Fire Protection

NATIONAL FIRE PROTECTION ASSOCIATION
The leading information and knowledge resource on fire, electrical and related hazards

https://www.nfpa.org/

About NFPA - https://www.nfpa.org/About-NFPA

The National Fire Protection Association (NFPA)
Originated in 1896
Sets Guidelines for Fire Protection
OSHA also sets Standards
Fire Marshal Oversees Inspection

Our vision: We are the leading global advocate for the elimination of death, injury, property, and economic loss due to fire, electrical and related hazards.

Our mission: To help save lives and reduce loss with information, knowledge, and passion.

NFPA Codes and Standards
https://www.nfpa.org/Codes-and-Standards

List of NFPA Codes and Standards
https://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/List-of-Codes-and-Standards

Referenced Standards in Action

NFPA 10. Portable fire extinguishers are required in many occupancies by both NFPA 1 and the *IFC*. For instance, when verifying field compliance with NFPA 10, you need to ensure that the proper portable fire extinguisher has been selected and installed for the hazard it is intended to protect and is readily accessible with a sign posted to note its location.

NFPA 25. Referenced documents found in NFPA 1, NFPA *101*, and the *IFC* place the responsibility for ITM of water-based fire protection systems on the building owner. NFPA 25 establishes combinations of frequencies, actions, and reporting methods for the different systems a building may have. The building owner is obliged to produce the ITM reports upon request from the AHJ.

NFPA 70® (NEC®). The *National Electrical Code®* is referenced by all of the building and fire codes in the United States. While the *NEC* contains many design and layout requirements for the electrical systems, it also contains requirements that relate to the quality of the installation. You must make sure that the installation itself is done in a neat and workmanlike manner that meets the level of quality required by the *NEC*.

NFPA 285. If you intend to apply an exterior wall system comprised of a metal composite material (MCM), you need to know the extent that compliance with NFPA 285 is required by Chapter 14 of the *IBC*.

Commonly Referenced Codes and Standards

NFPA 13, *Installation of Sprinkler Systems*

NFPA 13R, *Installation of Sprinkler Systems in Low-Rise Residential Occupancies*

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 72®, *National Fire Alarm and Signaling Code®*

NFPA 80, *Fire Doors and Other Opening Protectives*

NFPA 90A, *Installation of Air-Conditioning and Ventilating Systems*

NFPA 92, *Smoke Control Systems*

NFPA 96, *Ventilation Control and Fire Protection of Commercial Cooking Operations*

NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*

NFPA 72 – National Fire Alarm and Signaling Code

NFPA 72 provides the latest safety provisions to meet society's changing fire detection, signaling, and emergency communications demands. In addition to the core focus on fire alarm systems, the Code includes requirements for mass notification systems used for weather emergencies; terrorist events; biological, chemical, and nuclear emergencies; and other threats.

Classification of Fires

FIRE	FUEL	NOTES
Class A 	• Ordinary combustibles, such as: ◦ Paper ◦ Cloth ◦ Wood ◦ Rubber	These fuels leave ash after they burn up.
Class B 	• Flammable liquids, such as oil and gasoline • Combustible liquids, such as charcoal lighter fluid and kerosene	These fuels burn only at the surface because oxygen can't penetrate the depth of the fluid. Only the vapor burns when ignited.
Class C 	• Electrical equipment, such as wiring and motors	When the electricity is turned off and is no longer feeding the fire, the fire becomes a Class A or B fire, depending on the type of fuel.
Class D 	• Combustible metals, such as: ◦ Aluminum ◦ Magnesium ◦ Titanium ◦ Potassium ◦ Zirconium	Class D fires are not normally found in residential areas.
Class K 	• Cooking oils (vegetable or animal) • Fats used in cooking appliances	Class K fires are technically flammable liquid/gas fires (Class B), but because of their special characteristics, they are placed in a separate class. Class K can occur in commercial food preparation locations, such as restaurant kitchens, where large quantities of cooking oils are used.

Building Types:

A – Assembly: Auditoriums, Theaters
B – Business: Office, Retail, Restaurants
E – Educational: Schools
F – Factories
H – Hazardous Uses
I – Institutional: Hospitals, Nursing Homes
R – Residential: Apartments, Hotels

Life Safety Design

- Detect Danger
- Warn the building occupants
- Provide safe egress
- Control the fire
- Eliminate the fire
- Assist firefighters

What does it take for a fire to burn? Three elements:

1. **Fuel**, or material to be burned, which may be a liquid, a solid, or a gas
2. **Heat** that raises the temperature of the fuel to its ignition point
3. **Oxygen**: In an atmosphere of less than 20% oxygen, most fuels can be heated until they entirely vaporize, without burning.

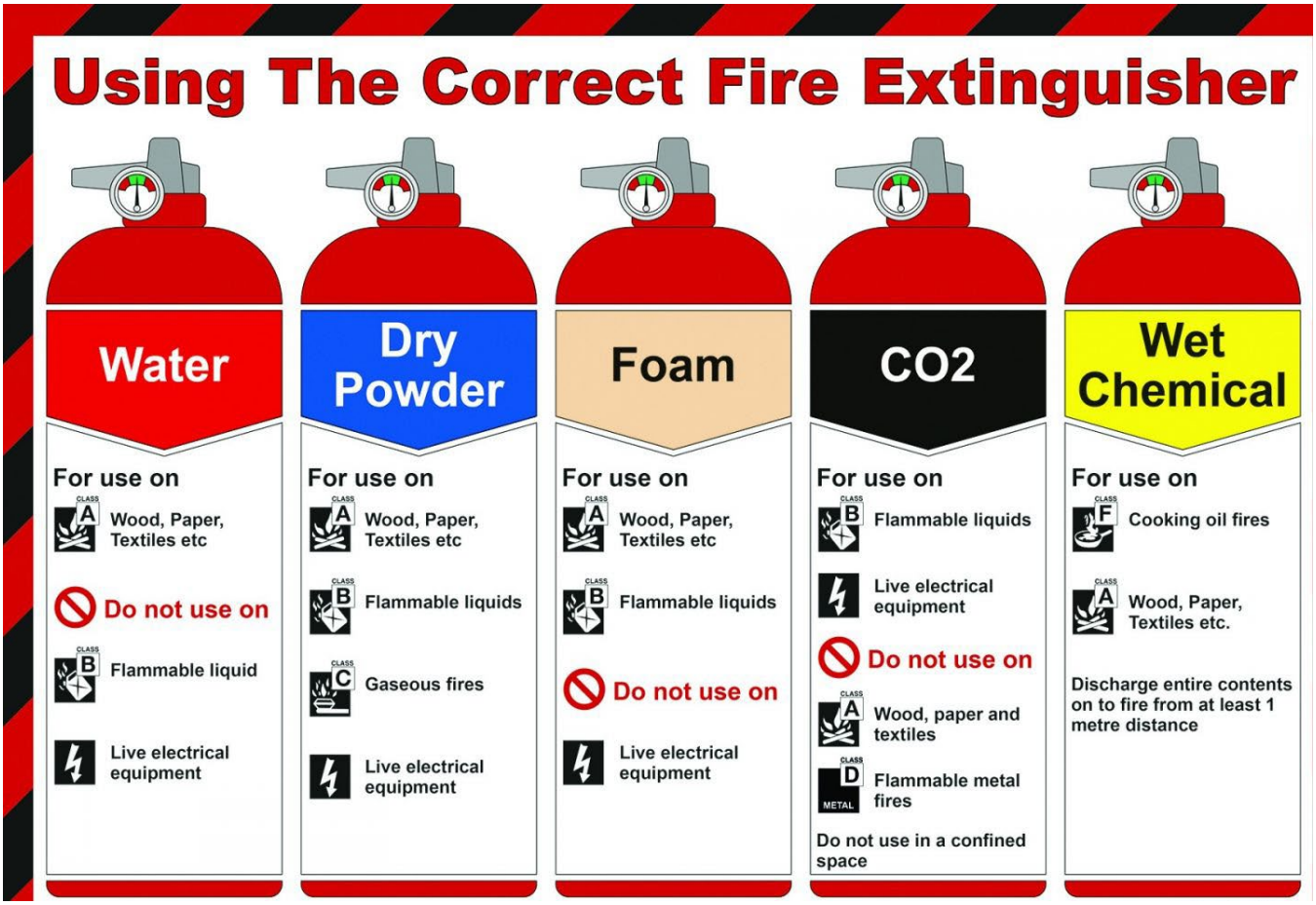
Firefighting Resources

One important reason for identifying the fire classification is to select the most effective means of suppressing the fire.

Four types of firefighting resources are available:

1. Portable fire extinguishers
2. Interior wet standpipes
3. Confinement
4. Creative resources

1. Portable Fire Extinguishers



2. Interior wet standpipes

- Typically found in commercial and apartment buildings.
- Usually consist of 100 feet of 1-inch jacketed hose with a nozzle tip
- Deliver up to 125 gallons of water per minute
- Should be used by three-person teams (one person to handle the hose, one to bleed air from the line, and one to control water pressure)

Interior Dry Standpipe

- Firefighters must connect a water source to the fire department connection

3. Confinement
   - Confining an interior fire by closing doors to rooms and hallways may help restrict the spread of smoke and heat, and it limits the amount of oxygen available to the fire.

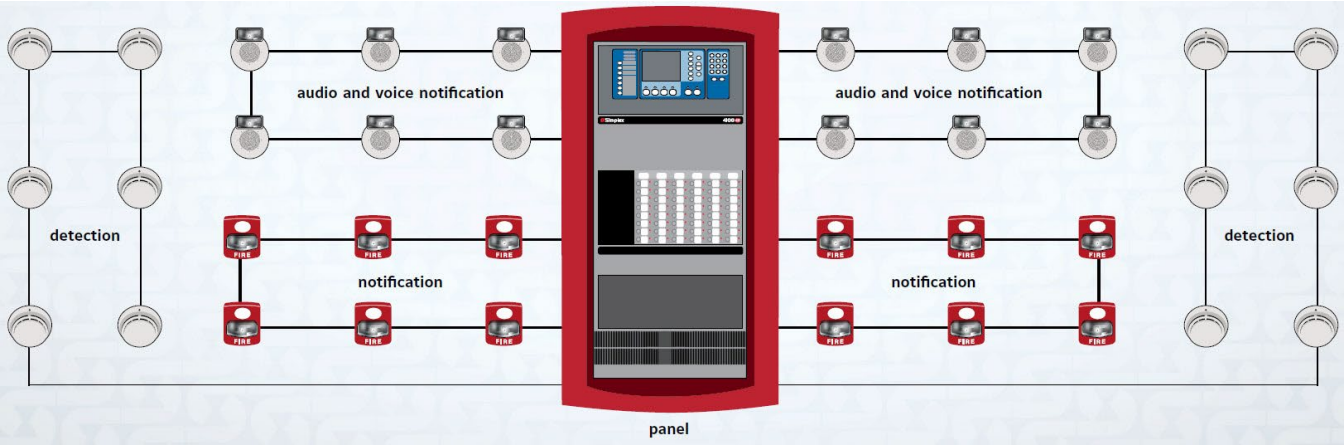
4. Creative Resources
   - In certain circumstances you can make use of resources on hand to fight fires. Such as:
     - Swimming pool or spa water and buckets
     - Sand or dirt and shovels
     - A garden hose

Main Functions of a Fire Alarm System

- Provide a means to identify an unsafe condition through automatic methods.
- Alert building occupants to an unsafe condition and the need to evacuate.
- Another common function is the transmission of an alarm notification signal to the fire department or other emergency response organization.
- Fire alarm systems may also shut down electrical, air handling equipment or special process operations, and they may be used to initiate automatic suppression systems.

Fire Alarm System Components

Fire Alarm Control Panel (FACP) – The main fire alarm system component that monitors equipment and circuits, receives input signals from initiating devices, activates notification appliances, and transmits signals off-site. Also called the Fire Alarm Control Unit (FACU).



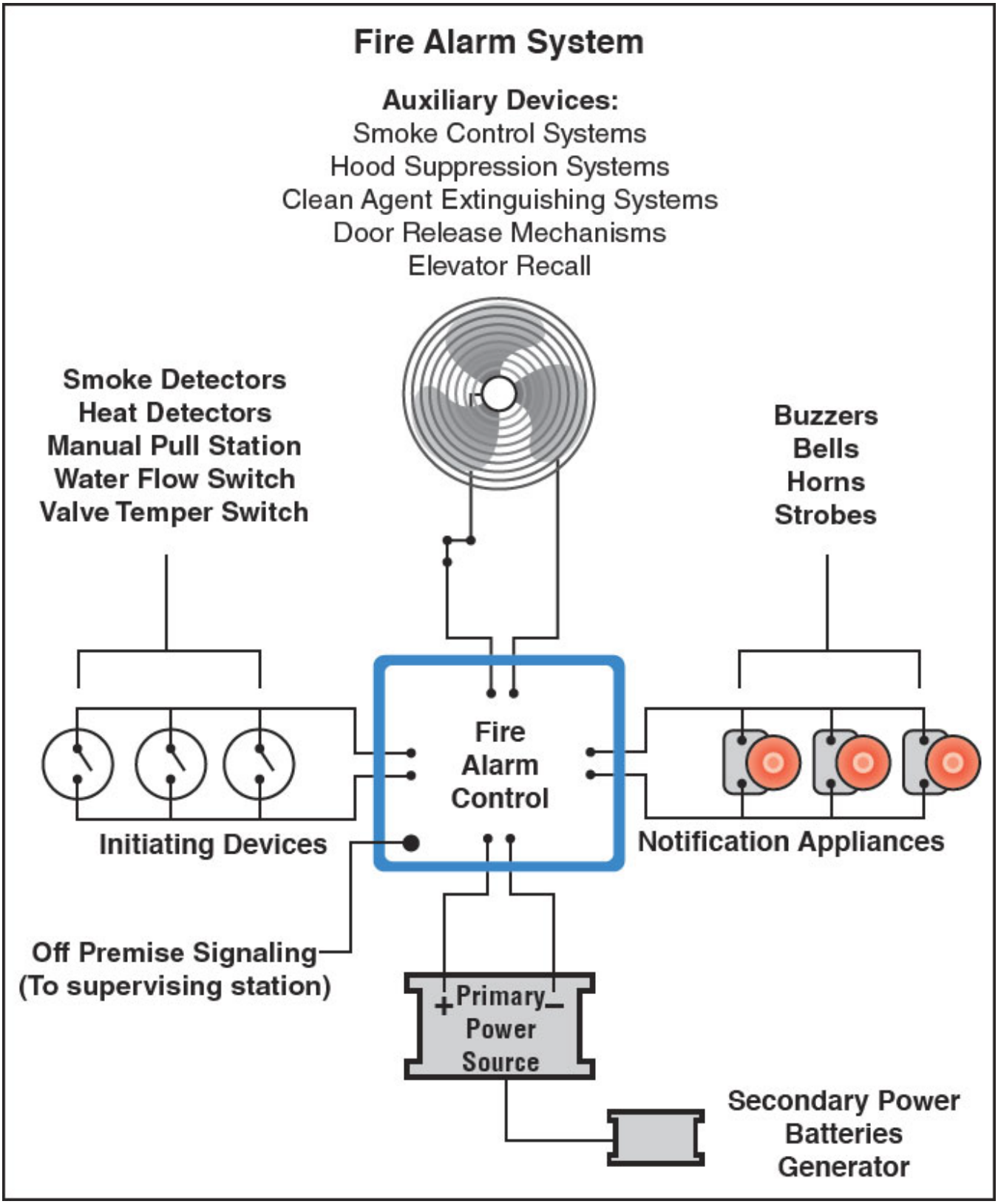
Controls for the system are in the FACP.

The FACP can also perform other functions, such as:

- Providing two-way firefighter communication
- Providing remote annunciator integration
- Controlling elevators, HVAC, fire doors, dampers, locks, or other fire protection features

The FACP can also provide public address messages and mass notification alerts through prerecorded evacuation messages or independent voice communications.

NOTE: Some fire alarm control units are designed for both security and fire protection. In these types of systems, fire protection is engineered into the system to assume the highest priority.


Fire Alarm System
Auxiliary Devices:
Smoke Control Systems
Hood Suppression Systems
Clean Agent Extinguishing Systems
Door Release Mechanisms
Elevator Recall
Smoke Detectors
Heat Detectors
Manual Pull Station
Water Flow Switch
Valve Temper Switch
Buzzers
Bells
Horns
Strobes
Fire
Alarm
Control
Initiating Devices
Notification Appliances
Off Premise Signaling
(To supervising station)
+ Primary –
Power
Source
Secondary Power
Batteries
Generator

Types of Fire Alarm Systems

Conventional

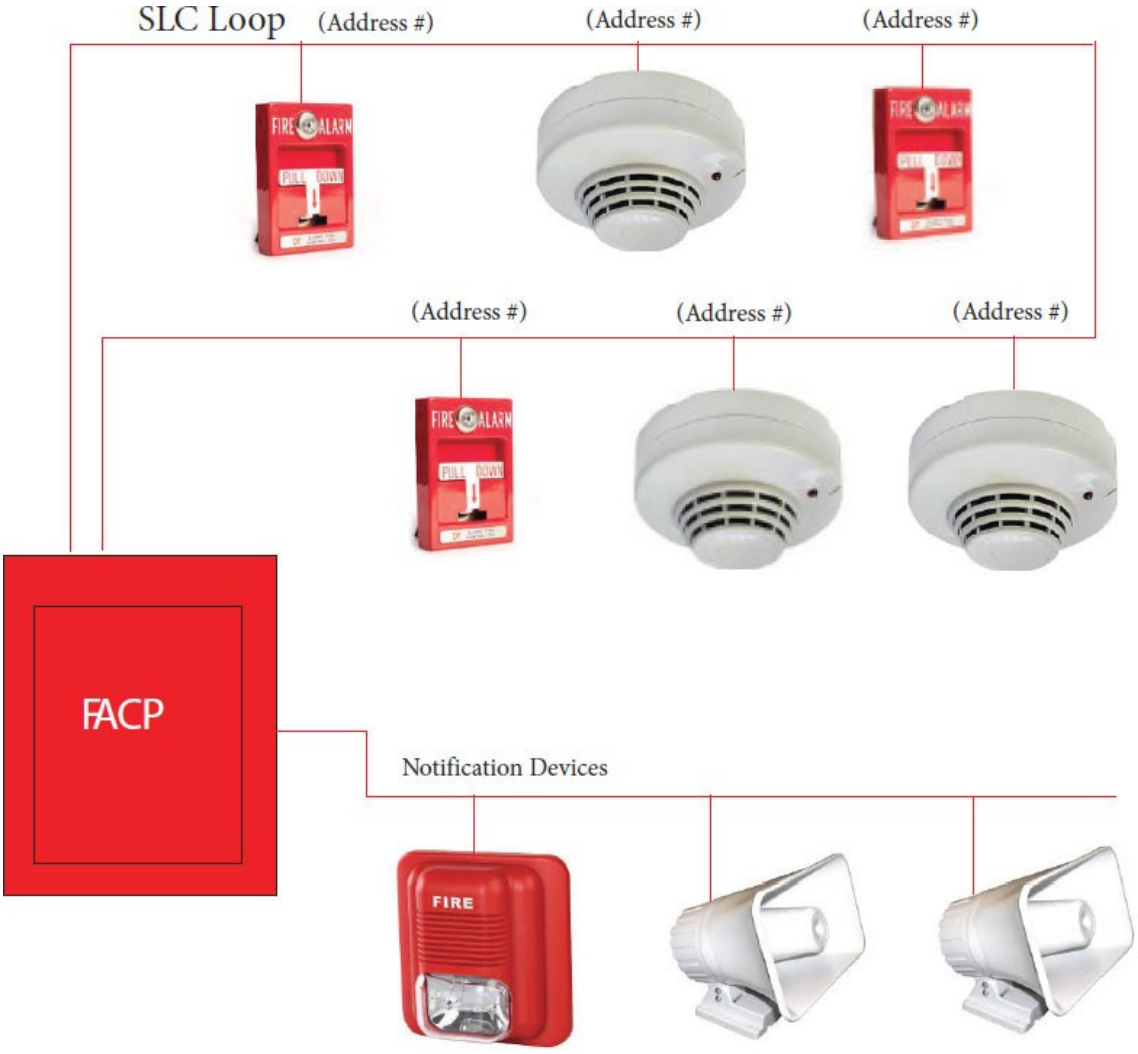
- Simplest type of protected premises alarm system
- Initiating device sends a signal to the FACP
- All the alarm-signaling devices operate simultaneously until the FACP is reset
- The FACP is incapable of identifying which initiating device triggered the alarm; building and fire department personnel must walk around the entire facility and visually check to see which device was activated.
- Practical for small occupancies with a limited number of rooms and initiating devices

Zoned Conventional Alarm System

- Fire-alarm system annunciation enables emergency responders to identify the general location, or zone, of alarm device activation.
- An annunciator panel, FACP, or a printout visibly indicates the building, floor, fire zone, or other area that coincides with the location of an operating alarm-initiating device
- Designed to help emergency responders quickly identify the location of a fire.

Addressable Alarm Systems

- Each component has individual unique identifiers
- Displays the location of each initiating device on the **FACP** and on **fire alarm annunciator panel (FAAP)**
- Exact location of the specific device that has been activated is identified on the FACP and FAAP
- Large facilities utilize these systems because they can quickly pinpoint where the trouble signal originated.



Supervising Station Alarm Systems

Fire alarm systems are required by model fire codes to be monitored at a constantly attended location. For buildings that are not constantly attended by qualified personnel, initiating device signals are required to be transmitted to a supervising station. A supervising station is a facility that receives signals from a protected premises fire alarm system and where the signal is processed by personnel.

NFPA® 72 designates supervising stations as:

- **Central** — A central supervising station is an independent business that is also listed by a nationally recognized testing laboratory. A central station is recognized as the most reliable type of supervising station.
- **Proprietary** — A proprietary supervising station is a supervising station under the same ownership as the buildings protected by the fire alarm systems. At a proprietary supervising station, personnel are constantly in attendance to supervise and investigate fire alarm system signals.
- **Remote** — A remote supervising station is not listed and operates as a business. Personnel are in attendance at all times to supervise and investigate signals.

Alarm Initiating Devices

Device	Function	Graphic	Preferred Symbol
Fixed Heat Detector	Heat detectors set to predetermined temperature ratings should be installed in ceilings and in areas that are expected to accumulate heat.		H F
Rate of Rise Heat Detector	A rate-of-rise heat detector operates on the principle that fires rapidly increase the temperature in a given area. These detectors respond at substantially lower temperatures than fixed-temperature detectors. Typically, rate-of-rise heat detectors are designed to send a signal when the rise in temperature exceeds 12° to 15°F (7°C to 8°C) degrees per minute because temperature changes of this magnitude are not expected under normal, nonfire circumstances.		H
Smoke Detector	Designed to actuate when visible or invisible products of combustion (other than fire gases) are present in the room or space where the unit is installed.		S
Duct Smoke Detector	Duct detectors are used primarily to sense smoke in the HVAC system to enable AHU (Air Handling Unit) shutdown to prevent distributing smoke throughout a facility. In some instances, duct detectors are also used to control fire/smoke dampers.		S D
Flame Detector	A flame detector is sometimes called a light detector. There are three basic types: ▪ Those that detect light in the ultraviolet wave spectrum (UV detectors) ▪ Those that detect light in the infrared wave spectrum (IR detectors) ▪ Those that detect light in both UV and IR waves		F
Flow Switch	An automatic initiating device is designed to activate an audible alarm (horn/strobe) when water begins to flow through the sprinkler system.		FS
Tamper Switch	Used to monitor the open position of an Outside Screw and Yoke (OS&Y) type gate valve or ball type valve.		TS
Manual Pull Station	Allow occupants to manually initiate the fire alarm signaling system. Manual pull stations may be connected to systems that sound local alarms, off-premise alarm signals, or both.		F

Alarm Signaling Devices

Device	Function	Graphic	Preferred Symbol
Horn	Audible notification appliance used to provide loud resonant tones as a warning to alert the occupants of a fire or other emergency condition requiring action. WP = Weather Proof		
Bell			
Speaker		 	
Strobe	Visible notification appliance used to provide flashing light as a warning to alert the occupants of a fire or other emergency condition requiring action.	 	
Horn/Strobe	Audible/visible (A/V) notification appliance with efficient electronic horn and high output xenon strobe.	 	

Fire Alarm System Wiring
Initiating Device Circuits (IDCs)
Notification Appliance Circuits (NACs)
Signaling Line Circuit (SLC)

Addressable Systems
Addressable systems use a Signaling Line Circuit (SLC) to communicate with detectors and modules. SLCs are a huge benefit because the fire panel can be expanded to perform more remote relay functions, dry contact monitoring, remote power control, releasing service and conventional zone monitoring.

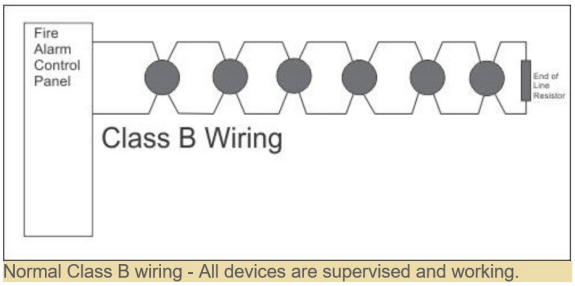
SLCs provide 2-way communication between a device and the panel via a SLC circuit. The panel and a device "talk" to each other every 4–5 seconds, referred to as "polling."

Circuit Types Overview
Addressable system panels can be wired as either Class A or Class B. The circuit type determines how a break in the loop affects the system's operation.

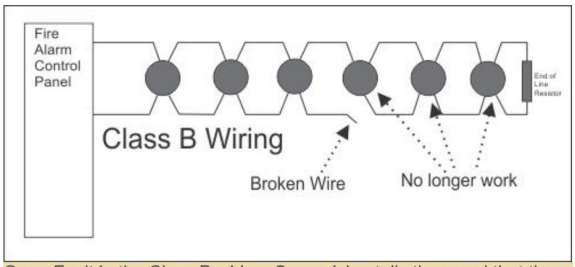
Class B Wiring
Most fire alarm system installations use Class B circuits. They provide the minimum level of protection that most facilities require. Class B circuits are characterized by the following features:

1. The circuit does not include a redundant path.
2. A single open on the circuit will render the devices located behind the location of the open circuit inoperable.
3. Any condition that affects the operation of the circuit will be annunciated as a trouble signal at the fire alarm control panel.
4. A single ground fault will not render the circuit inoperable. The presence of a single ground fault will be annunciated at the fire alarm control panel.

When wiring a conventional panel Class B, an End of Line Resistor (EOLR) is required to supervise each conventional input zone as well as any NAC output. When wiring an addressable panel Class B, an EOLR is required to supervise the notification appliance circuits (NACs) and Initiating Device Circuits (IDCs). However, the SLCs on an addressable panel does not need an EOLR to supervise the circuit. A SLC uses two-way communication between each device and the panel to monitor and supervise the circuit and device. This two-way communication also allows for t-tapping on SLCs.



Normal Class B wiring - All devices are supervised and working.

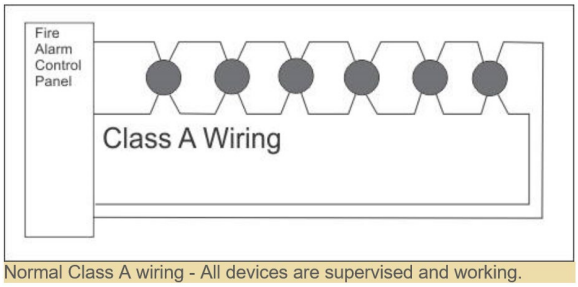


Open Fault in the Class B wiring. Supervision tells the panel that the wiring does not go through, but also the devices further from the panel don't work.

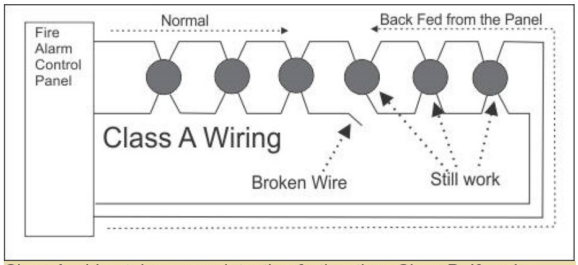
Class A Wiring

Class A circuits are used on certain types of installations (i.e., government, schools, hospitals, etc.), and when insurance authorities require it at a facility. Class A circuits can provide a higher level of system survivability. Class A circuits are characterized by the following features:

1. The circuit includes a redundant path.
2. The circuit will remain operable when there is a single open. The open will annunciate the fire alarm control panel as a trouble condition.
3. Any condition that affects the operation of the circuit will be annunciated as a trouble signal at the fire alarm control panel.
4. A single ground fault will not render the circuit inoperable. The presence of a single ground fault will be annunciated at the fire alarm control panel.



Normal Class A wiring - All devices are supervised and working.



Class A wiring takes error detection further than Class B. If a wire breaks, the panel uses a redundant wire path to maintain communication with devices beyond the break. Here even though a wire is broken, all devices work.

Fire Alarm Riser Diagram

SYMBOLS	
F	PULL STATION
F	HORN STROBE
S	SMOKE DETECTOR

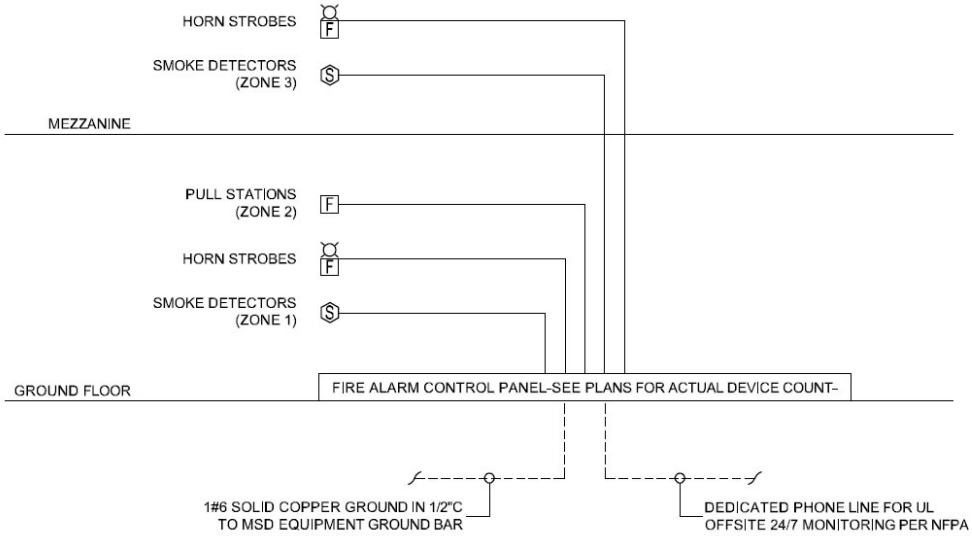
FIRE ALARM NOTES:

FIRE ALARM CONTRACTOR SHALL SUBMIT PLANS TO FIRE MARSHAL AND OBTAIN APPROVAL BEFORE ORDERING EQUIPMENT OR BEGINNING WORK. ALL SYSTEM WIRING SHALL BE IN CONDUIT

NOTES:

1. WHEN TWO SMOKE DETECTORS ARE ACTIVATED, GENERAL ALARM MUST BE SOUNDED IN THE BUILDING.

ALL FIRE WALL/CEILING PENETRATIONS TO BE FIRE STOPPED BY ELECTRICAL CONTRACTOR.



3 / E-131 FIRE ALARM RISER DIAGRAM
SCALE: N.T.S

Fire Alarm Symbols Legend

FIRE ALARM SYMBOLS LEGEND	
F	HORN STROBE; 80" AFF TO BOTTOM OR 6" BELOW CEILING TO TOP (WHICHEVER IS LOWER)
F	GUESTROOM MINI HORN; 80" AFF TO BOTTOM OR 6" BELOW CEILING TO TOP (WHICHEVER IS LOWER)
	GUESTROOM MINI HORN STROBE; 80" AFF TO BOTTOM OR 6" BELOW CEILING TO TOP (WHICHEVER IS LOWER)
F	FIRE ALARM PULL STATION; MANUAL; 48" TO TOP
S	SMOKE DETECTOR; BETWEEN 4" AND 12" DOWN FROM CEILING TO TOP OF DETECTOR
S	SMOKE DETECTOR; WITH SOUNDER BASE; BETWEEN 4" AND 12" DOWN FROM CEILING TO TOP OF DETECTOR
H	HEAT DETECTOR; BETWEEN 4" AND 12" DOWN FROM CEILING TO TOP OF DETECTOR
CO	CARBON MONOXIDE DETECTOR; TIED INTO FIRE ALARM SYSTEM
	DUCT MOUNTED SMOKE DETECTOR
	STROBE LIGHT; 80" AFF TO BOTTOM OR 6" BELOW CEILING TO TOP (WHICHEVER IS LOWER)
TS	TAMPER SWITCH
FS	FLOW SWITCH
PS	PRESSURE SWITCH
M	MAGNETIC DOOR HOLDER; TIED INTO FIRE ALARM SYSTEM
FACP	FIRE ALARM CONTROL PANEL

Fire Suppression Systems

A fire suppression system is any product designed to stop a fire from spreading. It gets the name suppression system as it aims to hold back the fire and the damage it may cause. Preventing the fire from spreading mitigates losses and allows time for emergency personnel to respond.

Fire Sprinkler System

Uses water to extinguish or control flames and minimize the spread of a fire until firefighters arrive.

Gaseous or Chemical Agent Systems

Different environments and different types of fires may require a suppression system that doesn't use water to extinguish the flames. Facilities that contain flammable or combustible liquids or electronic equipment require fire suppression systems such as FM 200, Carbon Dioxide (CO_2), wet chemical, or dry chemical. These systems use gaseous or chemical agents specially designed to extinguish the fire's source.

In some cases, owners may want to protect certain items from water damage even if code only requires a fire sprinkler system.

FM 200 Fire Suppression Systems

FM 200 fire suppression system dispenses an agent into the fire; it absorbs the heat and lowers the fire's temperature below the ignition point. Since the fire suppression agent leaves no residue and requires no cleanup, it's ideal for use in computer rooms, museums, historical archives, and many other applications. FM 200 fire suppression system benefits include requiring little storage space for the fire extinguishing agent in comparison to a carbon dioxide system. Additionally, the system can be located in areas occupied by the facility's personnel.

Carbon Dioxide Fire Suppression Systems

When activated a carbon dioxide fire suppression system releases a gaseous agent into the fire. It extinguishes the flames by displacing the oxygen. These systems work quickly, efficiently, and leave no residue. Many places that have printing presses, spray booths, flammable liquid storage, and dip tanks utilize this system. Major issues with carbon dioxide fire suppression systems are that the gaseous agent is extremely dangerous to humans. Unfortunately, carbon dioxide fire suppression system's locations are sometimes where people work. In this scenario, facilities must take certain precautionary measures to comply with NFPA and OSHA requirements. These additional precautionary measures help to protect facility's personnel.

Wet Chemical Fire Suppression Systems

Cooking applications use wet chemical fire suppression systems. When there's an emergency the system dispenses a chemical; suppresses the fire, blankets the flames, and prevents the fire from reigniting. This fire suppression system requires minimal cleanup after an activation which prevents loss of work and profits.

Dry Chemical Fire Suppression Systems

Dry chemical fire suppression systems expel a chemical powder designed to extinguish flames caused by flammable and combustible liquids. Some areas in a facility that use the chemical powder agent include mechanical rooms, furnace rooms, flammable liquid storage areas, and other places as well. Dry chemical fire suppression systems work very quickly to extinguish fires, but their chemical agent can cause quite a mess. Although, cleaning up a mess is a small price to pay when compared to the detrimental results of a fire.

Other than a wet chemical system which is always required in kitchen areas, FM 200, carbon dioxide, and dry chemical systems are used in more than one type of application. Fire & life safety service providers will consult with The Authority Having Jurisdiction and review NFPA code requirements to determine which type of fire suppression system is needed based on the hazard in the facility.