Storage Occupancies	30 dBA
Thoroughfares, High Density Urban	70 dBA
Thoroughfares, Medium Density Urban	55 dBA
Thoroughfares, Rural and Suburban	40 dBA
Tower Occupancies	35 dBA
Underground Structures and Windowless Buildings	40 dBA
Vehicles and Vessels	50 dBA

Notification Appliance Placement

- A fire alarm system component, such as a bell, horn, loudspeaker, visual notification appliance, or text display that provides audible, tactile, or visual outputs or any combination thereof 3.3.189.
- Notification appliances used for signaling other than fire shall not have the word FIRE or any fire symbol in any form (i.e., stamped, imprinted, etc.) on the appliance visible to the public 18.3.3.2*



Audible Notification Appliance Placement

- If ceiling heights allow, and unless permitted by 18.4.9.2 through 18.4.9.5, wall-mounted appliances shall have their tops above the finished floor at heights of not less than 90 in (2.29 m) and below the finished ceilings at distances of not less than 6 in (150 mm) 18.4.9.1.

Distinctive Signals

- New in NFPA 72 (2022 Edition) states that alarm audible signal pattern shall be used to do a total or partial evacuation or a relocation 18.4.2.
- When you hear the Temporal 3 tone, if not instructed to do otherwise, leave the building immediately.



Directional Sounders Placement

- Sounders are installed at exit doors.
- Directional sounders have shown evacuation times improved by 75%.
- By emitting a burst of white noise and tones draws the occupant to an exit door.
- Directional sounders can be used with emergency communication systems to play messages directing occupants to an exterior exit.



Sleeping Areas

- 15 dBA above ambient.
- Measured at the pillow.
- Low Frequency.
(520 Hz.)



520 Hz Sounders

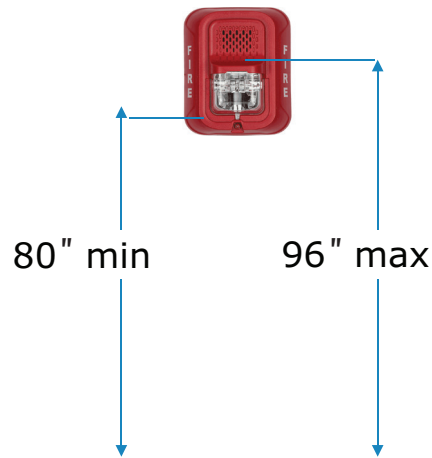
- Effective January 1, 2014.
- NFPA 720 requires low-frequency signaling in new or renovated sleeping area, such as dormitories, multi-family dwellings, hotels, and other properties.
- New to fire alarm systems.
- Designed to support NFPA for sleeping areas.
- Can be used for CO detection.
- Low frequency.
(520 Hz, square wave.)

¹PF24V Directional Sounder, https://www.anixter.com/en_us/products/PF24V/SYSTEM-SENSOR/Fire-Notification/p/674374#, 2019.

²HR-LF Sounder, Low Frequency, https://www.anixter.com/en_us/products/HR-LF/SYSTEM-SENSOR/Fire-Notification/p/674243, 2019.

Visual Notification Appliance Placement

- An average ambient sound level greater than 105 dBA shall require the use of visual notification appliance(s) in accordance with Section 18.5, where the application is public mode or Section 18.6, where the application is private mode 18.4.1.1.
- Wall-mounted appliances shall be mounted such that the entire lens is not less than 80 in (2.03 m) and not greater than 96 in (2.44 m) above the finished floor or at the mounting height specified using the performance-based, alternative of 18.5.5.7 (18.5.5.1).
- Strobes above the finished floor (over 30 feet) are not effective.



Room Spacing for Wall and Ceiling Visual Notification Appliance

Table 18.5.5.7.1(a) Room Spacing for Wall-Mounted Visual Notification Appliances

Maximum Room Size		Minimum Required Light Output [Effective Intensity (cd)]	
		One Visual Notification Appliance per Room	Four Visual Notification Appliances per Room (One per Wall)
ft	m		
20 × 20	6.10 × 6.10	15	NA
28 × 28	8.53 × 8.53	30	NA
30 × 30	9.14 × 9.14	34	NA
40 × 40	12.2 × 12.2	60	15
45 × 45	13.7 × 13.7	75	19
50 × 50	15.2 × 15.2	94	30
54 × 54	16.5 × 16.5	110	30
55 × 55	16.8 × 16.8	115	30
60 × 60	18.3 × 18.3	135	30
63 × 63	19.2 × 19.2	150	37
68 × 68	20.7 × 20.7	177	43
70 × 70	21.3 × 21.3	184	60
80 × 80	24.4 × 24.4	240	60
90 × 90	27.4 × 27.4	304	95
100 × 100	30.5 × 30.5	375	95
110 × 110	33.5 × 33.5	455	135
120 × 120	36.6 × 36.6	540	135
130 × 130	39.6 × 39.6	635	185

NA: Not allowable.

1

Table 18.5.5.7.1(b) Room Spacing for Ceiling-Mounted Visual Notification Appliances

Maximum Room Size		Maximum Lens Height*		Minimum Required Light Output (Effective Intensity); One Visual Notification Appliance (cd)
ft	m	ft	m	
20 × 20	6.1 × 6.1	10	3.0	15
30 × 30	9.1 × 9.1	10	3.0	30
40 × 40	12.2 × 12.2	10	3.0	60
44 × 44	13.4 × 13.4	10	3.0	75
20 × 20	6.1 × 6.1	20	6.1	30
30 × 30	9.1 × 9.1	20	6.1	45
44 × 44	13.4 × 13.4	20	6.1	75
46 × 46	14.0 × 14.0	20	6.1	80
20 × 20	6.1 × 6.1	30	9.1	55
30 × 30	9.1 × 9.1	30	9.1	75
50 × 50	15.2 × 15.2	30	9.1	95
53 × 53	16.2 × 16.2	30	9.1	110
55 × 55	16.8 × 16.8	30	9.1	115
59 × 59	18.0 × 18.0	30	9.1	135
63 × 63	19.2 × 19.2	30	9.1	150
68 × 68	20.7 × 20.7	30	9.1	177
70 × 70	21.3 × 21.3	30	9.1	185

*This does not preclude mounting lens at lower heights.

2

Q: What percent of evacuation increased by using Directional Sounders?

A: 75%

Q: What is the maximum distance a manual pull box can be mounted from an exit?

A: 5'

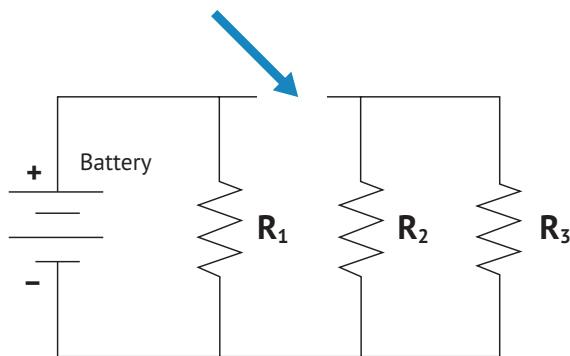
KNOWLEDGE CHECK

FIRE ALARM SYSTEMS:
CIRCUITS & POWER

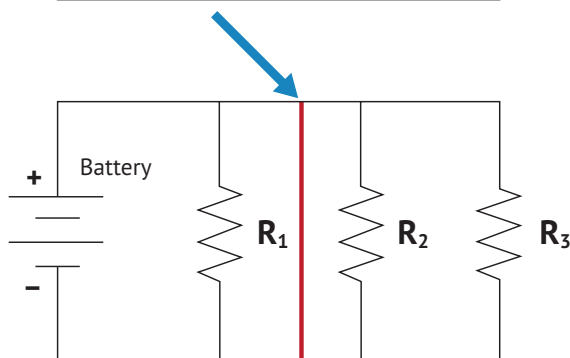


Open vs. Short Circuits

Open



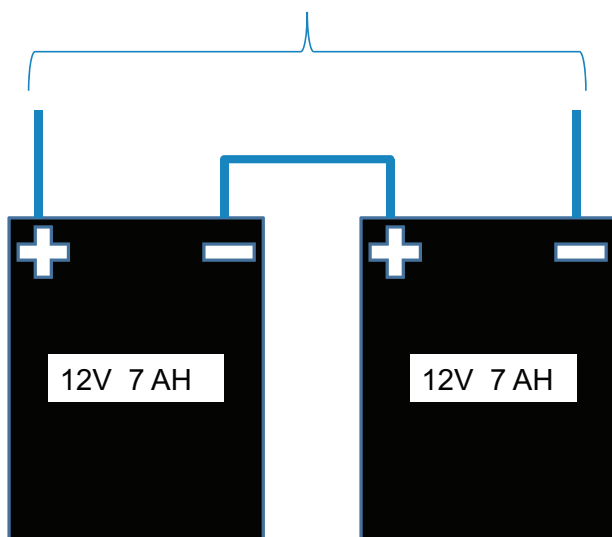
Short



Series Connection

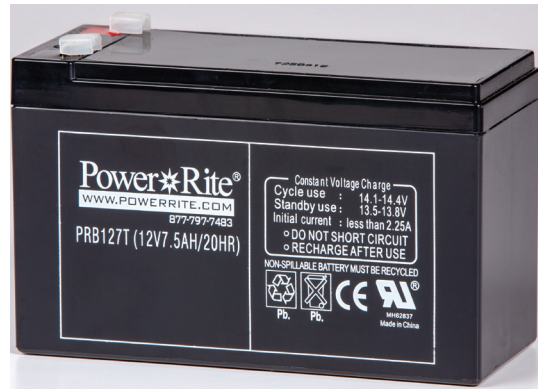
Connecting batteries in series, the voltage is doubled, same AH – Example 24 VDC and 7 AH.

24 V 7 AH



Battery Calculations

- Standby Load:
 - Total non-alarm current.
 - Includes the FACP and all peripherals.
 - Multiplied by 24 hours.
- Alarm Load:
 - The total FACP output in alarm.
 - Multiplied by 5 minutes (.083 hrs).
- 20% Safety Margin.
- Date Code:
 - 10.6.10.1.1 Batteries shall be marked with the month and year of manufacture using the month/year format NFPA 72 2022.
- Most manufactures have there own prefilled battery calculation forms:
 - Includes the FACP and all peripherals.
 - Less complicated for the technician.
 - Can be printed out and filed on site.



Power Supplies

- 24 VDC, 6 A supply.
- 4 Class B circuits.
- 1.5 A/NAC.
- Horn/strobe = .25 A.
- 6 devices/circuit.



Q: What kind of circuit will disconnect your devices?

A: Open

Q: If the fire alarm panel is maxed out for power, what would you add for extra power?

A: Power Supply

KNOWLEDGE CHECK

A hand is shown turning a fire alarm pull station handle on a control panel. The panel features several circular buttons and a square switch. The entire image is overlaid with a blue tint. The text "FIRE ALARM COMMUNICATIONS" is centered in white, bold, sans-serif font.

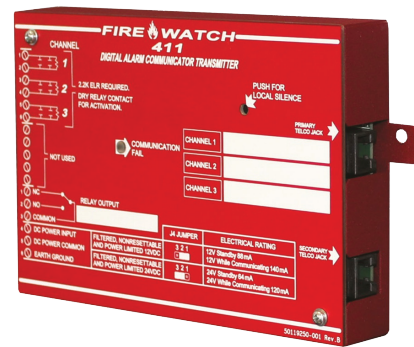
FIRE ALARM COMMUNICATIONS

Common Paths to Central Station

- DACT (Digital Alarm Communicator Transmitter).
- IP communicator.
- IP-GSM-4G.

Digital Communications

- Digital Alarm Communicator Transmitter (DACT):
 - Often referred to as dialers or communicators.
 - Requires 2 POTs lines (copper).
 - Requires a RJ31X jack (proper line seizure).
 - Must report every 24 hours.
 - The monitoring station must have a DACR (Digital Alarm Communicators Receiver).
- NFPA 72 2022, 26.6.4.2.4, Transmission Channels:
 - A system employing a DACT shall employ one telephone line (number). In addition, one of the following.
 - One-way private radio alarm system.
 - Two-way RF multiplex system.
 - Transmission means complying with 26.6.3 (new technology).
 - Must be received at Central Station within 90 seconds.
 - NFPA 72 2022, AHJ must approve 2nd phone line.
 - Must report test signal every 6 hours (New), 2 phone lines.
 - Report trouble at premises, if failure within 4 minutes.
 - Number of attempts is 10 (before system goes into trouble).



1



2

New Communications

- IP Communicator:
 - Single path.
 - Signal travels through the internet.
 - Uses contact ID format.
 - Central station must have a compatible receiver.
- IPGSM-4G:
 - Primary reporting path – Internet.
 - Back-up reporting path – GSM cellular.
 - Transmits through a service first.
 - Reports loss of AC and low battery.
 - Reports contact ID.

Central Station

- Central Station Monitoring Software:
 - Signal received by the site receiver.
 - Translated to software installed at the central station.
 - Information then displayed on an operators screen.
 - Proper action taken.
 - Calling the owner to verify (If requested).
 - Calling emergency services.



Q: Name 3 types of communication methods used to send signals to the Central Station?

A: DACT, IP Communicator, and IPGSM-4G

Q: True/False: According to 2013 NFPA 72 code, does the AHJ has to approve a 2nd phone line.

A: True

Q: What is required at the Central Station to receive signals?

A: DACR

KNOWLEDGE CHECK

CARBON MONOXIDE

A close-up photograph of a gas stove burner with blue flames, overlaid with a blue tint and the text 'CARBON MONOXIDE'. The image is a close-up of a gas stove burner with blue flames. The entire image has a blue tint. The text 'CARBON MONOXIDE' is centered in the upper half of the image in a white, bold, sans-serif font.

Carbon Monoxide

Carbon Monoxide (CO) is a odorless, colorless, and tasteless toxic gas that is produced by the incomplete burning of various fuels, such as:

- Propane.
- Wood.
- Charcoal.
- Natural Gas.
- Coal.

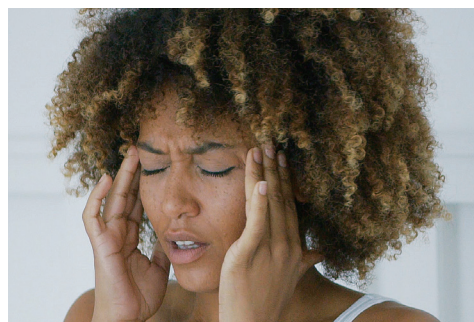
NFPA 72 2022 expanded to cover carbon monoxide equipment:

- Chapter 14: Installation, Testing, and Maintenance.
- Chapter 17: Initiating Devices.
- Chapter 29: Carbon Monoxide Alarms.
- Annex H: Provides explanatory information on carbon monoxide.
- NFPA 720 has been withdrawn and is no longer updated (last edition was 2015).

Symptoms of CO Poisoning

Low to moderate carbon monoxide poisoning

- Headache.
- Fatigue.
- Nausea.
- Dizziness.
- Similar to the flu but no fever.



High-level carbon monoxide poisoning

- Mental confusion.
- Vomiting.
- Loss of muscular coordination.
- Loss of consciousness.
- Death.



Causes of CO Poisoning

These are just a few examples – there are many sources of CO poisoning:

- Furnace (heating systems).
- Portable generators.
- Barbecues.
- Heaters.
- Gas ranges.



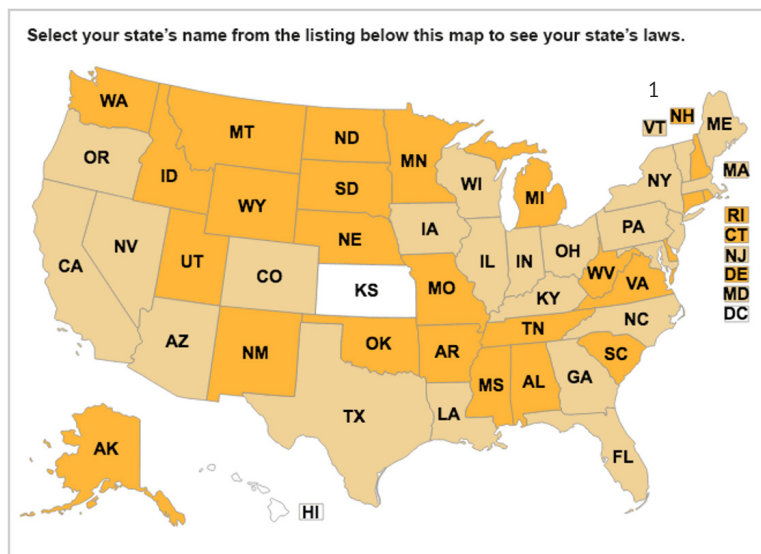
*Shutterstock

The Silent Killer

This “invisible killer” is produced by burning fuel in cars or trucks, small engines, stoves, lanterns, grills, fireplaces, gas ranges, portable generators, or furnaces. When the gas builds up in enclosed spaces, people or animals who breathe it can be poisoned. Ventilation does not guarantee safety.

U.S. Statistics

More than 400 people die each year from carbon monoxide poisoning. More than 20,000 visit the hospital and 4000 are hospitalized¹.



2

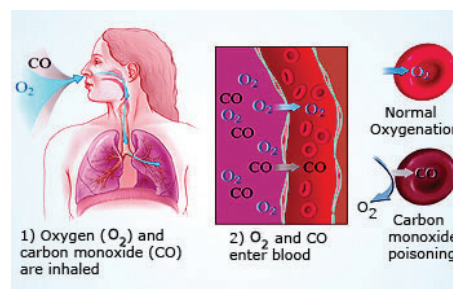
*Shutterstock, <https://www.shutterstock.com/image-photo/blue-flames-on-gas-stove-burner-643710484>.

¹CDC, Carbon Monoxide Poisoning – Frequently Asked Questions, retrieved from <https://www.cdc.gov/co/faqs.htm> on December 12, 2022.

²Kidde, Carbon Monoxide Laws, retrieved from <https://www.kidde.com/home-safety/en/us/co-safety/carbon-monoxide-laws/> February 16, 2023.

How CO Affects The Body¹

Carbon monoxide affects healthy as well as unhealthy people. Increased levels of carbon monoxide reduce the amount of oxygen carried by hemoglobin around the body in red blood cells. The result is that vital organs, such as the brain, nervous tissues, and the heart do not receive enough oxygen to function properly.



- The two factors that determine the severity of CO poisoning is the level of carbon monoxide (measured in ppm) and the time exposed.

Measuring CO

- CO is measured in parts per million (ppm).
- Normal 1-70 ppm – No symptoms.
- Low 71-150 ppm – Mild headache, shortness of breath, and mild nausea.
- Moderate 151-200 ppm – Headache, fatigue, dizziness, and nausea.
- High 200 ppm plus – Disoriented, unconsciousness, brain damage, and death.

Recovery From CO Poisoning

- Immediately move outside to fresh air.
- Call emergency services, fire department, or 911.
- Do a head count, if with others.
- DO NOT reenter the premises until first responders have given the all clear.

Weight of CO

- The weight of CO is slightly lighter than air.
- CO travels through a HVAC system or by natural forces.
- Therefore, CO detectors can be mounted on walls or ceilings.
- CO detectors should be mounted at least 10 feet away from the appliance. Follow the manufacture instructions.

CO weights 28.01 g/mol ($g = CO$) ($mol = molar\ mass$) The average molar mass of dry air is 28.97 g/mol

¹Simple Science, https://www.simply.science/images/content/chemistry/metals_and_non_metals/carbon_family/conceptmap/Carbon_Monoxide.html

CO Alarms vs Detectors

UL 2034 covers single and multiple station CO alarms intended for protection in homes, vehicles, mobile homes, and boats.

- These devices are self contained powered by AC or batteries to provide local annunciation.
- CO alarms do not need to be connected to a panel.



UL 2075 covers system type CO detectors intended for monitoring the environment.

- These devices are connected to a control panel where powered and monitored to provide local annunciation and send a signal to the monitoring station.
- CO detectors are required by UL 2075 to send an end-of-life trouble signal near the end of its useful life.

CO Alarms/Detectors

- UL 2034 and 2075:
 - No alarm at 30 ppm unless over 30 days.
 - 70 ppm: 1 to 4 hours.
 - 150 ppm: 10 to 50 minutes.
 - 400 ppm: 4 to 15 minutes.

These are the times that the device must warn you that CO is present

CO Detector Placement¹

- CO detectors should be installed in sleeping areas.
- Should be loud enough to wake you up.
- This is measured at the pillow at least 75 dB.
- Each state and/or jurisdiction has its own codes and laws.
- Check with your local AHJ.



Temporal 4

- The National code for CO detectors is Temporal 4.



Q: The Standard for the Installation of CO Detection and Warning Equipment is:

A: NFPA 720

Q: The national code for Carbon Monoxide alarms is?

A: Temporal 4

KNOWLEDGE CHECK

Glossary of Terms

- **Condition** – A situation, environmental state or equipment state of a fire alarm or signaling system.
- **Signal** – An indication of a condition communicated by electrical, visible, audible... or other means.
- **Response** – Action performed upon the receipt of a signal.
- **PoC** – Products of Combustion
- **PIV** – Post Indicator Valve
- **OS&Y** – Outside Stem and Yoke Valves
- **Cd – Candela** – Unit of luminous intensity
- **dB – Decibels** – Unit of sound intensity
- **EOLR** – End of Line Resistor
- **UL** – Underwriters Laboratories, Inc.
- **NFPA** – National Fire Protection Association.
- **NEC** – National Electrical Code (NFPA 70).
- **ANSI** – American National Standards Institute
- **ADA** – Americans with Disabilities Act



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