FPE CODE CONSULTANTS, LLC

PRACTICAL PREPARED PROFESSIONAL

Course FP101 – Fire Alarm Basics – PART 1

M. Nabeel Waseem, M.Eng, PE, CFPS

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Introduction

Fire alarm systems are critical for fire and life safety emergency situations. They are our first defense against preventing loss of life and property. They allow for early detection of fire, notification for occupant to evacuate the building and also alert the first responders of a fire situation. The fire alarm system is made up of several components which can be broken down to initiating devices, notification appliances, panels and wiring. When either designing, reviewing or testing a fire alarm system, it is important to know the functionality of the devices, proper placements, what codes and standards govern them and their interconnection. This course is a general overview to get the attendee familiar with the most basic requirements.

Codes and Standards

- Building codes indicate when fire alarm system is required and where to install the devices. International Building Code (IBC) and NFPA 101 are two major governing regulations in the USA. The focus of this presentation will be on IBC.
- Using the requirements in the building codes, the engineer of record determines the parameters of design for the appropriate fire alarm system.
- Main chapter in IBC dealing with fire alarm is chapter 9, however there are other section in the code that indicate when a system can be required such as chapter 4. The requirements are based on occupancy and use group of the building. Office business uses require a lower level of protection compared to hospitals, dorms, residential buildings, high-rise. International Fire Code (IFC) also contains requirements for special uses.
- The standard for fire alarm system is NFPA 72. This provide design, installation and testing guidelines.
- Building code override standard requirements. Follow the codes, their adopted references and check with AHJ for any other adoptions prior to design of systems. Check with AHJ what are the applicable codes and standards and the appropriate year edition to be followed. Just because a new ICC IBC book or standard is out, it does not mean it is applicable for that jurisdiction.

Initiating Devices

Initiating Devices
What is the purpose of fire alarm initiating devices?

- Devices used to start (initiate) the fire alarm system i.e. used to detect fire or smoke and begin the process associated with alarming (notifying) i.e. sound alarm, close doors, etc
- Allow for early detection such as when the fire is in incipient stages i.e. smoke or heat detector will detect smoke, heat respectively, signaling the fire alarm panel to energize the notification appliances to alert occupants to evaluate building and notify first responders.
- Manual Pull stations allow an occupant to manually activate the system
- Can initiate other fire safety functions such as closing dampers and doors to prevent smoke, heat and/or fire from spreading to different parts of the building,
- Can be used to locate fire ex

    1. Addressable devices can establish zones which can help locate fire
        - Note: Need to carefully consider the zone boundary being annunciated on the panel

    2. Water-flow switch can indicate when water is flowing through the sprinkler system which can help locate fire floor

Types of initiating devices

- Detector types: smoke (ionization – best for flaming fires and photoelectric: for smoldering fires), flame, radiation, line type, air sampling, heat (fixed vs rate of rise temperature), beam, gas, etc. See NFPA 72
- Pull stations
- Water flow switches determine when water is flowing through a sprinkler system i.e. an open sprinkler head
- Devices used for monitoring and sending supervisory signals (tamper switches, pressure switch, temperature or water level monitoring, etc.)

Types of systems utilizing initiating devices

- Sprinkler systems (pre-action where detectors are used to trip valves and fill pipe with water prior to sprinkler heads opening or for deluge system where detector open vales and water discharges from every head)
- Residential occupancies such as hotels, motels, homes, apartment buildings - Single and multiple smoke alarm are used to detect smoke.

Note for detector in home, hotels, motel or dorms, detection by a single smoke detector in each unit should not sound a full building wide alarm. This is because it does not make sense to evacuate ex a high rise building because someone burnt toast. Good practice to have two detectors in same unit (a detector in the bedroom and the kitchen) cause a full building wide alarm or have a delay sequence programmed such as full building wide alarm after 120s. The initial detection by the first detector should cause a supervisory signal. It is good practice for designers to provide a matrix showing the effects of operation of the fire alarm devices.

Types of systems utilizing initiating devices

- From NFPA 72-2013

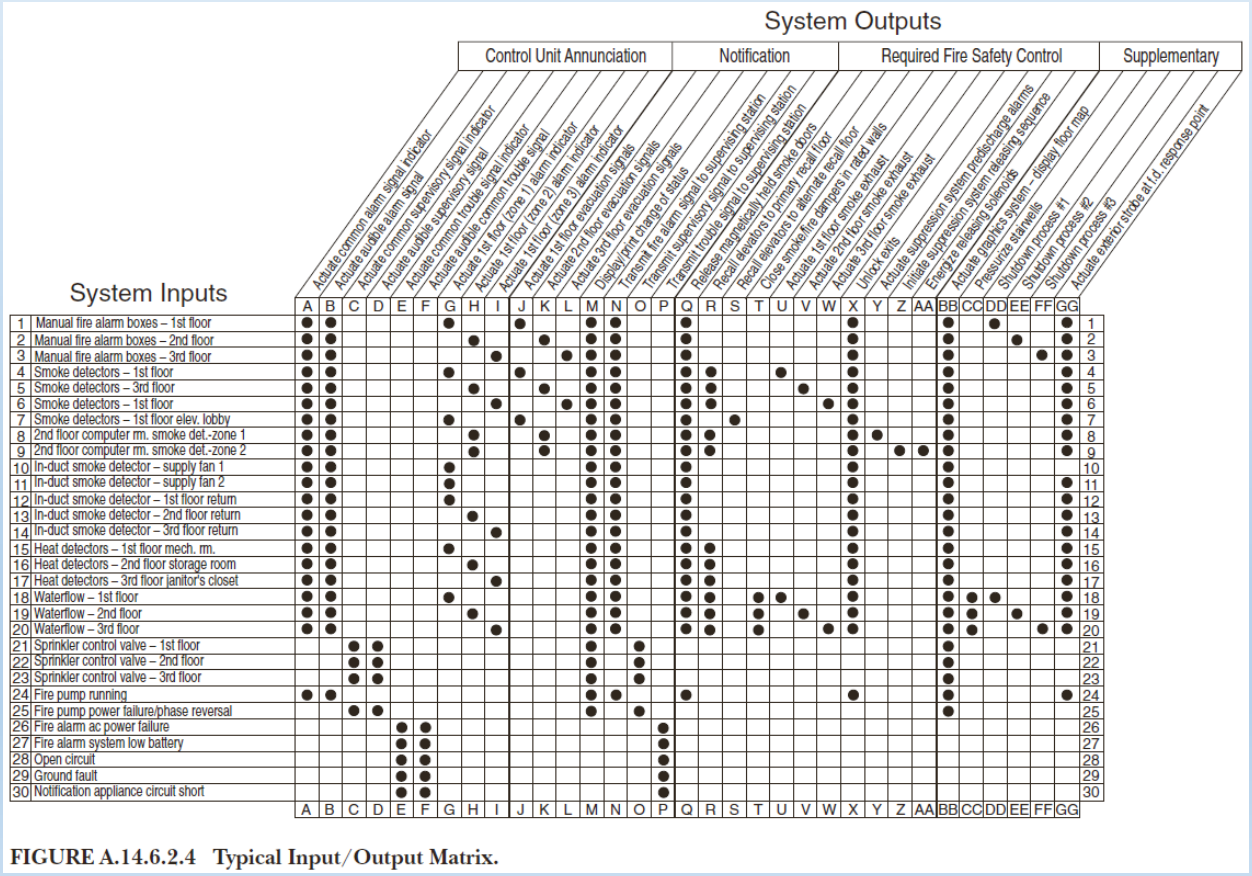


FIGURE A.14.6.2.4 Typical Input/Output Matrix.

Types of systems utilizing initiating devices

- Smoke control systems i.e. detectors are use to begin smoke exhaust process
  - devices: smoke detectors at ceilings, beam detectors in large open spaces like atriums
- HVAC system i.e. dampers in walls, floors,
  - air handler unit shuts down to prevent smoke spread to multiple compartments served by unit
- Fire doors and shutters: when fire alarm activates the door hold open devices (magnets) de-energize and close the doors

Circuit types

- There are two types of circuits used by initiating devices. These are capable of providing power and are used to transmit signals to the fire alarm control panel (FACP). The circuits are known as Indication device circuit (IDC) and signaling line circuit (SLC). Per NFPA 72 NFPA 72, 2013:
  - *3.3.133 - Initiating Device Circuit. A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated.*
  - 3.3.259 - *Signaling Line Circuit. A circuit path between any combination of addressable appliances or devices, circuit interfaces, control units, or transmitters over which multiple system input signals or output signals or both are carried.*

Circuit types

You may find IDC in some old building but most fire alarm system are being renovated to SLC because of addressable detectors and their ability to identify location of smoke/fire. Circuits may also be required to meet survivability depending on use group. For example, if you have multiple zones and one SLC is supplying all the devices, then a fire in one zone can damage the SLC and compromise the entire system. NFPA 72 discusses survivability in detail for where no protection of circuits is required, protection with building containing an automatic fire suppression system and 2hr fire rated cables and enclosures.

In old days, many devices were conventional non-addressable typically 4 wire type. These devices were powered independent from the Fire Alarm Control Panel (FACP). Today in new systems, all detectors are typically power by FACP through either the IDC or SLC. This also helps with the ability to reset the detectors from the panel instead of manually resetting at the detector location.

Wiring pathways are defined as Classes. Ex Class A provides redundant path which allows for operation of circuit if a single device is short circuit. NFPA 72 standard does not specify classes to be used. Typically this is in specifications by design architect/engineer. Be aware of the limitations of number of devices on a circuit –see panel cut sheet. Number of SLC circuits are also limited, however can add additional panels to increase capacity.

When and where are initiation devices required?

Recall, that the building code states where and what type of fire alarm system is to be used based on the occupancy and hazard present. IBC chapter 9 provides detail information on the types of devices associated with the required fire alarm system. Codes do not typically require entire building to be protected with detectors and neither does the NFPA 72 standard. Codes may require complete corridor protection such as smoke detection system in dorms or for hazardous uses.

Insurance companies may require extra protection per their own guidelines such as coverage in high fuel load areas such as file or storage rooms. All devices must be listed for use and appropriate for the location in which they are to be installed, i.e. temperature, air velocity, etc.

When and where are initiation devices required?

- Use appropriate detectors in unconditioned environment, outdoors, shower areas, pools, elevator shaft, open parking garage. Must make sure devices is listed for conditions.
- Smoke detector are more sensitive than heat detectors. Do not use them in kitchen, shower rooms, shafts or unconditioned spaces.
- Always check manufactures cut sheet which specify where to use and the specific conditions.
- Also note that you need to have remote LED indicator for detector(s) that are not visible i.e. in attic so it can be easily seen that the device is operating. Means should also be available to allow maintenance, testing and resetting.
- The current IBC requires FACP serving fire alarm system to have protection in the form of smoke or heat detector. You may encounter some existing buildings without this protection. This is because in the previous code editions, protection in the form of heat/smoke detector were not required when the building was fully protected by an NFPA 13 sprinkler system.

When and where are initiation devices required?

- In HVAC system (International Mechanical Code (IMC) Chapter 6 Duct System):
  - Detector must be powered by FACP which allows for reset from panel.
  - Individual units such as computer room air conditioning (CRAC) with built in smoke detector provided by manufacturer that only shut down the individual unit do not have to be tied to FACP. Modifying the detector or unit will void the warranty of units. These detectors have been already been tested as part of the assembly and needs no further compliance.
  - Duct detectors are required at upstream of ducts (see IMC for exact location):
    - return air systems with a design capacity greater than 2,000 cfm
    - multiple air-handling systems share common supply or return air ducts or plenums with a combined design capacity greater than 2,000 cfm
    - return air risers serve two or more stories and serve any portion of a return air system having a design capacity greater than 15,000 cfm
- Manual Pulls locations
  - 5’-0” from entrance to each exit (not inside exits or exit passageways), additional pull needed where travel distance exceeds 200ft per IBC
  - 42”-48”aff from floor level to handle or lever of box
  - When building is to be renovated or if an addition is being added, you must be consistent with pull station location i.e. IBC allows for exception for some use groups when building is fully sprinklered– only one pull station in approved location (typically entrance of building). Do not mix location. Talk to AHJ.

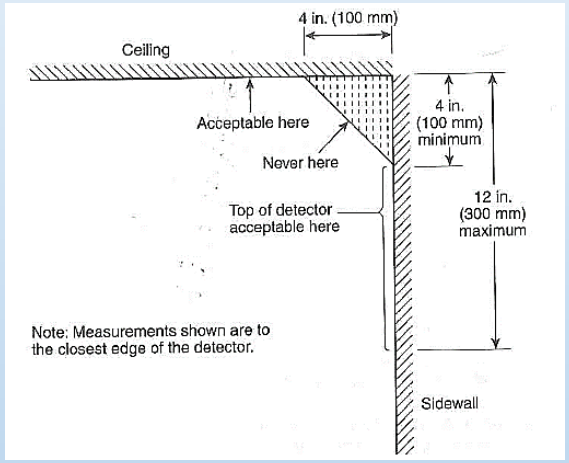
Smoke & Heat detector spacing

Spacing plays a critical role in an effective fire alarm system. Spacing detectors too far leaves to improper coverage allowing longer time for detection and for fire to grow. Too close spacing increase the cost of systems. NFPA 72 has guidelines for proper detector coverage. These must be used in-conjunction with the manufacturers cut sheet. It is important to note configuration of ceilings, walls, beams, obstructions ex mechanical rooms, electrical rooms with ceiling open to floor slab/deck and beams creating ceiling pockets. Typically detectors mount on ceiling or sidewall. NFPA 72 provides specific direction on placement based on ambient ceiling temperature, height of ceiling, beam and joist construction, sloped and peaked ceiling. Study the architectural drawings in details for appropriate placement.

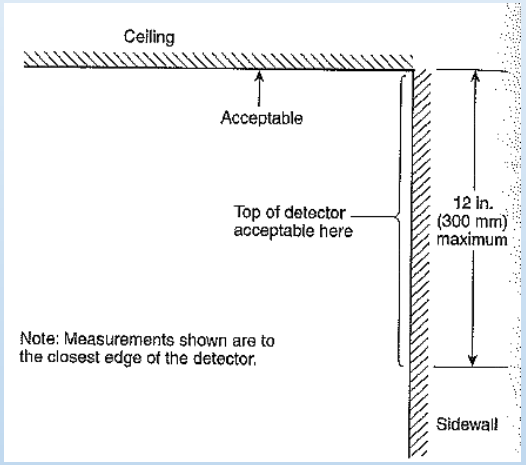
Smoke & Heat detector spacing

For wall corners:

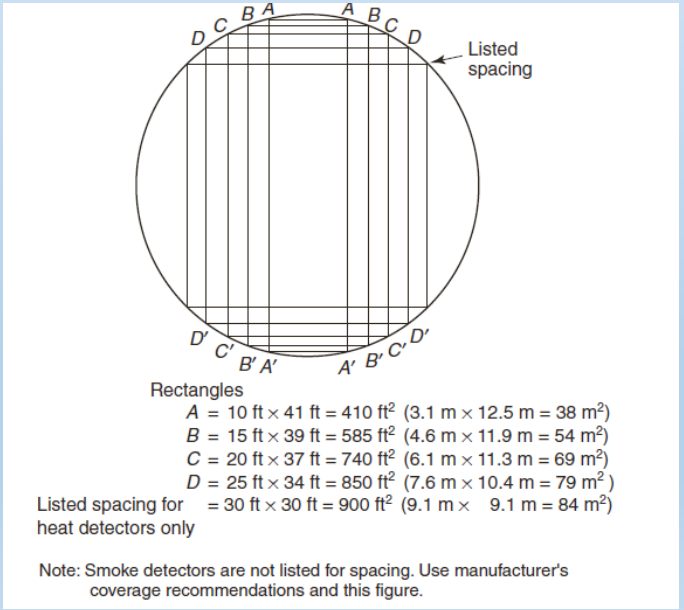
For heat detectors – 4” away from wall, within 4”-12” down



For smoke detectors–within 12”



See NFPA 72 appendix for special spacing for heat detectors. Use manufacturer requirements for smoke detector.



- Never more than 21ft from any wall (or per manufacturer) for smoke detectors

Smoke & Heat detector spacing

- Protective caps must be on smoke detectors during construction as dust can effect sensitivity. Only when building is ready for occupation should the caps be removed.
- Partitions within 15% of ceiling height shall be considered separate room for consideration of detector placement due to ceiling jet movement, unless a performance based method is approved. Keep away 3ft from supply diffusers or air flow as it dilutes air and inhibits detection.
- Other items of interest that you need to be aware of for fire alarm system that are not covered in this course in detail are:
  - Penetration details for conduits through rated walls. Make sure to provide detail pages showing the penetration detail assembly. Make sure to have a copy of the assemblies on hand during inspection.
  - Elevator hoist way –NFPA 72, Elevator Code ASME A17.1, See IBC chapter 30
  - Locks - IBC chapter 10, section 1008
  - Fire safety functions (doors hold opens, dampers, smoke control, AHU)
  - Ensure that correct scale is stated on the plans i.e. 1/4”=1’-0”, or 1/8” -1’-0”.
  - Although IBC and NFPA state limitations to maximum zones served by initiation devices, with addressable devices, each device becomes a zone and can identify location of where smoke/fire is present.

Fire Alarm Notification Devices

Fire Alarm Notification Devices

- We have discussed devices that detect heat, smoke and fire. Upon detection these devices send a signal via the SLC (or IDC) to the FACP. The FACP is the brain, of the fire alarm system. It receives these signals and is programmed to perform a specific function depending on the signal. When a signal is received from an initiation device the fire alarm panel will energize the notification appliances.
- So what do notification appliances do? The purpose of fire alarm notification appliances is to alert occupants that a fire has been detected in the building and notify them to exit or seek area of refuge. The FACP can also notify the fire department or a supervising station who can also call the fire department.

Types of Notification

There are two types of notification, Public mode vs Private Mode. The most common are Public mode, which is used to alert everyone in the building. Private mode notification can be thought of as a controlled notification, on a need to know basis, where people are trained to understand and respond to signal appropriately. Example of private mode is in hospitals where we don’t want to create a large panic, ex “code yellow”.

Types of Devices

Notification appliances work by producing either a distinctive visual effect or a sound alert. Visual devices include strobes which display an illuminating pattern at a specific flashing rate. There can also be a text display ex emergency message on a TV at a football game. Audio devices are horns, bells and speakers. Speaker can produce both voice, Emergency Voice Alarm Communication system, (EVAC) and horn sound in a temporal pattern. The key thing to be aware of is that the emergency notification must be distinct.

Spacing factors to consider for strobes

- The unit of measurement is candela (cd), which *“is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 x 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.”** Think of it as candle power and an effective intensity. 2cd is equivalent to brightness of 2 candles steadily burning. If you were to put a light meter in a room which was covered by a strobe to meet the standard or performance required you need to have 0.0375 lumens/ft² measured.
- NFPA 72 provides table for strobe coverage per a maximum room size for both wall and ceiling mounted devices. Larger rooms or those that have high ceilings require higher candela devices. The candela rating must be achieved for the given room or additional strobe are required to meet coverage.

*https://physics.nist.gov/cuu/Units/candela.html

Spacing factors to consider for strobes

- Example, a ceiling mounted 15cd can cover 20ft by 20ft room. 15cd / (20x20) or 15 / 400 = 0.0375 lumens/ft^2.
- During testing the fire alarm contractor and the inspector can use a light meter to test if proper coverage and lumens is achieved. Note that the 0.0375lumens/ft^2 much be achieved over the ambient (natural or artificial) light. Be aware of rooms with lots of natural light lots of windows, or lights in high ceiling. There has to be an effect created by light to alert occupants. If 0.0375lumens/ft^2 is not achieved, check voltage drop across the devices (should not be below 16vdc). If needed add higher candela devices or add more devices, ensuring that sufficient, current and voltage is present, along with capacity of the secondary power supply for the increased load.

Spacing factors to consider for strobes

- Strobes must meet UL 1971 *Standard for Signaling Devices for the Hearing Impaired*, or equivalent. Strobe coverage is required in all public and commons areas such as copy room, common bathrooms, break room, ADA rooms, open offices. Certain percentage of hotel/motel/dorm rooms may also need to have strobe coverage due to ADA requirements (see IBC chapter 9 and ADA Accessibility Guidelines or ADAAG which is a federal law). Per IBC chapter 9, Employee work areas also need to have 20% spare capacity for any future ADA. Example, a person who has an office with audio fire alarm coverage becomes hearing impaired or is given to a hearing impaired person. Need to have capability to add strobe for notification.

Common strobe coverage items to be aware of:

- Corridors 20ft and less can use 15cd devices and the spacing in between can be increased to 100ft
- Consider obstructions: soffits/bulkhead, changes in ceiling height. Be aware of doors at corridors, lintels, partitions, curtains
- Ceiling mount vs wall mount:
  - Difference in coverage areas
  - Ceiling mounted – note with higher ceiling, strobe coverage is reduced
  - Wall mounted – candelas not affected by ceiling height but need to have lens at proper height between 6’-8” and 8’-0” (per NFPA 72).
  - See standard for low ceiling area as it requires adjustment

Common strobe coverage items to be aware of:

- Strobes are not required to be seen to get coverage. The key thing is to see the effect. This can be via direct or in-direct method i.e. reflection of surfaces (walls) ex. in grocery store with aisles and high racks – you need not to provide coverage in every aisle if indirection means of creating candela effect can be achieved. Be extra careful for spacing requirement for where racks are movable – see NFPA 72 appendix for section on direct and indirect signaling effect.

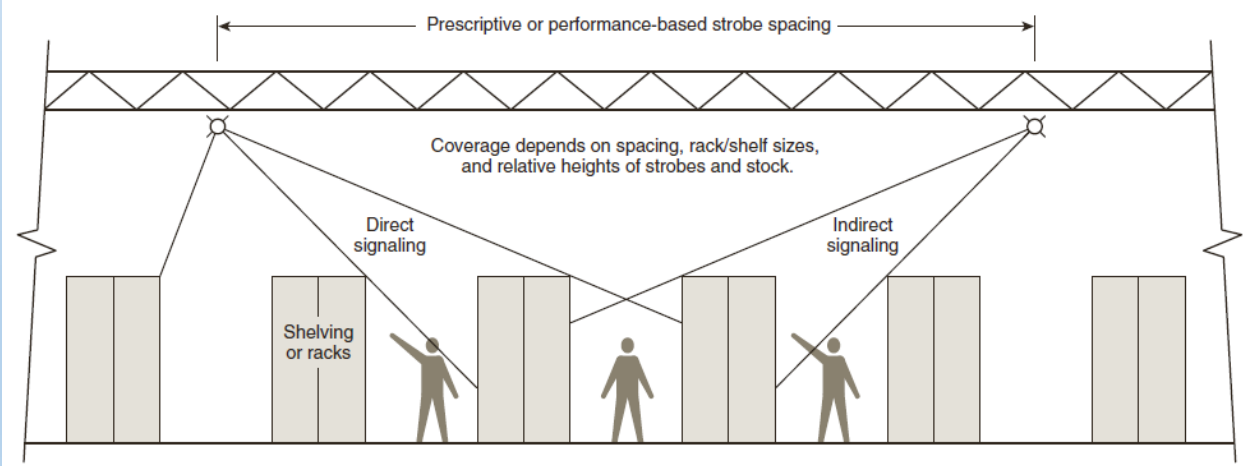


FIGURE A.18.5.4(b) Visible Notification Appliances in Stores. *(Courtesy of R. P. Schifiliti Associates, Inc.)*

Common strobe coverage items to be aware of:

- See conditions for strobe spacing for sleeping areas where required per building code i.e. 16ft from pillow at either 110cd or 177cd depending on lens height (NFPA 72).
- 1000cd max in any space. More than this can cause blindness and impair evacuee from successfully escaping.
- Strobe flashing shall be synchronized, in same room or within the field of view. Be cognizant of glass doors, transom and windows. Standard does not allow for unsynchronized coverage as it can lead to seizures for some people.

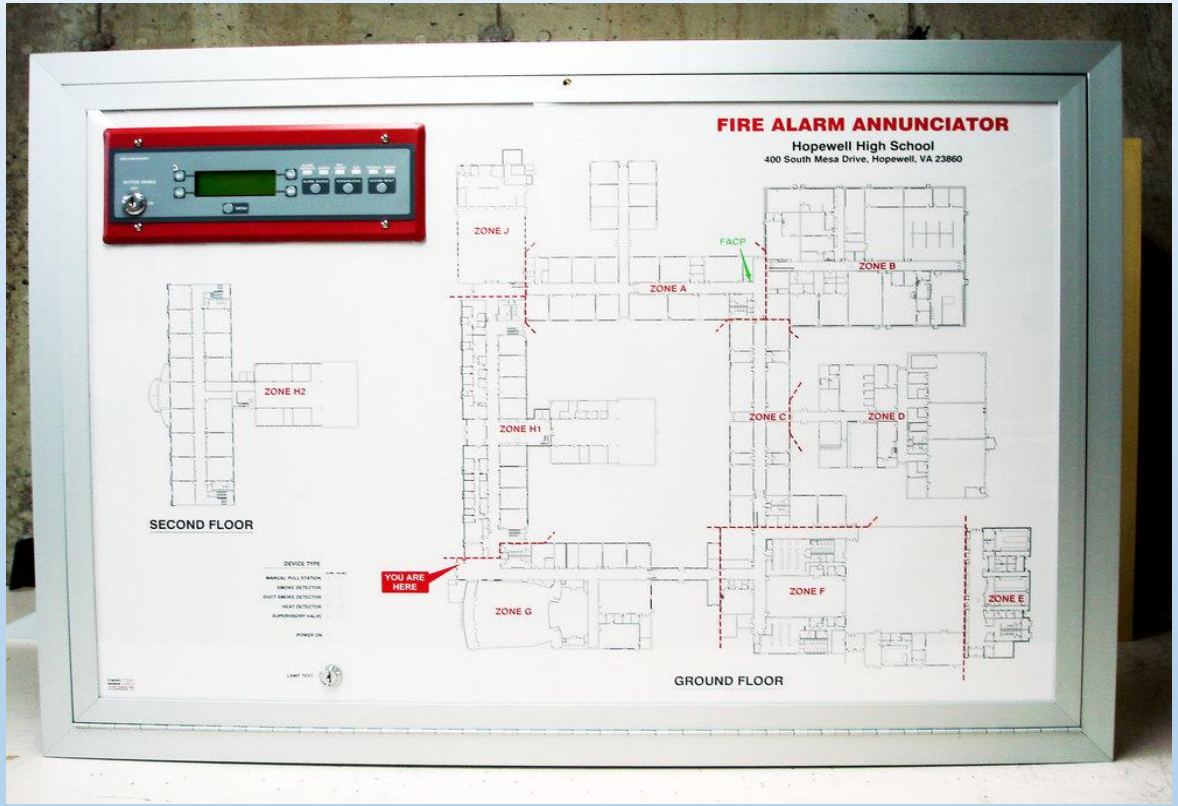
Common strobe coverage items to be aware of:

The FACP also serves as a means of notification. It has LED indicators that indicate status of the fire alarm system. It is used by first responders to control fire safety functions, identify location of smoke/fire, and provide overall control of the fire alarm system.

An extension of FACP is the annunciator panel which mirrors the FACP in a sense of identifying location of fire and status of the fire alarm system. The annunciator panel is typically located near the main entrance. In large buildings with multiple entrance, there can be multiple annunciator panel but there is usually one FACP. Graphic layout panel (GAP) provide a map of the building floor plan and are provided either as part of the FACP or located next to it. For complex building such as high-rise, IBC requires the graphic layout to be provided as part of the FACP/annunciator panel. This is to quickly and clearly identify the area of fire or sprinkler flow, zones, standpipes, stairwells, so that responders can work effectively.

Contact your local AHJ for direction on any specific items that may be required as part of FACP and GAP.

Common strobe coverage items to be aware of:



Images above of annunciator panel with and without graphic floor layout from Ampac

Common strobe coverage items to be aware of:

- Click here for example of Fairfax County requirements non high-rise annunciator panel layout
- Click here for example of Fairfax County requirements High-rise annunciator panel layout
- Another form of notification is the Digital Alarm Communicator System which utilizes the Digital Alarm Communicator Transmitter (DACT) to seize telephone lines. This then sends notification of changes in signal to a central station which can then relay to fire station or send runner technician for trouble/supervisory signals. Fire alarm system that require monitoring stations need to be designed with two telephones lines (or capability to seize lines) which must be present for the DACT to use in case of emergency. Owners should be made aware of this expense early on as it will stay with the life of the system.

Audibility /Voice intelligibility

Audibility /Voice intelligibility

All spaces must have audibility coverage (per IBC). This mean we MUST be able to hear the horn sound EVERYWHERE. Sound is measured in Sound Pressure Levels(SPL) (dBA, dB is decibel, A is weight scale). Average sound for auditability require 15dBA above average ambient or 5dBA above max for at least 60s measured 5ft above finished floor. NFPA 72, 2013, Table A.18.4.3 has appendix had data on average ambient noise level measured in certain occupancies. Prior to designing for appropriate dBA in an existing building, it is best to field verify SPL with meter and take average ex music, room, auditorium, atriums, large open space with lots of people, to get accurate data for design. Use sound meter min and max reading button to get accurate measurement above ambient. Close doors when taking reading.

Audibility /Voice intelligibility

- Horns must generate a three pulse temporal pattern. NFPA 72, 18.4.2.2 states “A single-stroke bell or chime sounded at “on” intervals lasting 1 second ±10 percent, with a 2-second ±10 percent “off” interval after each third “on” stroke, shall be permitted.” Mount audio devices at ceiling or min 7’-6” above finish floor (aff) and at least 6” down from finished ceiling for wall mounted devices.
- For strobe and audio combination devices, follow strobe spacing as indicated on manufactures specification.
- A SPL of 110dBA or over can cause hearing pain. Therefore we must ensure that the audio produced is keep below 110dBA and in environment where 15dBA or 5dbA over the maximum cannot be achieved due to the 110dBA threshold, add visual device ex machine rooms, mechanical rooms, etc.
- Be aware that doubling the distance from sound source will result in a lose of 6dBA. So if you have a horn/speaker producing 88dBA at 10ft per cut sheet, at 20ft you will have 82dBA, at 40ft, 76dBA. Sound attenuation through doors and walls can results in 25-45dbA loss. It may be beneficial to refer to wall partition schedule to note rooms with sound insulation.

Audibility /Voice intelligibility

- As a general rule of thumb, use 1000sqft per speaker for open space. Calculation for SPL are a bit complex. Society of Fire Protection Engineering (SFPE) Handbook provides method for how to calculate sound loss through various building elements.
- A good place to start when designing is with the device cut sheet which would indicate source (the device) dBA at a certain distance, example Horn/speaker 88dBA at 10ft. Use this and rules above to space devices.
- Sleeping areas require minimum 75dBA at pillow. This is because we need to wake up a sleeping person in fire/emergency situation.
- Note that audibility requirements apply to horns, not voice message. Voice intelligibility requirements are for message to be understandable and distinguishable. Only speaker for voice evac systems are allowed in exits, exit passageways and on a different paging zone. No strobes or horns in exit areas as it will create panic or disorient people trying to exit.

When is a Voice EVAC system required?

Voice intelligibility deals with being able to clearly understand the message. This topic is subjective and although quantification of intelligibility is not called for in the standard it can be required by AHJ. See NFPA 72 appendix, specifically context relating to IEC 6084. Measuring intelligibility is complex but not impossible. Work closely with AHJ during design so that during testing desired results and approval is achieved. Best to hire an expert with experience with designing voice intelligibility in fire alarm system.

When is a Voice EVAC system required?

- See your building code
- According to IBC, atriums more than 2 stories, assembly over 1000 occupants, high-rise etc.
- In 2010ed, NFPA 72 introduce the concept of Acoustically Distinguishable Spaces (ADS) which is “An emergency communications system notification zone, or subdivision thereof, that might be an enclosed or otherwise physically defined space, or that might be distinguished from other spaces because of different acoustical, environmental, or use characteristics, such as reverberation time and ambient sound pressure level.” The designer of record can categorize such spaces and voice intelligibly can be excluded from some spaces. Spaces that don’t require intelligibility Per NFPA 72 are: (1) Private bathrooms, shower rooms, saunas and similar rooms/areas (2) Mechanical/ electrical/ elevator equipment rooms (3) Elevator cars (4) Individual offices (5) Kitchens (6) Storage rooms (7) Closets (8) Rooms/areas..

Factors that affect voice Intelligibility

- Although it is difficult to quantify intelligibility, we have come to know that loudness, reverberation (echo – high surface reflectivity), distortion of signal, background noise of paging system, power supplied to amplifiers, high watt taps, frequency, are some factors that impact producing and understanding of the message. Some things that can be done to improve intelligibility are:
    - Use ceiling mounted speakers in large room with ceiling less than 15ft i.e. open office areas, open mall areas. DO NOT USE wall mounted as long distances causes reverb.
    - General rule: if width of room is equal to or greater than 4 times height, then go to ceiling mount
    - If ceiling height is greater than 20ft, use wall mounts ex gymnasium, indoor polls, churches, rooms with large reflective construction

Factors that affect voice Intelligibility

- Garages are challenging so install speakers same location as strobe
- Supply low power to speaker with more speakers instead of higher power (speaker generally have a switch for watt tap, 1/2W, 1W, 2W which can be adjusted). Note lower tap will decrease dbA. Start by designing for the required dBA and make adjustments.
- Furniture can effect SPL and can decrease reverb but also dBA. Carpet help reduce reverb but absorb sound. Hard surfaces achieve dBA but increase reverb.
- Currently, there are no code or standard requirement for what the initial recorded voice message needs to be (neither in IBC or NFPA 72). Best thing is to keep it short ex. “Fire Detected, please evacuate” – get AHJ to approve during design.
- Textual appliance can only be used in addition to visual and audio. See NFPA 72 for further details.

Some items to be aware of:

- ALWAYS check with AHJ for code/standard and edition used for designing system.
- Know any local amendments.
- Confirm correct scale on plans is present.
- Notification and initiating devices should not be on same circuit unless specified by manufacturer (they require different circuits to run)
- There can be different notification zones ex high rise, hospitals which requires partial evac or relocation
  - consider survivability for partial evacuation and relocated and protection of circuit
  - need to carefully design boundary of notification zones (need to provide clear indication on annunciator panel/Graphic panel)
- Can add power expander panels to have additional notification appliance circuit (NAC)
  - cannot go over the rated ampere of panel – see panel manufacturer cut sheet
  - cannot go over the rated ampere of circuit – see panel manufacturer cut sheet
  - voltage drop calculations are required to show circuit is sized appropriately
  - battery calculation are required to make sure battery are sized to run appliance for the specified duration during loss of primary power
  - penetrations through fire rated walls need to be noted on plans with details or cut sheet of fire rated assemblies to be utilized.

FIRE ALARM AND ELEVATORS

Elevator Recall & Shunt

- Elevator recall and shunt requirements have been in the codes and standards for decades. However, the basic functionality of these items at times tends to get misunderstood causing delays in getting plans approved by AHJ and confusion during testing.
- Let us begin by defining the recall function. Upon detection of smoke by the elevator lobby detector(s) (these are typically smoke detectors but can be heat detectors in certain cases), the elevator moves to an assigned designated level typically the ground floor or an alternative level depending if smoke is detected by designated level lobby detector. This prevents people in the elevator from getting trapped and expose to products of combustion if succumbed by fire and discharges them on a level where smoke hasn't yet been detected. Once the elevators are recalled to the designated or alternative elevator, they stay on the level with the doors open. This prevents panic and large crowd to use elevator during unsafe condition (use stairs instead, seek out area of refuge). In this recalled mode, only the fire fighter can use their key to access the elevator and use it to reach fire floor. If smoke or heat are introduced in the elevator shaft, detected by smoke/heat detector located in shaft, the fire fighter hat button indicator will light up in the elevator cart making aware the fire fighter that the shaft has been compromised.

Elevator Recall & Shunt

The shunt trip function cuts electrical power to elevator and control equipment prior to the operation of water suppression system (i.e. sprinkler located at the top of elevator hoistway and/or sprinklers located at the elevator machine control room. This is become wetting of the cart/panel can cause the elevator to function improperly. Shunt function is not to prevent electrocution rather to prevent water from short circuiting circuits which will cause dangerous operation of the elevator cart with people or fire fighters trapped inside. Elevator recall occurs before shunt (recall utilizes smoke detector which are more sensitive to products of combustion). Additionally shunts prevent pre-wetting of elevator breaks.

Code Requirements

- ASME A17.1 is the nationally implemented elevator code in United States. This works in conjunction with building code IBC chapter 30 and the reference standard NFPA 72. ASME A17.1 defines in detail, operation of Phase I Emergency Recall (what we have discussed above).
- There are several code changes and different version of ASME 17.1 Elevator Code. Beware of this when examining elevators in existing buildings.
- Both recall and shunt are independent i.e. they shall not be set off by other building detectors or pulls stations.

For Recall:

- Detectors must be connected to building fire alarm system (when present) and must cause building wide alarm upon smoke detection from devices serving recall functions.
- If no building fire alarm system is present, then need to add a fire alarm panel just to serve the recall function (You do not need a fire alarm system for the entire building)
- Where are detector(s) required?
  - In conditioned building, place smoke detector in elevator machine room or any room containing elevator controls/panel
  - Place smoke detector in elevator lobby. Detector in lobby on ceiling within 21ft of centerline of each elevator door (for ceilings higher than 15ft, see standard as closer spacing is required). One detector can serve multiple elevator as long as within 21ft from door.
    - Use smoke detector in elevator hoistway/shaft only when shaft is sprinklered at the top.
    - If shaft is unsprinklered, then NFPA 72 requires smoke detector to be present only if used to active elevator shaft smoke relief. To meet total fire protection goals, as outlined in the NFPA 72 handbook, you can have detector for that suitable environment other than smoke to perform elevator recall.
  - If ambient conditions do not favor installation of smoke detectors, then use other listed detector (ex. listed heat detector for outside use in open parking garage, cold weather, near stage where smoke affects are used, moisture, humidity, dirt, exhaust areas – This is to prevent false alarm.
- Install smoke detector on signaling line circuit. If on initiating device circuit (IDC), then power separately or provide on separate IDC independent from other devices.

For Recall:

To recap again, the difference between designated and alternative is:

- Designated is primary level for elevator to return to, nonstop
  - Activated by detectors located at any lobby, elevator machine/control room, hoistway except those located on designated level.
- Alternative sends elevator to the alternative level upon activation of detectors located at lobby, elevator machine/control room of designated level.

For Shunt

- De-energize electrical control before water discharge. Elevator circuits inside the elevator (i.e. lights) are not disrupted.
- Follow sprinkler requirements in NFPA 13.
- If piston elevator, then detector for shunt is only at elevator panel (since there is no elevator electrical components in shaft)
- Sprinkler head(s) installed in pit does not affect circuitry and power to elevator. It does not have to be tied to shunt but typically one sprinkler line feeds the bottom and top of shaft so it automatically become apart of the elevator suppression system if a water flow device is used for shunt.
- Detector at top of shaft is heat type, rate of rise, with temperature rating less than that of sprinkler head (we want the detector to go off first and de-energize power before sprinkler head operates). Typically 135F rate of rise heat detector with intermediate temperature sprinkler heads 212F and above
- Heat detector is placed within 24” of sprinkler head
- If a flow switch is serving sprinkler head in hoistway, it can also be used to de-energize power to the elevator, however there cannot be any time delay. You cannot have any software build that will cause a delay in flow switch. For nuisance pressure surges that can activate flow switch, use check valve upstream of flow switch.

Machine room less elevators

Machine room less elevators means the elevator machine is located inside the elevator shaft. See building code for guidelines (in Virginia for example machine room less elevators must be sprinkler and therefore need to meet shunt requirements).

All circuits serving the elevator recall and shunt are monitored by faults, power loss by the fire alarm panel. Not all elevator have recall functions. Fire service elevator and occupant evacuation elevators, those that are used in very tall building are designed with more robust construction and can be used for evacuation.

Testing for Recall and Shunt

Each component serving the recall and elevator function must be tested. Use smoke cans (not magnets) for smoke detectors. Use heating elements such as hair dryer for heat detector rate of rise. During activation, monitor fire alarm panel which must indicate device activated. Both designated and alternative level must be verified. If shunt trip is through water flow device then flow water (via drain and test). Remember, there needs to be immediate shunt as soon as flow occurs (no time delay). Use fire key inside elevator to confirm override functions.

Summary

- Fire alarm is an active system that alerts occupants and first responders against fires. Hundreds and thousands of lives have been saved and property damage averted due to the properly designed, inspected and tested fire alarm systems.
- Devices such as smoke and heat detectors, pull stations, flow and pressure switch; these are used to detect fire, smoke, heat, water flow, changes in water pressure are known as initiating devices. Via the Fire Alarm Panel (FACP), the brain of the system, signals are received from these devices (alarm, supervisory, or trouble) to trigger actions such as energize the building wide notification appliances. Notification appliances are those that provide alert, awareness, whether it is through flashes of light (strobes), bells and horns, or messages communicated through voice using the voice evacuation system to provide detail information to the occupants about safe existing.

Summary

Lastly, elevator recall and shunt trip function follow a series of steps:

- With Recall: Smoke detectors sense smoke from a fire and send signal to elevator control panel. The elevator control panel send the elevator to designated (or alternative) floor, nonstop. Upon arriving at the level the doors open and remain open unless overridden by fireman key. Alarm signal is sent to panel and entire building goes to alarm if there is a full fire alarm system (otherwise a local alarm operates).

- With Shunt: Heat buildup causes heat detector to de-energize power to elevator controls. Power can only be resorted manually. Further heat buildup opens sprinkler head located either at the top of shaft (including machine room less elevators) or in elevator machine room. Shunt trip only occurs when the elevator or elevator control panel is protected by a fire suppression sprinkler system.

THANK YOU FOR CHOOSING