



**PDHonline Course E514 (4 PDH)**

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**Design to the Fire Alarm Code, NFPA  
72-2016**

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**2020**

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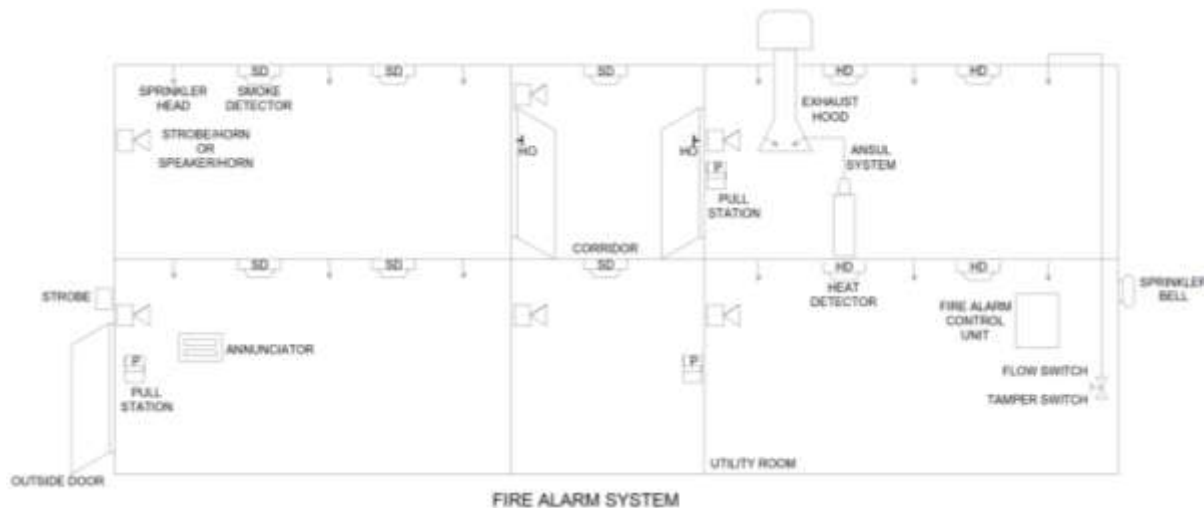
An Approved Continuing Education Provider

# Design to the Fire Alarm Code, NFPA 72-2016

*Thomas Mason, P.E.*

The first section of this course establishes context. Concepts and examples are introduced.

The second section of this course is a paragraph-by-paragraph summary of NFPA 72-2016, Ch. 10, 17, 18, 24.4, and 24.8, Fundamentals, Initiation Devices, Notification Devices, In-Building Voice Notification and Two-Way Wired Emergency Services. For design of typical commercial fire systems, the remainder of the Code is supplementary and may or may not be referenced.



This is a generic building with a generic commercial fire alarm system. The general recommendation is to include all components in the first pass design and delete later as more information becomes available. Do not leave a blank and expect to remember it later. Also, devices can be “deleted” in software if the Authority Having Jurisdiction (AHJ) prefers.









































































<b>Side Note, AHJ</b>	<b>The AHJ makes all final decisions. Any disagreement results in project delays. One exception is, if you can find supporting commentary in the Fire Alarm Code Handbook, 70HB-16.pdf, there is a good chance he will listen to reason.</b>
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The generic system includes sprinklers, fed through the shut-off valve indicated with the tag, “Flow Switch, Tamper Switch.” A single riser is shown, but the fire protection designer will provide two zones for the two floors, requiring two sets of flow switches and tamper switches. In a large or complex building, a single floor may have multiple zones and sets of fire alarm supervisory switches.

The sketch contains an omission. A smoke detector is required immediately above the FACU to assure that progressive loss of the FACU results in an alarm. Similarly, an SD is required over any extender device which supplements power and repeats digital information for distant initiation or notification devices. This is the proper point to note that the power for the FACU must come from a dedicated circuit breaker, painted red, labeled and provided with a lockable device (available sheet metal accessory).

Another oversight is carbon monoxide and nitrous / nitric oxide detectors. Carbon monoxide detectors are required by your author in spaces adjacent to concealed or exposed flues and natural gas appliances, such as boilers, water heaters, fired HVAC and kitchen appliances. Normal operation of such appliances occasionally releases carbon monoxide, which is considered acceptable. When enough is released to start moving toward occupied spaces, evacuation is required. An alarm level of 100ppm is recommended. Nitrous /nitric oxide is a similar toxic released by diesel engines (see 2015 Volkswagen scandal).

Along the ceilings are smoke detectors, tagged, “SD,” nominally 30-ft c-c, and Heat Detectors, nominally 30-ft c-c tagged “HD”. Smoke detectors are faster but sensitive to dust and vapors. There are frequently used symbols, but no standard symbols. It is important to include a SYMBOL LEGEND in your fire alarm set to identify the symbols used. DO NOT include them with ELECTRICAL SYMBOLS in the electrical set. The set gets ripped apart for each subcontractor.

<p><b>Side Note, Symbols</b></p>	<p><b>It is an error to say that there are no standard symbols. NFPA has published a standard, NFPA170-2015, which is available to view for free at NFPA.org. They are notably bad symbols. See below:</b></p> <table border="1" data-bbox="618 863 1219 1463"> <tr> <td>FIRE</td> <td></td> <td>STAIRPIPE</td> <td></td> <td>STAIRWELL PRESSURIZATION</td> <td></td> </tr> <tr> <td>HEAT DETECTOR</td> <td></td> <td>FIRE DEPARTMENT CONNECTION</td> <td></td> <td>ELEVATORS</td> <td></td> </tr> <tr> <td>SMOKE DETECTOR</td> <td></td> <td>EMERGENCY SHUTOFF</td> <td></td> <td>SECURITY CAMERAS</td> <td></td> </tr> <tr> <td>GAS DETECTOR</td> <td></td> <td>PAGING ZONE</td> <td></td> <td>ENERGY MANAGEMENT</td> <td></td> </tr> <tr> <td>MANUAL PULL STATION</td> <td></td> <td>EMERGENCY PHONE</td> <td></td> <td>POWER MONITORING</td> <td></td> </tr> <tr> <td>ALARM SOUNDING</td> <td></td> <td>ALL CALL</td> <td></td> <td>AUTOMATIC UNLOCKING EGRESS DOORS</td> <td></td> </tr> <tr> <td>ALARM SILENCED</td> <td></td> <td>SMOKE CONTROL FANS</td> <td></td> <td>ELECTRICAL ROOM</td> <td></td> </tr> <tr> <td>SPRINKLER WATERFLOW</td> <td></td> <td>SMOKE VENTS</td> <td></td> <td>HAZARDOUS MATERIALS STORAGE</td> <td></td> </tr> </table>	FIRE		STAIRPIPE		STAIRWELL PRESSURIZATION		HEAT DETECTOR		FIRE DEPARTMENT CONNECTION		ELEVATORS		SMOKE DETECTOR		EMERGENCY SHUTOFF		SECURITY CAMERAS		GAS DETECTOR		PAGING ZONE		ENERGY MANAGEMENT		MANUAL PULL STATION		EMERGENCY PHONE		POWER MONITORING		ALARM SOUNDING		ALL CALL		AUTOMATIC UNLOCKING EGRESS DOORS		ALARM SILENCED		SMOKE CONTROL FANS		ELECTRICAL ROOM		SPRINKLER WATERFLOW		SMOKE VENTS		HAZARDOUS MATERIALS STORAGE	
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The next most prominent device in the generic system is the Strobe / Speaker, nominally 30-ft c-c. The speaker is fully capable of delivering conventional tone notification, but also delivers recorded messages and live messages from the Fire Alarm Control Unit (FACU) and Annunciator.

<p><b>Sidenote, required vs optional</b></p>	<p><b>We like to think that things in NFPA 72 are required. For the most part, it works out that way. But, there are exceptions. One local Fire Marshall doesn't believe in smoke detectors and pull stations. He forbids them, in writing. We have been successful in following his instructions in areas of his authority. The elevators and HVAC come under another jurisdiction, though, and smoke detectors remain in elevator lobbies, in return air ducts of big fans and over the FACU and extender units. He does not object to heat detectors which are very</b></p>
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**widely applied on these projects.**

<b>Sidenote, voice notification</b>	<p><b>In 2007, the Fire Alarm Code was renamed, “National Fire Alarm and Signaling Code.” (Signaling, here, means emergency communications.) In the same revision, three categories were identified as more important than fire alarm. They are Weather or Natural Disaster, Toxic Spill and Terrorism.</b></p> <p><b>Voice notification is optional, see above sidenote, but it is the only reasonable way to respond to the three more important dangers.</b></p> <p><b>NFPA 72-16 specifies the content of voice notification messages, as follows:</b></p> <ol style="list-style-type: none"> <li><b>(1) Tell occupants what has happened and where</b></li> <li><b>(2) Tell occupants what they should do</b></li> <li><b>(3) Tell occupants why they should do it</b></li> </ol> <p><b>Compare this with modern newspaper and television reporting, where the headline is all teaser and it is difficult or impossible to find factual content.</b></p>
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We just picked up the FACU and Annunciator in the sidenotes. The FACU is the box that contains the computer which controls the fire alarm system. It contains batteries and non-volatile storage of events monitored by the system as alarms or trouble indications. It provides status information and detailed alarm information, as the alarm initiating detector name and location. It may have a graphic display with a map of the building and a flashing point for the detector in alarm. It contains a handset for voice notification and emergency communications (more, later).

The annunciator is a smaller version of the FACU, with all of the displays and a handset. It is located at the expected fire fighters’ entrance to the building.

Another control box, the Data Gathering Panel, can be used as a sub-panel. It handles local initiation and notification devices and shares status with two-way communications with the FACU. It continues to function with loss of communications with the FACU.

Pull stations are next on our tour. They must be placed at each personnel door.

<b>Sidenote, pull station at door</b>	<p><b>For some reason, some Owners balk at pull stations. This may be based upon the experience of having students avoid examinations by initiating an alarm. Other owners cannot envision a circumstance which includes the main entrance being blocked and secondary exits are all that is left. Pull stations alert occupants in other parts of the building.</b></p>
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Your author locates additional pull stations in high-hazard locations. We expect grease fires at a grille. A pull station permits the cook to alert the building if it gets out of control. Similarly, any flammable storage location should have means available to alert the building if danger develops.

The pull station next to the exhaust hood in the illustration is not part of the local fire suppression system. The local fire suppression system for a kitchen is usually mechanical, with manual release by “pulling a pin.” The local fire suppression system must be connected to the building fire alarm for supervision and general alarm (if so directed by the AHJ).

<b>Sidenote, Ansul</b>	<b>“Ansul” is a brand of fire suppression system commonly used in kitchens. Many persons would not recognize the term, “suppression” but recognize “Ansul”.</b>
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<b>Sidenote, kitchen suppression auxiliaries</b>	<p><b>The AHJ may or may not require that a local suppression trip disconnect lights under the hood, power to electric cooking appliances and shut-off of natural gas cooking appliances. It is recommended that the designer include these features in the initial design. Shunt-trip circuit breakers, in the panel or external, work well. External contactors work well. The natural gas solenoid valve requires coordination with the piping designer as to pipe diameter, normally-open or normally-closed. The electrical designer records the decision on 24 VDC (direct fire alarm connection) or 120VAC (with a control interface module from the fire alarm). Identify which contractor supplies the valve.</b></p> <p><b>Note that The Mechanical Designer specifies the stand-alone suppression system.</b></p>
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Still inside, we find devices marked “HO” at the doors to the corridor. These are magnetic Hold Opens. The Architect chooses these on a Door Schedule but they are wired into the fire alarm to permit the door to spring closed upon alarm.

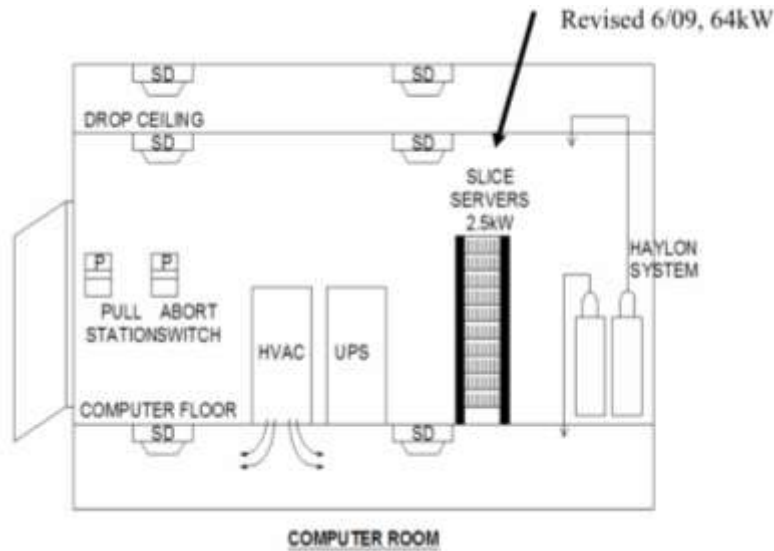
Magnetic door hold opens cause problems on some projects. Your author’s interpretation of the Code is that smoke detectors are required on both sides of a door with a hold open. Your author prefers permanent magnet hold opens that get a shot of 24VDC from the fire alarm in order to release. They draw 10 / 1,000 A. Other forms are acceptable, but more complicated.

If the corridor is long, over 200-ft, an intermediate pull station is required. There will be a pull station at each end, just this side the stair or exit door.

The strobe outside the building is required in some jurisdictions. Your author includes it on all projects. It is an additional aid to the fire fighters. Not shown is a Knox Box. This is a substantial box containing a key to be building. Only fire fighters have access to the box.

Also outside the building is a Sprinkler Bell. This is required by the Sprinkler Code and easily provided by the fire alarm. The alternative is a non-supervised local electric bell or a hydraulic motor that dumps water on the ground nearby. The source location of this course is Northern Ohio, where dumped water in -20F weather is a hazard.

Another common space in a commercial structure is the Computer Room. A generic sketch follows:

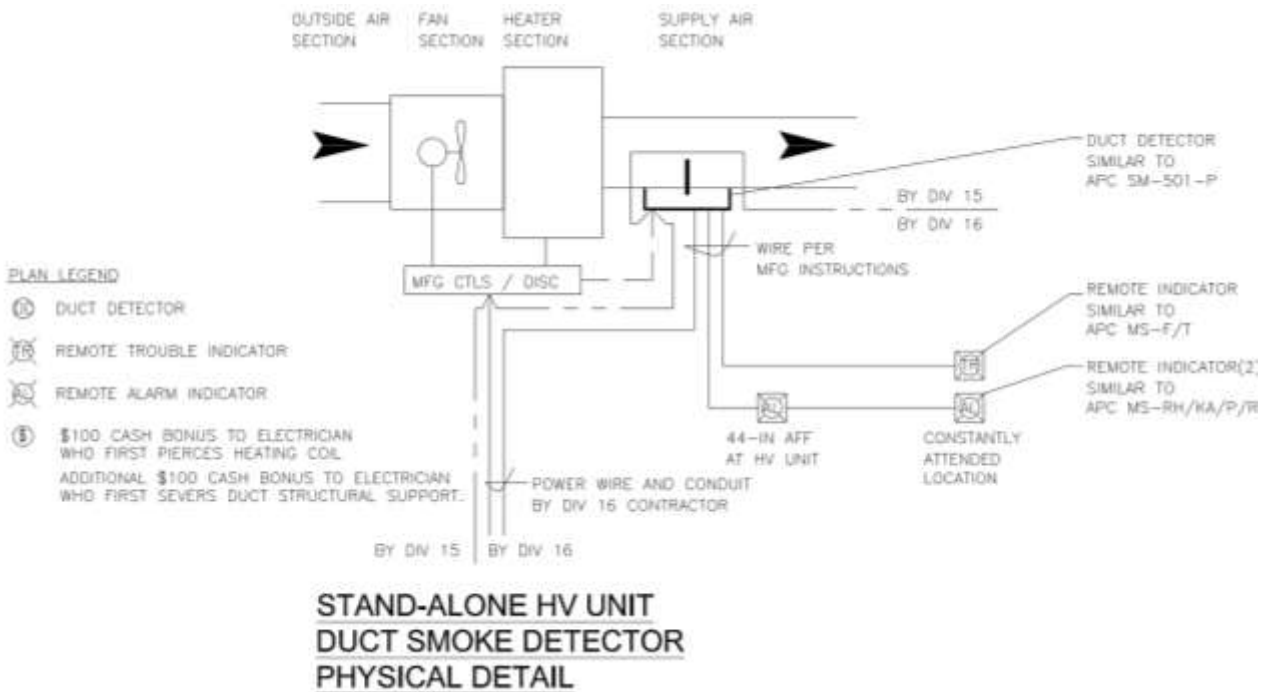


There are two, independent fire alarm systems in this computer room. The Mechanical Designer selected a stand-alone suppression system with smoke detectors, a powder or gaseous suppression agent, shut-down of power UPS / PDU, shut-down of HVAC, manual trip and manual abort. The building fire alarm monitors the local suppression system for alarm or trouble.

The smoke detectors in the above-ceiling space and in the below-floor space are for the local suppression system. The power loads are shown to indicate the high air velocity required for conventional cooling. Special duct detectors are used on HVAC to accommodate these high velocities. Leading edge technology includes distribution of coolant to the walls of the racks and to the heat sinks of the individual rack equipment.

The smoke detectors in the occupied space are for the building fire alarm system. They are not connected physically or logically to the suppression system.

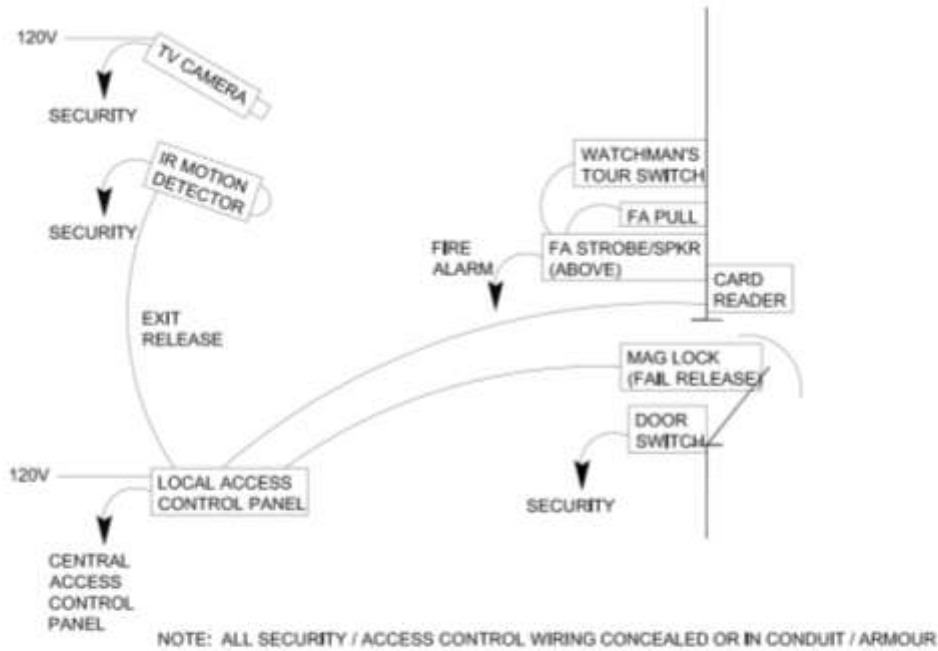
<b>Sidenote, Haylon</b>	<b>Haylon is a legacy brand, now forbidden by EPA. It is commonly recognized in function. It cost \$1,000 to test a Haylon system and refill the tanks 30 years ago.</b>
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HVAC duct detectors were mentioned in the discussion of Computer Room HVAC. Above is a detail from a job. The fire alarm designer must ask the HVAC designer for locations of duct detectors and connected dampers. We translate this information to symbols and tags on the electrical plan diagram. Normally, the canned fire alarm specification takes care of equipment selection.

<p><b>Sidenote, HVAC interfaces</b></p>	<p><b>Ask the HVAC Designer for locations of duct detectors and dampers which require fire alarm or electrical connection. Write a note about the conversation and put it in the project file.</b></p> <p><b>Check the bid set HVAC to see if he has added any since you talked.</b></p> <p><b>Normally, the HVAC designer selects the duct detectors and required reset stations.</b></p>
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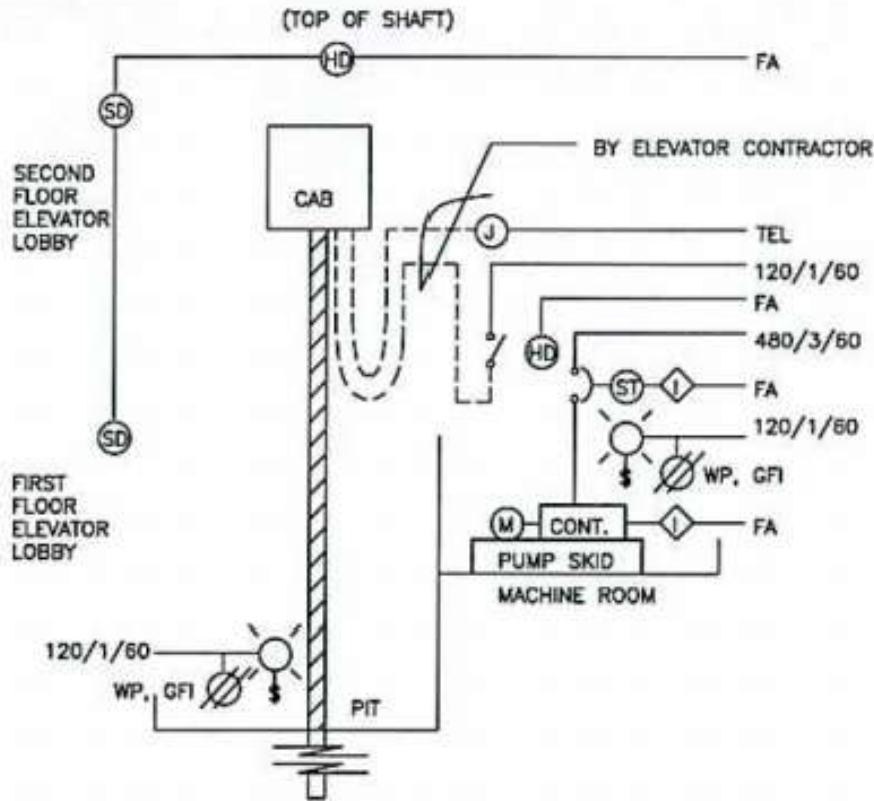


## DOOR SECURITY / ACCESS CONTROL DETAIL

Above is a detail for electronics at an outside door. It is current, except that power is now provided on the data lines via Power Over Ethernet (POE). Watchman's tour switch is commonly included in fire alarm.

<p><b>Sidenote, unimpeded path of egress</b></p>	<p><b>The rule is that during an emergency, occupants must be able to get out. The security system can include a magnetic lock, but it must be released during an emergency. For us, that means a connection to the fire alarm. Other methods of releasing the mag lock are the motion detector, shown, a Request To Exit (RTX) button or an electric panic bar. A fail-secure mag lock can be used if approved by the Authority Having Jurisdiction.</b></p>
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**1** ELEVATOR CONNECTIONS  
SCALE: NONE

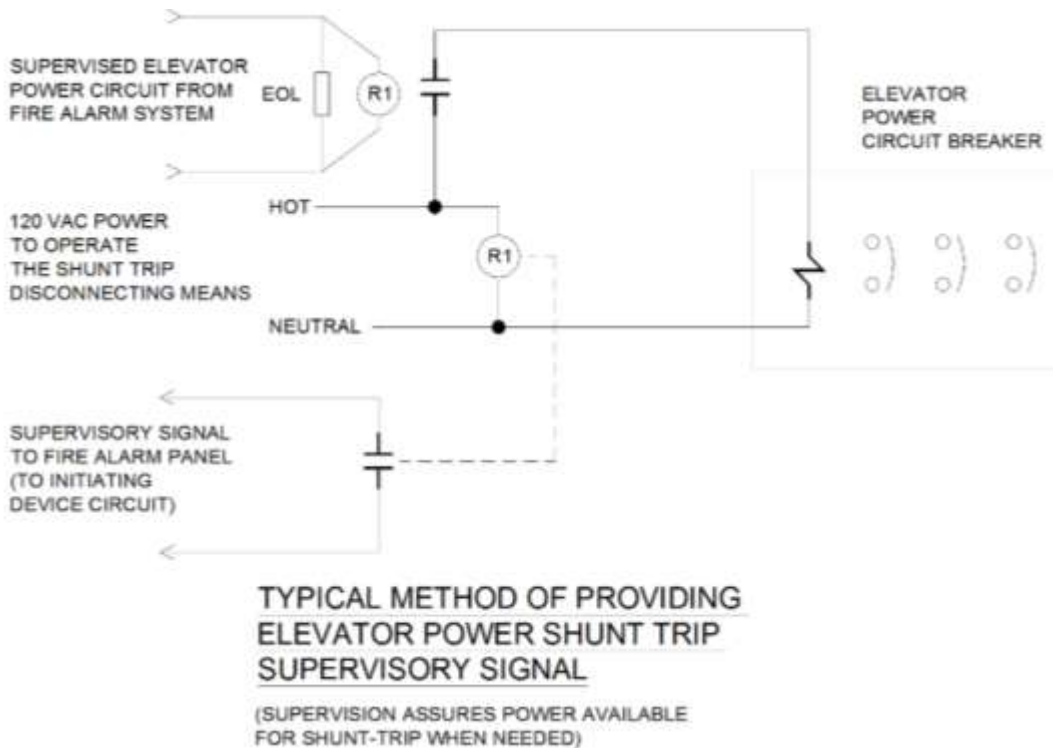
Above is a detail from a school Bid Set, some years ago. Note the heat detector in the shaft and the shunt-trip on the elevator power. A current specification, with more requirements, is reproduced below:

- C. Electrical Service, Conductors, and Devices:
  1. Lighting and GFCI convenience outlets in pit, machine room, and overhead machinery spaces. Provide one additional non-GFCI convenience outlet in pit for sump pump and oil return pump.
  2. Three-phase mainline copper power feeder with true earthen grounding to terminals of each elevator controller in the machine room with protected, lockable "open" disconnecting means with auxiliary contacts to allow Elevator Contractor to electronically interlock battery power lowering unit.
  3. Single-phase copper power feeder to each elevator controller for car lighting and exhaust blower with individual protected, lockable "open" disconnecting means located in machine room.
  4. Emergency telephone line to each designated elevator control panel in elevator machine room.

5. Fire alarm initiating devices in each elevator lobby for each group of elevators or single elevator and each machine room to initiate firefighters' return feature. Device at top of hoistway if sprinklered. Provide alarm initiating signal wiring from hoistway or machine room connection point to elevator controller terminals. Device in machine room and at top of hoistway to provide signal for general alarm and discrete signal for Phase II firefighters' operation.
6. Firefighters' telephone and announcement speaker in car with connection to individual elevator control panels in elevator machine room and elevator control panel in firefighters' control room when required by local AHJ.
7. When machine room and/or equipment areas are sprinklered, means to automatically disconnect power to affected elevator pump unit and controller prior to activation of machine room fire sprinkler system and/or hoistway fire sprinkler system. Manual shut-off means shall be located outside bounds of machine room.
8. When sprinklers are provided in the hoistway all electrical equipment located less than 4'-0" above the pit floor shall be identified for use in wet locations. Exception: seismic protection devices.

Present National Electric Code interpretations require that all 120V pit receptacles and power sources be GFCI protected.

An NFPA 72 requirement, not commonly followed, is for supervision of the shunt-trip on the elevator power. This is so power is disconnected before the sprinklers start.



Another little known requirement is for two-way communications with the elevator lobby and stairwells. Two-way communications (telephone) to the elevator cab is commonly known as emergency communications (voice call box) in identified Areas of Safe Refuge. Below is an excerpt from the International Building Code on emergency two-way communications. The introductory note is from the speaker at a fire alarm seminar (by e-mail).

The two-way area of refuge communication is required in lobbies even in sprinklered buildings that don't have physical area of refuge. That requirement comes from the following IBC code section. It buried in the accessible egress requirements of the code.

ing with Section 1025. Each *area of refuge* shall be designed to minimize the intrusion of smoke.

**Exception:** *Areas of refuge* located within an enclosure for *exit access stairways* or *interior exit stairways*.

**1007.6.3 Two-way communication.** *Areas of refuge* shall be provided with a two-way communication system complying with Sections 1007.8.1 and 1007.8.2.

**1007.7 Exterior area for assisted rescue.** Exterior areas for assisted rescue shall be accessed by an *accessible route* from the area served. Exterior areas for assisted rescue shall be permitted in accordance with Section 1007.7.1 or 1007.7.2.

**1007.7.1 Level of exit discharge.** Where the *exit discharge* does not include an *accessible route* from an *exit* located on a *level of exit discharge* to a *public way*, an exterior area of assisted rescue shall be provided on the exterior landing in accordance with Sections 1007.7.3 through 1007.7.6.

**1007.7.2 Outdoor facilities.** Where *exit access* from the area serving outdoor facilities is essentially open to the outside, an exterior area of assisted rescue is permitted as an alternative to an *area of refuge*. Every required exterior area of assisted rescue shall have direct access to an *interior exit stairway*, *exterior stairway*, or elevator serving as an *accessible means of egress* component. The exterior area of assisted rescue shall comply with Sections 1007.7.3

buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2.

**1007.8 Two-way communication.** A two-way communication system shall be provided at the elevator landing on each *accessible floor* that is one or more stories above or below the *story of exit discharge* complying with Sections 1007.8.1 and 1007.8.2.

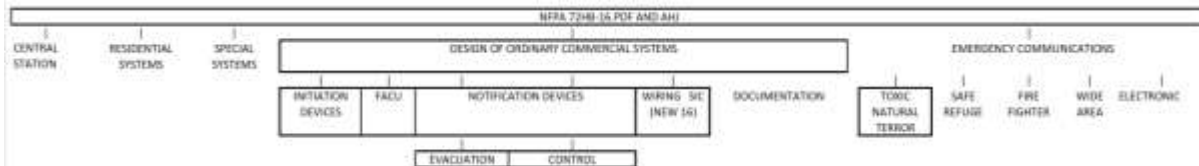
**Exceptions:**

1. Two-way communication systems are not required at the elevator landing where the two-way communication system is provided within *areas of refuge* in accordance with Section 1007.6.3.
2. Two-way communication systems are not required on floors provided with *ramps* conforming to the provisions of Section 1010.

**1007.8.1 System requirements.** Two-way communication systems shall provide communication between each required location and the fire command center or a central control point location *approved* by the fire department. Where the central control point is not constantly attended, a two-way communication system shall have a timed automatic telephone dial-out capability to a monitoring location or 9-1-1. The two-way communication system shall include both audible and visible signals.

Do not assume that the Project Architect is familiar with these requirements. Put emergency communications stations in. It is acceptable to simply show a box and the tag, "EC" on plan drawings, with explanation on the Symbol Legend Sheet. If someone tells you to delete them, write down who and when and put the note in the project file.

Before starting Section Two, Code Summary, please consider the following graphic which shows the relationships among the Code and design responsibilities to be reviewed:



The top level is 72HB-16.pdf. This is a searchable, printable .pdf that you buy from NFPA for about \$150. It can be loaded on multiple computers, for use at work, at home, on the road and at the construction office. This license permits use by only one person. New this year is the ability to print from the .pdf. New, recently, is the ability to view low-resolution .pdf's of NFPA documents for free, at NFPA.org.


The top level is 72HB-16.pdf and AHJ. This is a reminder, as previously explained, that we really work for the Authority Having Jurisdiction. The Code is a powerful tool, but only a tool.

The next layer down indicates many of the topics in the Code. The boxes indicate those which are intentionally included in this course. Most of it should be self-evident. Not so obvious is the separation of notification into evacuation and control. This is not the way it is presented in the Code but may be a better way of conceptualizing.



When an alarm event is determined by the computer that is the FACU, it trips the evacuation notification devices - strobes and speakers. However, there are a range of control functions which must occur simultaneously. Elevators are commanded to return to a safe exit floor; mag locks are released; a call is made to the central monitoring station; the HVAC system goes into smoke control mode.

<b>Sidenote, more than strobes and speakers</b>	<b>The 2016 edition of NFPA 72 expands notification to include emergency communications systems in Chapter 24. A.24.3.8 adds short message service (SMS), e-mail, computer pop-ups, smart phone applications (Apps), reverse 911 / automated dialing broadcast media, message boards and social networks. Tactile notification is under development.</b>
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What information should an effective emergency message contain?

Research shows that the message is one of the most important factors in determining the effectiveness of a warning system and that the message must provide the following content:

- Information on the hazard and danger
- Guidance on what action people should take
- Description of the risk or hazard location
- Direction on when people need to act
- Name of the warning source (who is giving it)

Warning style is also crucial — it must be specific, consistent, certain, clear, and accurate. See also the requirements located in [24.3.6](#).

Compare these message directions with those quoted at the beginning of the course. Those instructions are for a fire emergency only.

The next not-so-obvious topic is wiring. It is critical to design and operation of the fire alarm. However, it is completely neglected in this course beyond the statement, “per manufacturer’s recommendations, in red enamel painted electrical metallic conduit and not less than type FLP cable rating.”

In order to make a fire alarm design biddable, the designer must not specify vendor-specific components. There are a range of digital wiring types used by different manufacturers. Beyond supporting the digital communications of the system, the wiring must provide power for the digital part of pull stations and the digital and processing portions of smoke detectors, heat detectors and addressable control devices. Similarly, the wiring must provide power for the digital, processing and notification portions of strobe speakers.

Some design firms design and select wiring to a single manufacturer, then require a substitute manufacture refigure the load and voltage drop calculations and submit the calculations for

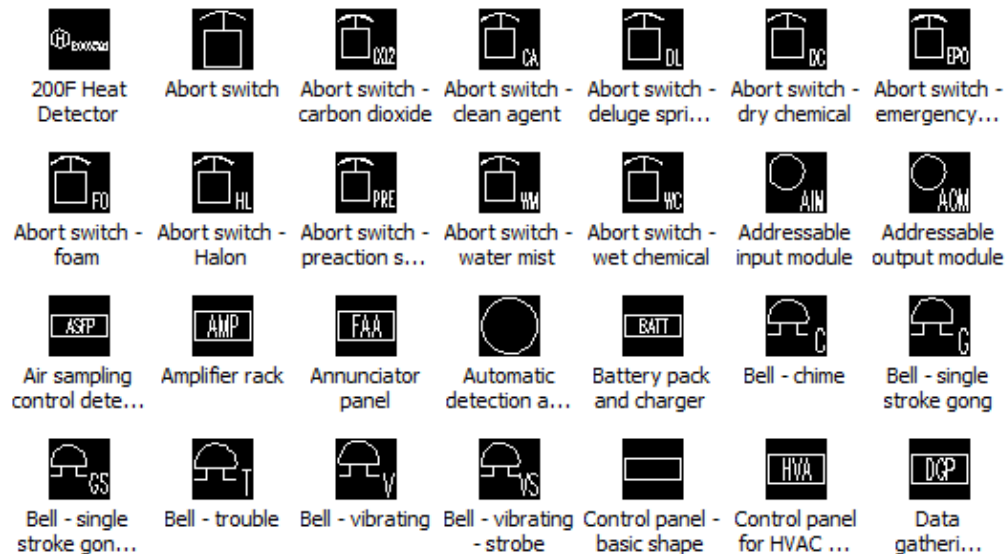
review. Since the ultimate review of the load and voltage drop calculations lies with the AHJ, design firms in my geographic locality leave all wiring selection to the vendor.







































































Similarly, documentation is of critical importance. This is new. Installed systems normally have no documentation at all, beyond manufacturers' nameplates. Today, the Code, and many AHJ, require full documentation before the acceptance test by the AHJ. There are two chapters (7 and 14) of blank forms. Since this is between the installing Contractor and the AHJ, design firms in my geographic locality do not invest design hours to this task.

A fire alarm design is communicated to Plans Reviewers and Contractors for Bid by means of legend sheets, plan drawings, schematic drawings, schedules and details. Samples of each are offered for review. Some commentary is offered for each.

### LEGEND SHEETS

The fire alarm symbols provided by AutoDesk with AutoCAD MEP 2013 are reproduced below. On a plan sheet, they show up as black lines and black text on the white background. In use, the drafter clicks on a symbol and drags it to the plan location, places it, then rotates it to the desired orientation.



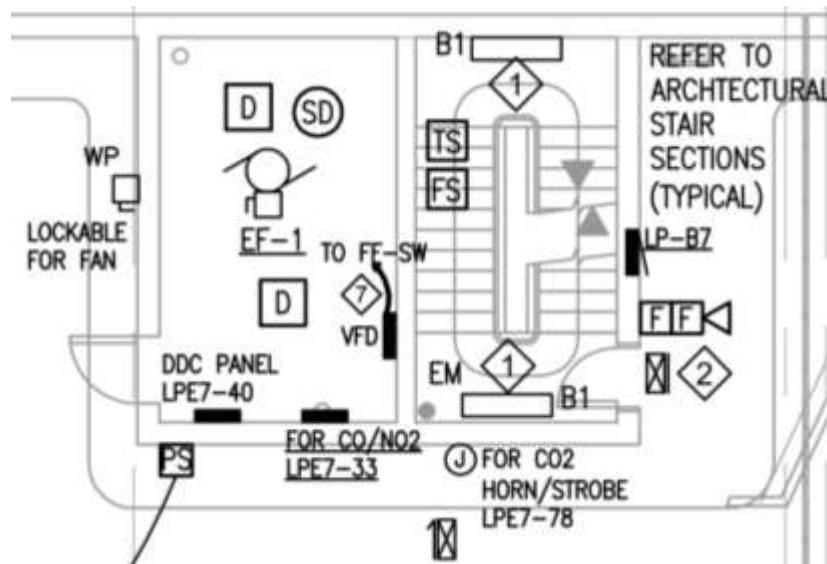
						
Duct Heat Detector	Duct Smoke Detector	Elevator status-recall	End Of Line Resistor	Fire Alarm Annunciator	Fire alarm communicator	Fire alarm control panel
						
Fire Alarm Control...	Fire alarm control unit	Fire Alarm Door Hold...	Fire Alarm Door Hold...	Fire Alarm Door Hold...	Fire Alarm Door Holde...	Fire Alarm Flow - Circle
						
Fire Alarm Flow - Square	Fire Alarm Hold Open	Fire Alarm Horn	Fire Alarm Horn - Stro...	Fire Alarm Horn - Stro...	Fire Alarm Horn - ...	Fire alarm master box
						
Fire Alarm Mini Horn	Fire Alarm Pull Box	Fire Alarm Remote ...	Fire Alarm Remote Panel	Fire Alarm Speaker	Fire Alarm Strobe ...	Fire Alarm Strobe 1
						
Fire Alarm Strobe 2	Fire Alarm Tamper...	Fire Alarm Tamper...	Fire alarm termin...	Fire Alarm Transponder	Fire alarm transpond...	Fire command system
						
Fire Pump Remote Sta...	Fire service or emergency ...	Fire service or emergency ...	Fire service or emergency ...	Fire service or emergency ...	Fire system annuncia...	Fire system control panel
						
Fire system control pa...	Fire system control pa...	Fire system control pa...	Fire system control pa...	Fire system control pa...	Fire system control pa...	Fire system control pa...
						
Fire system control pa...	Firefighter's Control a...	Firefighter's Telephon...	Fireman Phone	Fixed 135F Heat Detector	Fixed 200F Heat Detector	Fixed Heat Detector
						
Flame detect...	Flame detector - ...	Flame detect...	Flame detect...	Flame detecto...	Flame detect...	Flow detector - switch
						
Gas detector	Gong	Heat Det 2	Heat Detector	Heat detector - combinati...	Heat detector - fixed tem...	Heat detector - line-type ...

Heat detector - rate comp...	Heat detector - rate of ris...	Heat detector (thermal de...	Hex Smoke Detector - D	Hex Smoke Detector - E	Hex Smoke Detector - S	Horn with light as one asse...
Horn with light as separate...	Indicator Light	Level detector - switch	Manual station	Manual station - carbon dio...	Manual station - clean agent	Manual station - deluge spr...
Manual station - dry chemical	Manual station - foam	Manual station - Halon	Manual station - pull station	Manual station - water mist	Manual station - wet chemical	Master Fire Station
Mini-horn	Output relay	Plain Hex Smoke...	Plain Round Smoke D...	Pressure detect...	Purge panel	Rate of Rise 135F Hea...
Rate of Rise 200F Hea...	Rate of Rise Heat Detector	Relay alarm panel	Remote alarm indicating a...	Remote MIC for voice ...	Rotating beacon	Round Smoke Smoke Det...
Round Smoke Smoke Det...	Smoke-heat detector	Smoke detector	Smoke detector - ...	Smoke detector - ...	Smoke detector...	Smoke detector...
Round Smoke Smoke Det...	Smoke-heat detector	Smoke detector	Smoke detector - ...	Smoke detector - ...	Smoke detector...	Smoke detector...
Smoke detector - ...	Smoke detector ...	Speaker-horn (electric horn)	Sprinkler alarm panel	Tamper detector	Temperature switch - hi...	Temperature switch - lo...
Voice communicati...	Voice evacuati...	Water motor alarm (wa...				

Conventionally, circle-devices are ceiling-mounted and box-devices are wall-mounted. Your author has a strong aversion to condensed-width text as being unreadable.

### PLAN DRAWINGS





This is a fan room for an underground ground garage and the adjacent stairwell. The HVAC system utilizes carbon dioxide and nitrous /nitric oxide detectors to start the fans. The same toxic gas detectors are used to initiate evacuation. Fans start at 10ppm. Evacuation sounds at 100ppm.

PS is the power supply for the CO / NO<sub>x</sub> sensors. Box-D are duct detectors in the exhaust fan ducts. SD is a ceiling-mounted smoke detector in the fan room. The outside fan disconnect switch was included as an absolute safety for maintenance persons entering the fan room.

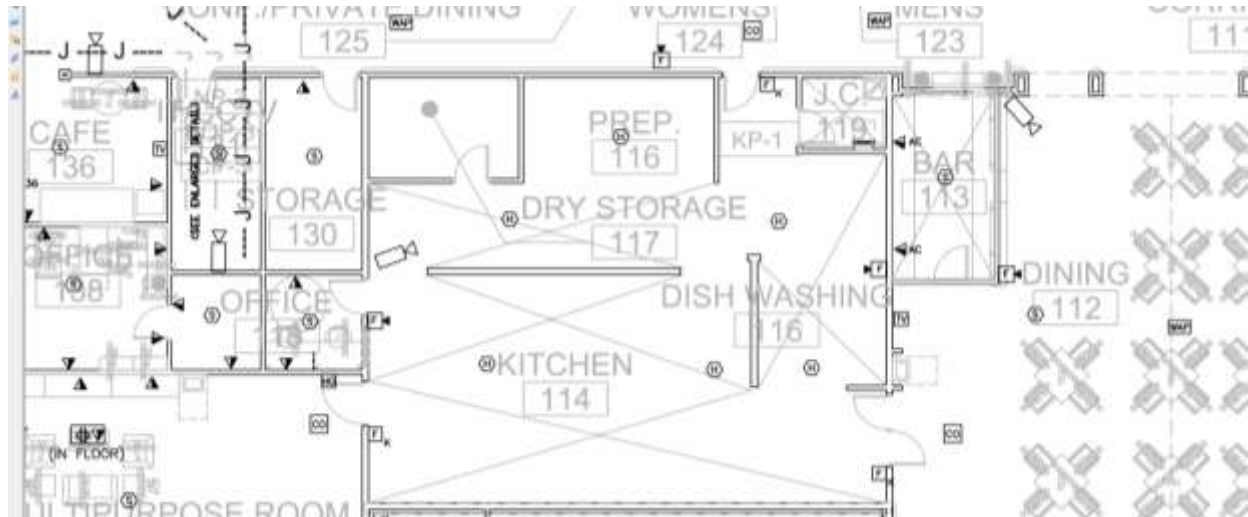
Outside the stairwell are a hand pull station and strobe / speaker. I like to keep these together to provide feedback to the occupant that his pull station operation was recognized and acted upon.

Notes 1 and 2 refer to lighting. Note 7 refers to the Fire Fighters' Fan Control Panel adjacent to the Fire

Alarm Control Unit, in the garage office. There is a manual switch to force each fan into high-speed operation.

In the adjacent stairwell are located tamper switch and flow switch for the sprinkler system. The tamper switch operates when the valve is moved from full-open position. The flow switch is a sail in the 8-in pipe which moves and operates the switch on for of water. UL requires that it changes contact state when the flow to a single sprinkler head takes place.

Note that the duct smoke detectors, flow and tamper switches are selected and located by mechanical designers. The electrical designer and Electrical Contractor are responsible for getting them connected to the fire alarm.



This is the food preparation area of a skilled nursing center. The kitchen equipment had not been confirmed at the time of preparation of this plan. Note the heat detectors throughout. Vapors will be present which would cause false-trips of smoke detectors. Similarly, “puffs” from gas appliances would trip carbon monoxide detectors.

Heat detectors are 10x slower than smoke detectors. As we gain more experience with IR fire detectors, we may be able to better protect vapor-laden occupancies. Integral seconds delay in firefighter response correspond to percent loss and increased reconstruction cost. The benefits of fast alarm initiation for evacuation are obvious.

Smoke detectors are located in occupied spaces adjacent to food preparation, as are carbon monoxide detectors.

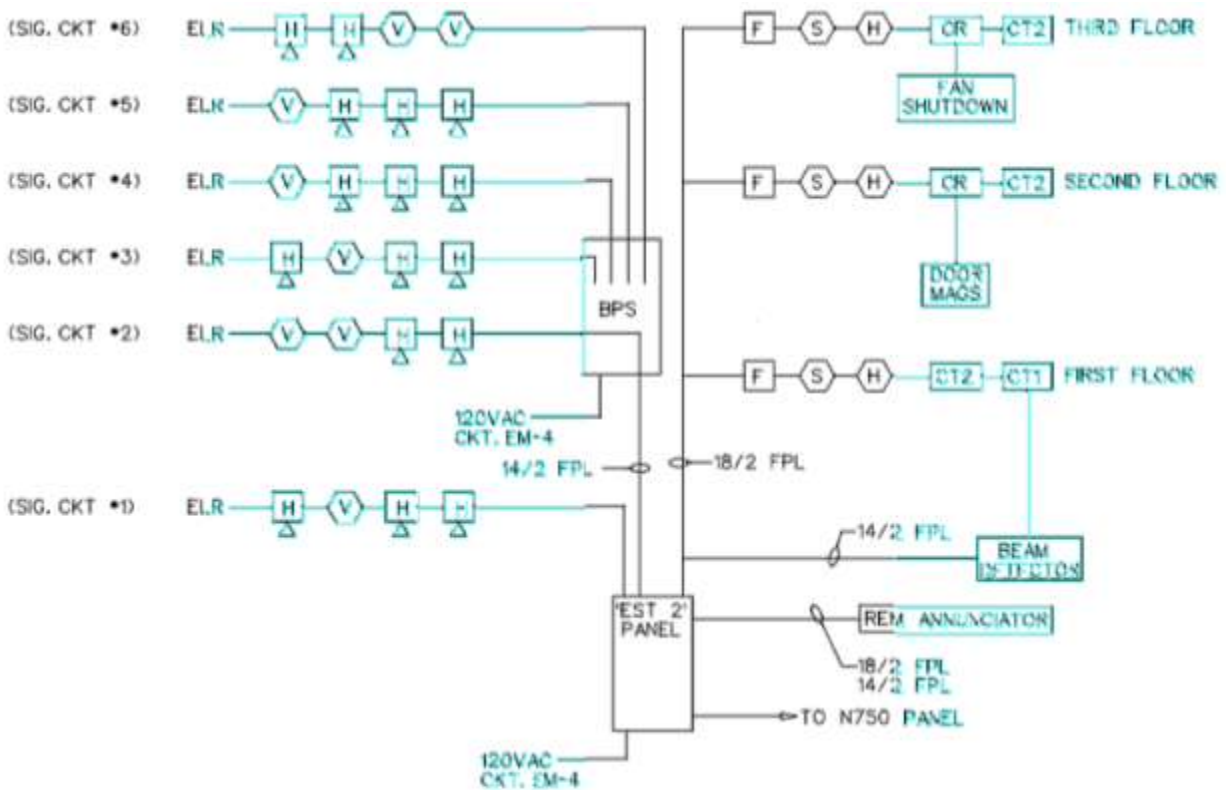
In a skilled care facility, there are trained persons on duty 27/7. Under these circumstances key-limited pull stations are permitted, so long as each staff member carries a key.

The operators of skilled nursing facilities are very focused on their business. On this sheet I was trying to initiate the idea of security CCTV recording of who carries slabs of meat out of the cooler and the benefits of wi-fi throughout.

### **SCHEMATIC DRAWINGS**

The summary schematic diagram for a fire alarm system is called the Riser Diagram (not to be confused with the main vertical pipe of the sprinkler system, which is also called the riser.)

Today, there is always a disclaimer that the drawing is representative and not specific to the job. Previously, and today, in some parts of the country, a job-specific riser is prepared. The representative diagram shows all components which might be present. The job-specific riser shows the actual components, the actual count and physical locations, identified by room and corridor numbers.



## FIRE ALARM SYSTEM

NOT TO SCALE

### NOTES:

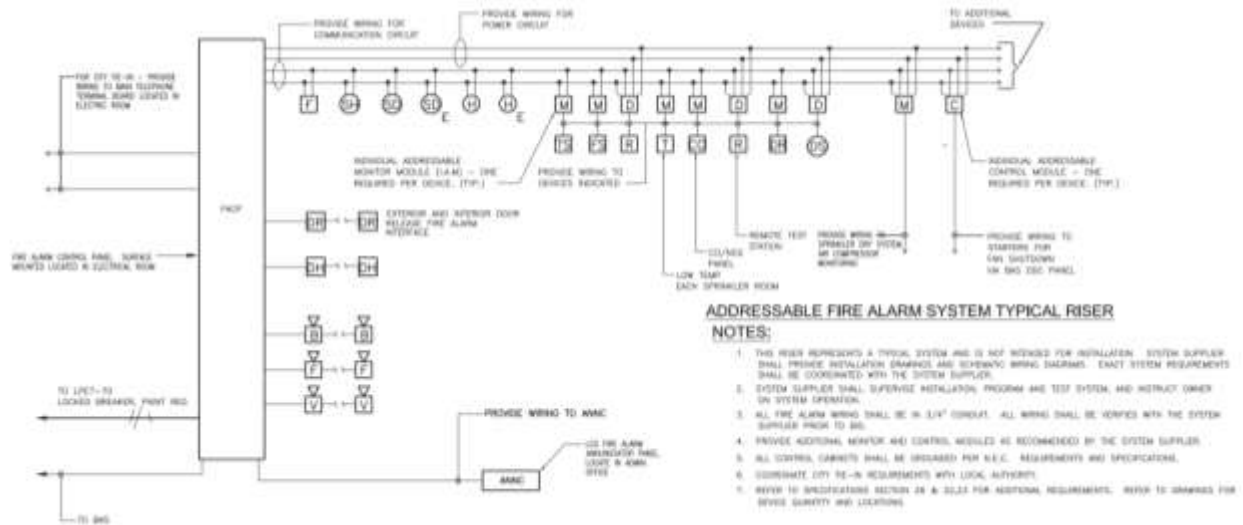
1. TYPICAL RISER DIAGRAM. VERIFY QUANTITY AND LOCATION OF DEVICES FROM POWER/COMM. PLANS. (SHEETS E2.0, E2.1 & E2.2)
2. REFER TO MECHANICAL SPECS FOR SMOKE CONTROL SEQUENCE OF OPERATION. (SECTION 15985)

Several comments must be made about this riser diagram. First, the cyan color was created by the plot-to-.pdf operation. The original was a 2001 .pdf which was inserted into a 2013 AutoCad drawing as a reference. It displayed properly on the screen and plotted to paper correctly. Plotting to .pdf was not so good.

The abbreviations shown are not explained on the accompanying Legend Sheet. EL.R refers to *End-of-Line Resistor*, an essential component in 1950's hard-wired systems. The system represented is an electronic system and most likely does not have end-of-line resistors. CR, CT1 and CT2 are *smart* fire alarm interfaces. They have system addresses and provide inputs to the fire alarm computer or outputs from the fire alarm computer. As UL-listed fire alarm devices, they are supervised, meaning that a malfunction is reported to the Fire Alarm Control Unit (this is the new name for the Fire Alarm Control Panel / computer).

N750 is a security control panel. Be careful with such interfaces. The safest is "dry contacts". That means a set of relay contacts is provided on one end with copper wires in conduit going to the other end. Test voltage and closure sensing takes place on the other end. This form is extremely unlikely to damage either end in any foreseeable malfunction. Digital interfaces are offered by vendors, termed gateways. They are new and relatively unmaintainable. A meter or battery and light demonstrates operation of dry contacts.

There are beam detectors which are extremely economic fire protection devices for large spaces. There beam detectors which are extremely economic intrusion alarms for security systems. They are very different. This diagram gives little information. The general rule is to keep foreign systems out of the fire alarm. This is a recognized rule for life-safety systems.



This is the riser diagram from the underground parking garage renovation. The “E” subscript usually means to re-use existing devices. If this is done, then the installing Contractor provides no warranty or free-callback visits.

Note the conflict between fire-alarm-shuts-down-fans and firefighter-turn-on-fans. Shut-down is a normal control and turn-on is an emergency override. The VFD manufacturer has thought through a wide range of control schemes and is not stressed by this request.

**SCHEDULES**

Vendor-provided fire alarm specifications will include schedules of products and part numbers. This is undesirable for Construction Documents intended for Bid. The only really appropriate area would be the application of fixed heat detectors. Today, however smart analog-addressable heat detectors report the actual temperature and let the computer in the fire alarm control unit apply trip thresholds and rate-of-rise limits. Be aware that fixed heat detectors are available for operation above 400F.

**TABLE 17.6.2.1** Temperature Classification and Color Code for Heat-Sensing Fire Detectors

Temperature Classification	Temperature Rating Range		Maximum Ceiling Temperature		Color Code
	°F	°C	°F	°C	
Low*	100–134	39–57	80	28	Uncolored
Ordinary	135–174	58–79	115	47	Uncolored
Intermediate	175–249	80–121	155	69	White
High	250–324	122–162	230	111	Blue
Extra high	325–399	163–204	305	152	Red
Very extra high	400–499	205–259	380	194	Green
Ultra high	500–575	260–302	480	249	Orange

\*Intended only for installation in controlled ambient areas. Units shall be marked to indicate maximum ambient installation temperature.

It has been very difficult to obtain numeric information on addressable analog heat detectors. One vendor provided the following:



**Series 65A Heat Detector**

The Series 65A Heat Detector monitors temperature by using a dual thermistor network which provides a voltage output proportional to the external air temperature. There are nine heat detectors in the Series 65A range designed to suit a wide variety of operating conditions.

- Can be used for applications where smoke detectors are unsuitable
- Ideal environments that are dirty or smoky under normal conditions
- Wide operating voltage
- Flashing LED option
- Flashing LED and magnet operated test switch option

<b>Series 65A Heat Detector</b>	
135°F - Standard	55000-140
135°F - flashing LED	55000-139
135°F - flashing LED and magnetic test switch	55000-138
170°F - Standard	55000-143
170°F - flashing LED	55000-142
170°F - flashing LED and magnetic test switch	55000-141
200°F - Standard	55000-146
200°F - flashing LED	55000-145
200°F - flashing LED and magnetic test switch	55000-144

**SIGNALING**




The major manufacturers, Tyco, Honeywell, Siemens, would reveal nothing.

**SPECIFICATIONS**

The following is the on-sheet specification being used for an April, 2016, construction project:

**ANALOG ADDRESSABLE VOICE-NOTIFICATION FIRE ALARM SYSTEM**

1.01 MANUFACTURERS

A. FIRE ALARM CONTROL UNITS - BASIS OF DESIGN: HONEYWELL

1.02 FIRE ALARM SYSTEM

- A. FOR REMODELLING JOBS, EXTEND EXISTING SYSTEM USING NEW DEVICES OF THE ORIGINAL MANUFACTURER OR LABELED AS BEING COMPATIBLE WITH THAT SYSTEM.
  
- B. EACH FIRE ALARM CONTROL UNIT MUST BE FED BY A DEDICATED 120V CIRCUIT, WITH THE LOCKED BREAKER PAINTED RED AND LABELED, "FIRE ALARM". THERE MUST BE A SMOKE DETECTOR OVER THE FIRE ALARM CONTROL UNIT LOCATION. THERE MUST BE A SMOKE DETECTOR OVER EACH LOOP EXTENDER INSTALLED.
  
- C. FOR NEW CONSTRUCTION FIRE ALARM SYSTEM: PROVIDE A NEW ANALOG ADDRESSABLE VOICE NOTIFICATION LIFE-SAFETY AUTOMATIC FIRE DETECTION AND ALARM SYSTEM:
  - 1. PROVIDE ALL COMPONENTS NECESSARY, REGARDLESS OF WHETHER SHOWN IN THE CONTRACT DOCUMENTS OR NOT.
  
  - 2. PROTECTED PREMISES: ENTIRE BUILDING SHOWN ON DRAWINGS.
  
  - 3. COMPLY WITH THE FOLLOWING; WHERE REQUIREMENTS CONFLICT, ORDER OF PRECEDENCE OF REQUIREMENTS IS AS LISTED:
    - a. THE REQUIREMENTS OF THE LOCAL AUTHORITY HAVING JURISDICTION.
  
    - b. APPLICABLE LOCAL CODES.
  
    - c. NFPA 72; WHERE THE WORD "SHOULD" IS USED CONSIDER THAT PROVISION MANDATORY; WHERE CONFLICTS BETWEEN REQUIREMENTS REQUIRE DEVIATION FROM NFPA 72, IDENTIFY DEVIATIONS CLEARLY ON DESIGN DOCUMENTS.
  
    - d. THE CONTRACT DOCUMENTS (DRAWINGS AND SPECIFICATIONS).
  
    - e. THE AMERICANS WITH DISABILITIES ACT (ADA).
  
  - 4. EVACUATION ALARM: MULTIPLE SMOKE ZONES; ALLOW FOR EVACUATION NOTIFICATION OF ANY INDIVIDUAL ZONE OR COMBINATION OF ZONES, IN ADDITION TO GENERAL EVACUATION OF ENTIRE PREMISES.



5. GENERAL EVACUATION ZONES: EACH SMOKE ZONE IS CONSIDERED A GENERAL EVACUATION ZONE UNLESS OTHERWISE INDICATED, WITH ALARM NOTIFICATION IN ALL ZONES ON THE SAME FLOOR, ON THE FLOOR ABOVE, AND THE FLOOR BELOW.

B. CIRCUITS:

1. NOTIFICATION APPLIANCE CIRCUITS (NAC): CLASS B, STYLE W.
2. SIGNALING LINE CIRCUITS (SLC) WITHIN SINGLE BUILDING: CLASS B, STYLE 0.5.
3. INITIATING DEVICE CIRCUITS (IDC): CLASS B, STYLE A.

C. POWER SOURCES:

1. EACH COMPUTER SYSTEM: PROVIDE UNINTERRUPTIBLE POWER SUPPLY (UPS).
2. SECONDARY: STORAGE BATTERIES.
3. CAPACITY: SUFFICIENT TO OPERATE ENTIRE SYSTEM FOR PERIOD SPECIFIED BY NFPA 72.

1.03 FIRE SAFETY SYSTEMS INTERFACES

A. SUPERVISION: PROVIDE SUPERVISORY SIGNALS IN ACCORDANCE WITH NFPA 72 FOR THE FOLLOWING: EMERGENCY GENERATOR, FIRE PUMP AND STAND-ALONE SUPPRESSION SYSTEMS, IF PRESENT.

B. ALARM: PROVIDE ALARM INITIATION AND NOTIFICATION IN ACCORDANCE WITH NFPA 72 FOR THE FOLLOWING: INITIATION DEVICES, NOTIFICATION DEVICES, ELEVATOR, HVAC SMOKE CONTROL DEVICES, EXTERIOR BELL AND STROBE, IF PRESENT.

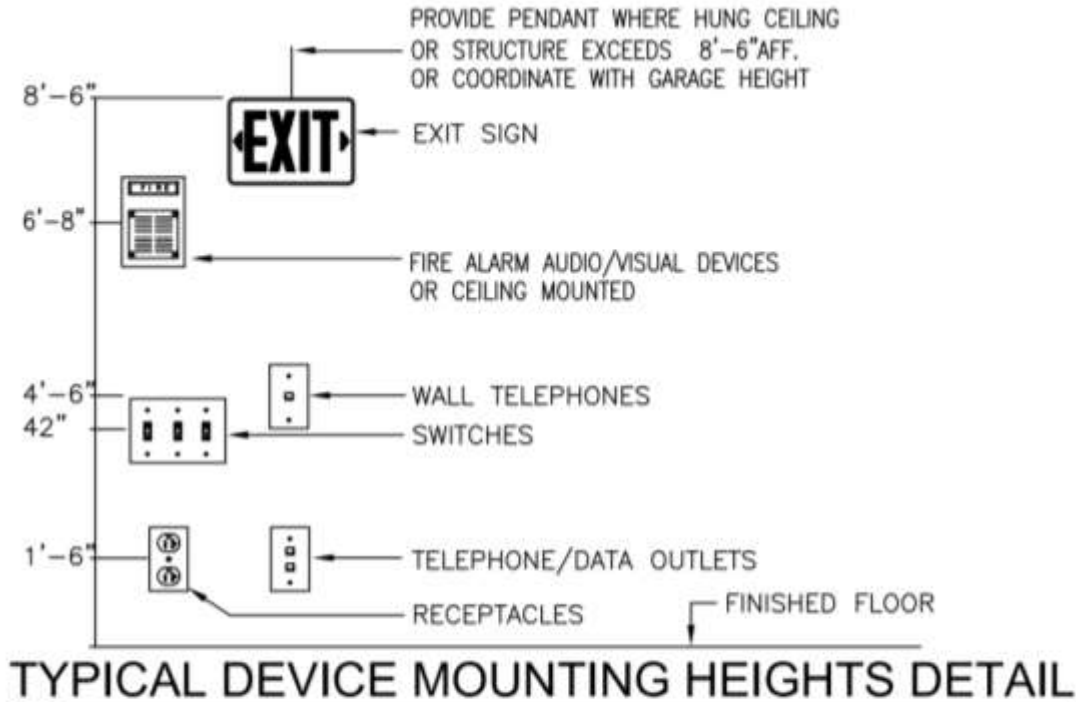
1.04 COMPONENTS

A. GENERAL:



1. PROVIDE FLUSH MOUNTED UNITS WHERE INSTALLED IN FINISH AREAS; IN UNFINISHED AREAS, SURFACE MOUNTED UNIT ARE ACCEPTABLE.
  2. PROVIDE LEGIBLE, PERMANENT LABELS FOR EACH CONTROL DEVICE, USING IDENTIFICATION USED IN OPERATION AND MAINTENANCE DATA.
- C. INITIATING DEVICES: COMBINATION SMOKE / HEAT / CO DETECTORS, DUCT DETECTORS AND PULL STATIONS
- D. NOTIFICATION APPLIANCES: STROBE-SPEAKER, STROBE ONLY, OUTSIDE BELL AND STROBE.
- E. CIRCUIT CONDUCTORS: COPPER OR OPTICAL FIBER; PROVIDE 200 FEET EXTRA; COLOR CODE AND LABEL.
- F. SURGE PROTECTION: IN ACCORDANCE WITH IEEE C62.41 B3 COMBINATION WAVEFORM AND NFPA 70; EXCEPT FOR OPTICAL FIBER CONDUCTORS.
- G. LOCKS AND KEYS: DELIVER KEYS TO OWNER.
- H. INSTRUCTION CHARTS: PRINTED INSTRUCTION CHART FOR OPERATORS, SHOWING STEPS TO BE TAKEN WHEN A SIGNAL IS RECEIVED (NORMAL, ALARM, SUPERVISORY, AND TROUBLE); EASILY READABLE FROM NORMAL OPERATOR'S STATION.
- I. FRAME: STAINLESS STEEL OR ALUMINUM WITH POLYCARBONATE OR GLASS COVER.
- J. PROVIDE ONE FOR EACH CONTROL UNIT WHERE OPERATIONS ARE TO BE PERFORMED.
- K. OBTAIN APPROVAL OF OWNER PRIOR TO MOUNTING; MOUNT IN LOCATION ACCEPTABLE TO OWNER.
- L. PROVIDE EXTRA COPY WITH OPERATION AND MAINTENANCE DATA SUBMITTAL
- 1.05 START-UP - PROVIDE CONFIGURATION AND START-UP BY MANUFACTURER-TRAINED TECH.

## **DETAILS**



N.T.S.

NOTES:

1. ALL MOUNTING HEIGHTS SHALL BE MEASURED FROM FINISHED FLOOR TO CENTERLINE OF DEVICE EXCEPT EXIT SIGNS.
2. DEVICES SHALL BE INSTALLED ON A COMMON VERTICAL CENTERLINE WHEREVER POSSIBLE.
3. ALL DEVICES SHALL BE INSTALLED AT MOUNTING HEIGHTS AS INDICATED ON THIS DETAIL UNLESS OTHERWISE NOTED.

A detail for ceiling detector installation should indicate minimum 4-in spacing from walls and 6-ft from HVAC registers. Locate wall-mounted detectors a minimum of 4-in below the ceiling to avoid the “dead spot” in the corner. Use nominal 30-ft c-c spacing for smoke or heat detectors if you don’t know anything different.

This is a “boilerplate” detail, included in all projects. The greatest value is warning the Owner and Architect of what they are going to get.

This detail should include low-voltage control devices, as thermostats and projector controls at the same height as the light switches. These are installed by other trades and look really bad when they are almost the same height.

Outside strobe and sprinkler bell should be 12-ft above grade.

Before we begin the paragraph-by-paragraph review of 72HB-16, note that the only content change to the design section is the addition of wiring, Type N, loop Ethernet.

**NFPA 72-16.pdf, Design of typical commercial fire alarm systems  
SUMMARY, Ch. 10, 17 and 18, Sections 24.4, 24.8-12**

<b>Chapter 10</b>	<b>Fundamentals</b>	
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<p><b>10.1.1, Complete fire alarm shall comply with Ch10</b></p>	<p><b>Provide initiation, notification and control devices as shown in the first part of the course. No such thing as “partial fire alarm system.” (Subject to AHJ determination and some exceptions which should be avoided.)</b></p>	<p><b>Show smoke detectors, heat detectors, pull stations, notification devices, HVAC connections, elevator connections, central monitoring per first part of course.</b></p>
<p><b>10.3.1, listed equipment</b></p>	<p><b>NFPA is avoiding lawsuits by deleting reference to Underwriters Laboratories. As Designer, you can make this requirement. Installation must follow manufacturer’s instructions.</b></p>	<p><b>Sheet note and specification language, “All materials provided shall carry UL listing as used.”</b></p>
<p><b>10.3.3, devices must be used with control as listed</b></p>	<p><b>Mix-and-match of SD, HD, and FACU is limited to those listed (tested and labeled) for use together. Notification devices are specifically not covered.</b></p>	<p><b>Check submittals for common mfg. Look closely for listing if not common mfg. Lack of addressability on notification devices hinders maintenance. You can still require it.</b></p>
<p><b>10.3.5, 85-110% Volts, 32-120F, 85% RH</b></p>	<p><b>Minimum requirements for device operation as shown. Show special devices approved for use outside these ranges.</b></p>	<p><b>It is easy to be outside 32-120F in US north country or south country. Use special rated devices.</b></p>
<p><b>10.4.1, A10.4.1, list of AHJ submittal documentation</b></p>	<p><b>This course assigns this responsibility to the installing Contractor. The full list, 13 items, is in Appendix 10.4.1. The complete sequence of operation, including all inputs and outputs, is extensive.</b></p>	<p><b>Specify a system in strict compliance with NFPA 72-2016 and state required coordination with the AHJ. (You can require more strict compliance than the currently adopted Code.)</b></p>

<b>10.4.4, SD required at each control or extender unit</b>	<b>HD permitted if dust, vapors or temp exclude SD. This is a new requirement.</b>	<b>Show the additional SD or HD at indicated devices. Call out requirement in note to Riser Diagram.</b>
<b>10.4.5.3, Pull stations can be key operated or in locked box</b>	<b>Generally, a pull station is required within 5-ft of each personnel door. Under special circumstances, these can be key-operated or in a locked box, ONLY IF STAFFED 24/7 by person with key.</b>	<b>Use pull station with key for correctional, healthcare and custodial spaces which are staffed 24/7.</b>
<b>10.5.1.3, designer qualifications</b>	<b>Subject to the AHJ, fire alarms can be designed by Professional Engineer, certified technician (NICET) or manufacturer-certified designer.</b>	<b>Request submittal of fire alarm designer name and certification.</b>
<b>10.5.1.4, designer identification</b>	<b>The system designer shall be identified on system design documents.</b>	<b>Require that detailed equipment selection and battery calculations be submitted and signed.</b>
<b>10.5.2, installer qualifications</b>	<b>Installation personnel must have documented qualification</b>	<b>Request submittal of fire alarm installer name and certification.</b>
<b>10.5.3 Inspection, testing and service personnel</b>	<b>Not covered by this course</b>	
<b>10.5.3.5 Programming personnel</b>	<b>Not covered by this course</b>	<b>The transition of major fire protection functions to the computer make programming and configuration critical. But, it is between the</b>

		<b>Installer and AHJ.</b>
<b>10.6.5.2 circuit identification and accessibility</b>		<b>Provide a dedicated 120VAC circuit with a locking attachment, painted red, labeled FIRE ALARM.</b>
<b>10.6.7.2, battery capacity</b>	<b>Not covered by this course</b>	<b>In some localities it is normal for the design engineer to perform battery calculations.</b>
<b>10.7, signal priority</b>	<b>The Code recommends a stakeholder meeting reach a consensus for the immediate installation. The AHJ will be “first among equals.” Supervisory and trouble signals have lower priority than alarms.</b>	<b>The default factory programming takes care of this, unless the Installer performs overrides. This is between the Installer and AHJ.</b>
<b>10.10, distinctive signals</b>	<b>Each alarm, supervisory and trouble signal shall have a distinctive auditory tones or cadences.</b>	<b>This will become critical as weather, natural disaster, terrorism and toxic releases become prominent components of fire alarms / emergency communications systems. Voice notification is a simple, effective solution. Carbon monoxide is the toxic gas most often encountered today.</b>
<b>10.17.5, annunciation zoning</b>	<b>Annunciation for fire fighters’ use must correspond to smoke, fire and sprinkler zones. A zone must not extend beyond one floor.</b>	<b>Get a copy of the Architect’s Emergency Egress Plan and include it in reference material for the fire alarm specification.</b>
<b>10.18.2, two-way</b>	<b>Specific requirements for two-way</b>	<b>Be careful that life-</b>

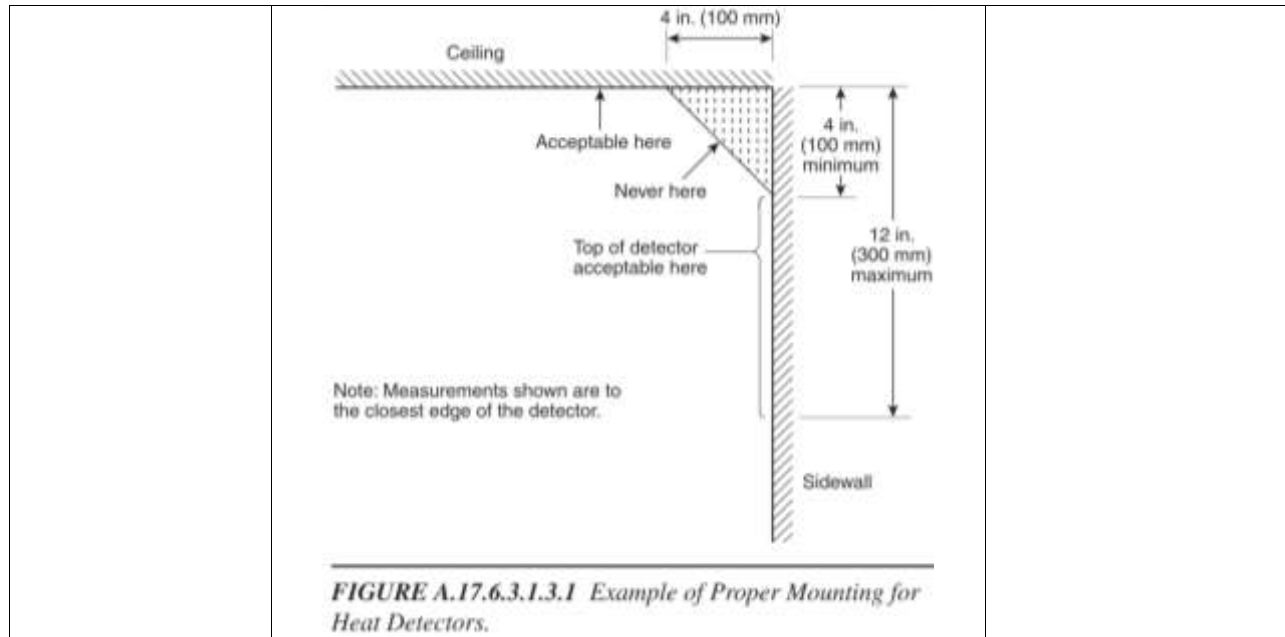
<b>telephone communications</b>	<b>communications are stated.</b>	<b>safety requirements are followed in two-way communications to Locations of Safe Refuge (see the IBC excerpt on page 14 of this course material.</b>
<b>10.21, unwanted alarms</b>	<b>Nonhazardous unwanted alarms shall be classified as malicious, nuisance, unintentional or unknown.</b>	<b>Don't say "false alarm" but design to avoid or accommodate them.</b>
<b>Chapter 17</b>	<b>Initiating Devices</b>	
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<b>Heat Detectors</b>		
<b>17.1, application</b>	<b>Other mandates identify needed initiation devices. NFPA 72 defines performance, selection, use and locations.</b>	<b>Similar, previous projects, approved by this AHJ give good insight into local interpretation of external requirements.</b>
<b>17.3, performance-based design</b>	<b>Innovation and non-standard approaches are acceptable if the AHJ is convinced</b>	<b>Conventional "catalog engineering" is usually more cost effective and faster.</b>
<b>17.4, general requirements</b>	<b>Initiation devices include manual alarm boxes, heat detectors, smoke detectors, radiant-energy-sensing detectors, gas detectors sprinkler waterflow switches, pressure switches, valve tamper switches, building temperature monitoring devices and signaling switches from special extinguishing systems.</b>	<b>Be careful to identify all fire alarm initiation devices selected by others, as HVAC duct smoke detectors, HVAC toxic gas detectors, sprinklers and fire suppression systems.</b>
<b>17.4.2</b>	<b>Protect initiating devices from mechanical</b>	<b>Specify guards.</b>

	<b>damage.</b>	<b>Locate devices away from hazards. Your author recommends concrete-filled bumper posts in industrial locations.</b>
<b>17.4.7</b>		<b>Apply remote indicator / reset devices when initiating device is not readily accessible.</b>
<b>17.4.7.1</b>	<b>Provide permanent label on remote indicator / reset device.</b>	<b>Embossed plastic tape, pencil, ink or crayon are not acceptable.</b>
<b>17.5.1, recessed mounting</b>	<b>Conventional detectors must not be recessed mounted.</b>	<b>This differs from notification devices. See _____</b>
<b>17.5.2, partitions</b>	<b>Partitions that extend to within 15 percent of the ceiling height shall constitute separate rooms.</b>	<b>This recognizes the conventional behavior of a smoke plume. Your author recommends that you err in the direction of too many detectors when there is a question. Store a dated note with names if someone tells you to delete detectors.</b>
<b>17.5.3.1, excluded spaces</b>	<b>This paragraph lists locations which need not have detectors, as closets, elevator shafts, enclosed stairways, dumbwaiter shafts and chutes.</b>	<b>Spend extra time examining these spaces. Generally, a detector just outside the space meets the needs of life safety.</b>



<b>17.5.3.1; 17.5.3.1.1</b>	<b>The appendix and second section return elevator shafts and enclosed stairways.</b>	<b>It is safer and cheaper to initially include the detectors and remove them if needed. Record the date and name of who tells you to remove them.</b>
<b>17.5.3.1.4, plenum ceiling spaces</b>	<b>Where above ceiling space is used as a return air plenum, then provide area smoke detectors or detectors at the connection to return air ducts.</b>	<b>Area smoke detectors are still required in the occupied space.</b>
<b>17.6, heat detectors</b>	<b>Conventional heat detectors respond to convective heat transfer, not radiant.</b>	<b>Characteristics of the smoke plume tell us where to place heat detectors and where to avoid.</b>
<b>Exhibit 17.17</b>	<b>Conventional spot heat detectors are illustrated along with line-type heat detectors.</b>	<b>Your author has no experience with line-type heat detectors and is suspicious of published information from vendors.</b>
<b>17.6.1.4</b>	<b>Conventional spot heat detectors have a trip value and a response time index (RTI).</b>	<b>Your author specifies analog addressable detectors with computer applied trip values, rate-of-rise calculation and apply analytics. RTI still applies.</b>
<b>Table 17.6.2.1 heat detector trip levels</b>	<b>This table was reproduced earlier and again below:</b>	<b>Your author can offer no assistance in selecting high-temperature devices. I specify 135F fixed / 12F per minute rate-of-rise detectors. If the installer used</b>

	<p><b>TABLE 17.6.2.1 Temperature Classification and Color Code for Heat-Sensing Fire Detectors</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Temperature Classification</th> <th colspan="2">Temperature Rating Range</th> <th colspan="2">Maximum Ceiling Temperature</th> <th rowspan="2">Color Code</th> </tr> <tr> <th>°F</th> <th>°C</th> <th>°F</th> <th>°C</th> </tr> </thead> <tbody> <tr> <td>Low*</td> <td>100-134</td> <td>39-57</td> <td>80</td> <td>28</td> <td>Uncolored</td> </tr> <tr> <td>Ordinary</td> <td>135-174</td> <td>58-79</td> <td>115</td> <td>47</td> <td>Uncolored</td> </tr> <tr> <td>Intermediate</td> <td>175-249</td> <td>80-121</td> <td>155</td> <td>69</td> <td>White</td> </tr> <tr> <td>High</td> <td>250-324</td> <td>122-162</td> <td>230</td> <td>111</td> <td>Blue</td> </tr> <tr> <td>Extra high</td> <td>325-399</td> <td>163-204</td> <td>305</td> <td>152</td> <td>Red</td> </tr> <tr> <td>Very extra high</td> <td>400-499</td> <td>205-259</td> <td>380</td> <td>194</td> <td>Green</td> </tr> <tr> <td>Ultra high</td> <td>500-575</td> <td>260-302</td> <td>480</td> <td>249</td> <td>Orange</td> </tr> </tbody> </table> <p><small>*Intended only for installation in controlled ambient areas. Units shall be marked to indicate maximum ambient installation temperature.</small></p>	Temperature Classification	Temperature Rating Range		Maximum Ceiling Temperature		Color Code	°F	°C	°F	°C	Low*	100-134	39-57	80	28	Uncolored	Ordinary	135-174	58-79	115	47	Uncolored	Intermediate	175-249	80-121	155	69	White	High	250-324	122-162	230	111	Blue	Extra high	325-399	163-204	305	152	Red	Very extra high	400-499	205-259	380	194	Green	Ultra high	500-575	260-302	480	249	Orange	<p><b>something else, I don't hear about it. If it trips too easily, it can easily be replaced during warranty by the installer.</b></p>
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<p><b>17.6.2.2.2.2, adjustable trip heat detectors</b></p>	<p><b>The Handbook commentary following this section relates the use of analog addressable detector elements and the fire alarm control unit computer.</b></p>	<p><b>This section recommends analog addressable heat detectors for possible fast, flaming fires where smoke detectors are not feasible.</b></p>																																																				
<p><b>Table A17.6.3.1.1 heat detector spacing</b></p>	<p><b>A range of room sizes is presented with rest results of maximum detector spacing. It is reproduced below:</b></p> <p><b>TABLE A.17.6.3.1.1 Test Spacing for Spot-Type Heat Detectors</b></p> <table border="1"> <thead> <tr> <th colspan="2">Test Spacing</th> <th colspan="2">Maximum Test Distance from Fire to Detector (0.7D)</th> </tr> <tr> <th>ft</th> <th>m</th> <th>ft</th> <th>m</th> </tr> </thead> <tbody> <tr> <td>50 × 50</td> <td>15.2 × 15.2</td> <td>35.0</td> <td>10.7</td> </tr> <tr> <td>40 × 40</td> <td>12.2 × 12.2</td> <td>28.0</td> <td>8.5</td> </tr> <tr> <td>30 × 30</td> <td>9.1 × 9.1</td> <td>21.0</td> <td>6.4</td> </tr> <tr> <td>25 × 25</td> <td>7.6 × 7.6</td> <td>17.5</td> <td>5.3</td> </tr> <tr> <td>20 × 20</td> <td>6.1 × 6.1</td> <td>14.0</td> <td>4.3</td> </tr> <tr> <td>15 × 15</td> <td>4.6 × 4.6</td> <td>10.5</td> <td>3.2</td> </tr> </tbody> </table>	Test Spacing		Maximum Test Distance from Fire to Detector (0.7D)		ft	m	ft	m	50 × 50	15.2 × 15.2	35.0	10.7	40 × 40	12.2 × 12.2	28.0	8.5	30 × 30	9.1 × 9.1	21.0	6.4	25 × 25	7.6 × 7.6	17.5	5.3	20 × 20	6.1 × 6.1	14.0	4.3	15 × 15	4.6 × 4.6	10.5	3.2	<p><b>Your author uses 30-ft c-c spacing, which is towards the midpoint of the table.</b></p>																				
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<p><b>17.6.3.1.3.1, forbidden detector locations</b></p>	<p><b>Detectors pick up the smoke plume. A characteristic is the "dead pocket" at the corner where the wall meets the ceiling. See below:</b></p>																																																					



<p><b>17.6.3.1.3.2, line heat detectors</b></p>	<p><b>The Code recommends studying manufacturers' literature on proper mounting of line heat detectors.</b></p>	<p><b>The manufacturers' instructions become part of the UL listing and become enforceable by the AHJ.</b></p>
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<p><b>Table 17.6.3.5.1, heat detectors closer on high ceiling</b></p>	<p><i>TABLE 17.6.3.5.1 Heat Detector Spacing Reduction Based on Ceiling Height</i></p> <table border="1"> <thead> <tr> <th colspan="2">Ceiling Height Greater than (&gt;)</th> <th colspan="2">Up to and Including</th> <th rowspan="2">Multiply Listed Spacing by</th> </tr> <tr> <th>ft</th> <th>m</th> <th>ft</th> <th>m</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>10</td><td>3.0</td><td>1.00</td></tr> <tr><td>10</td><td>3.0</td><td>12</td><td>3.7</td><td>0.91</td></tr> <tr><td>12</td><td>3.7</td><td>14</td><td>4.3</td><td>0.84</td></tr> <tr><td>14</td><td>4.3</td><td>16</td><td>4.9</td><td>0.77</td></tr> <tr><td>16</td><td>4.9</td><td>18</td><td>5.5</td><td>0.71</td></tr> <tr><td>18</td><td>5.5</td><td>20</td><td>6.1</td><td>0.64</td></tr> <tr><td>20</td><td>6.1</td><td>22</td><td>6.7</td><td>0.58</td></tr> <tr><td>22</td><td>6.7</td><td>24</td><td>7.3</td><td>0.52</td></tr> <tr><td>24</td><td>7.3</td><td>26</td><td>7.9</td><td>0.46</td></tr> <tr><td>26</td><td>7.9</td><td>28</td><td>8.5</td><td>0.40</td></tr> <tr><td>28</td><td>8.5</td><td>30</td><td>9.1</td><td>0.34</td></tr> </tbody> </table>	Ceiling Height Greater than (>)		Up to and Including		Multiply Listed Spacing by	ft	m	ft	m	0	0	10	3.0	1.00	10	3.0	12	3.7	0.91	12	3.7	14	4.3	0.84	14	4.3	16	4.9	0.77	16	4.9	18	5.5	0.71	18	5.5	20	6.1	0.64	20	6.1	22	6.7	0.58	22	6.7	24	7.3	0.52	24	7.3	26	7.9	0.46	26	7.9	28	8.5	0.40	28	8.5	30	9.1	0.34	<p><b>This is why beam detectors become so attractive for high-ceiling spaces, as warehouses and big-box stores.</b></p>
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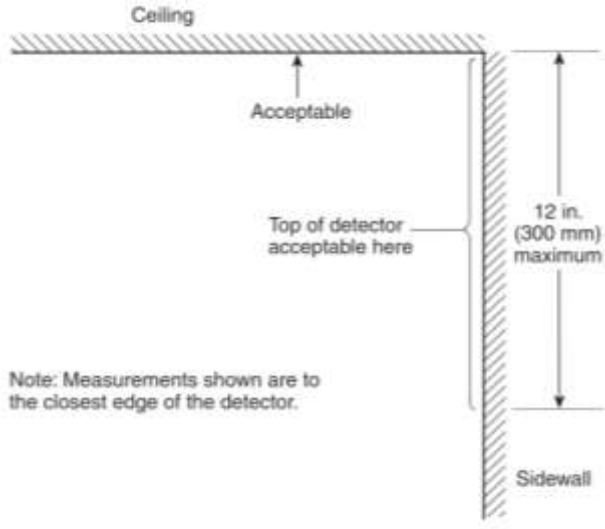
<p><b>Smoke Detectors Codespeak</b></p>	<p><b>English</b></p>	<p><b>Action Required</b></p>
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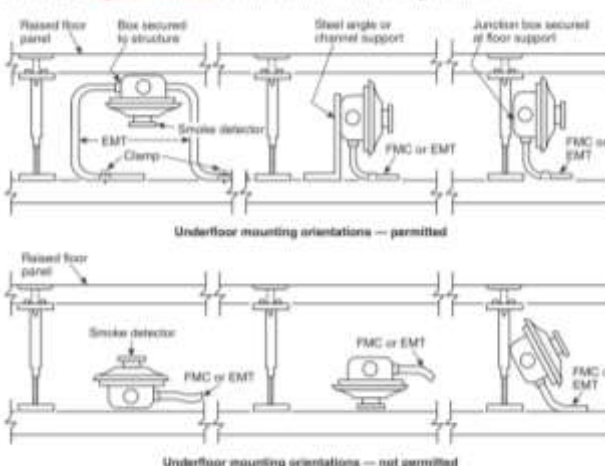
<p><b>17.7.1.1</b></p>	<p><b>Smoke detectors are the best alarm initiation device where a life safety objective is to be achieved. Customarily, smoke detectors are spaced at 30-ft c-c.</b></p>	<p><b>Show smoke detectors generously on the plan drawings.</b></p>
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<p><b>17.7.1.6</b></p>	<p><b>The requirement for smoke detectors comes from other laws, Codes or Standards. NFPA 72 guides locations and installation.</b></p>																															
<p><b>17.7.1.8, environmental limitations</b></p>	<p><b>Smoke detectors are limited to: 32F &lt; Temp &lt; 100F Humidity &lt; 93% Air velocity &lt; 300 ft / min</b></p>	<p><b>Note that US climates include ambients greater than 100F and less than 32F. Heat detectors are the alternative. Developing technologies may be appropriate, as IR.</b></p>																														
<p><b>Table A.17.7.1.8, additional environmental limits</b></p>	<p><i>TABLE A.17.7.1.8 Environmental Conditions that Influence Smoke Detector Response</i></p> <table border="1"> <thead> <tr> <th>Detection Protection</th> <th>Air Velocity &gt;300 ft/min (&gt;91.44 m/min)</th> <th>Altitude &gt;1000 ft (&gt;304.8 m)</th> <th>Humidity &gt;93% RH</th> <th>Temperature &lt;32°F (&gt;100°F) (&lt;0°C &gt;37.8°C)</th> <th>Color of Smoke</th> </tr> </thead> <tbody> <tr> <td>Ion</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>O</td> </tr> <tr> <td>Photo</td> <td>O</td> <td>O</td> <td>X</td> <td>X</td> <td>X</td> </tr> <tr> <td>Beam</td> <td>O</td> <td>O</td> <td>X</td> <td>X</td> <td>O</td> </tr> <tr> <td>Air sampling</td> <td>O</td> <td>O</td> <td>X</td> <td>X</td> <td>O</td> </tr> </tbody> </table> <p><small>X: Can affect detector response. O: Generally does not affect detector response.</small></p>	Detection Protection	Air Velocity >300 ft/min (>91.44 m/min)	Altitude >1000 ft (>304.8 m)	Humidity >93% RH	Temperature <32°F (>100°F) (<0°C >37.8°C)	Color of Smoke	Ion	X	X	X	X	O	Photo	O	O	X	X	X	Beam	O	O	X	X	O	Air sampling	O	O	X	X	O	<p><b>Be warned that ion-type detectors contain radioactive sources and air sampling-type have mechanical drives.</b></p>
Detection Protection	Air Velocity >300 ft/min (>91.44 m/min)	Altitude >1000 ft (>304.8 m)	Humidity >93% RH	Temperature <32°F (>100°F) (<0°C >37.8°C)	Color of Smoke																											
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<p><b>Table A17.7.1.9(a), additional smoke detector limitations</b></p>	<p><i>TABLE A.17.7.1.9(a) Common Sources of Aerosols and Particulate Matter Moisture</i></p> <table border="1"> <tbody> <tr> <td>Moisture</td> <td>Humid outside air Humidifiers Live steam Showers Slop sink Steam tables Water spray</td> </tr> <tr> <td>Combustion products and fumes</td> <td>Chemical fumes Cleaning fluids Cooking equipment Curing Cutting, welding, and brazing Dryers Exhaust hoods Fireplaces Machining Ovens Paint spray</td> </tr> <tr> <td>Atmospheric contaminants</td> <td>Corrosive atmospheres Dust or lint Excessive tobacco smoke Heat treating Linen and bedding handling Pneumatic transport Sawing, drilling, and grinding Textile and agricultural processing</td> </tr> </tbody> </table>	Moisture	Humid outside air Humidifiers Live steam Showers Slop sink Steam tables Water spray	Combustion products and fumes	Chemical fumes Cleaning fluids Cooking equipment Curing Cutting, welding, and brazing Dryers Exhaust hoods Fireplaces Machining Ovens Paint spray	Atmospheric contaminants	Corrosive atmospheres Dust or lint Excessive tobacco smoke Heat treating Linen and bedding handling Pneumatic transport Sawing, drilling, and grinding Textile and agricultural processing	<p><b>These are not prohibitions, rather warnings. Use professional judgement. Periodic change-out solves most problems.</b></p> <p><b>Backup heat detectors are recommended.</b></p>																								
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	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: none;">Engine exhaust</td> <td style="border: none;">Diesel trucks and locomotives Engines not vented to the outside Gasoline forklift trucks</td> </tr> <tr> <td style="border: none;">Heating element with abnormal conditions</td> <td style="border: none;">Dust accumulations Improper exhaust Incomplete combustion</td> </tr> </table> <p style="text-align: center;"><i>TABLE A.17.7.1.9(b) Sources of Electrical and Mechanical Influences on Smoke Detectors</i></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;"><i>Electrical Noise and Transients</i></th> <th style="width: 50%; text-align: center;"><i>Airflow</i></th> </tr> </thead> <tbody> <tr> <td style="border: none;">Vibration or shock</td> <td style="border: none;">Gusts</td> </tr> <tr> <td style="border: none;">Radiation</td> <td style="border: none;">Excessive velocity</td> </tr> <tr> <td style="border: none;">Radio frequency</td> <td></td> </tr> <tr> <td style="border: none;">Intense light</td> <td></td> </tr> <tr> <td style="border: none;">Lightning</td> <td></td> </tr> <tr> <td style="border: none;">Electrostatic discharge</td> <td></td> </tr> <tr> <td style="border: none;">Power supply</td> <td></td> </tr> </tbody> </table>	Engine exhaust	Diesel trucks and locomotives Engines not vented to the outside Gasoline forklift trucks	Heating element with abnormal conditions	Dust accumulations Improper exhaust Incomplete combustion	<i>Electrical Noise and Transients</i>	<i>Airflow</i>	Vibration or shock	Gusts	Radiation	Excessive velocity	Radio frequency		Intense light		Lightning		Electrostatic discharge		Power supply		
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<p><b>17.7.1.10, avoid swamp coolers</b></p>	<p><b>Evaporative coolers, common in dry southern states, cause elevated humidity, which, in turn, causes stratification and hinders the smoke plume jet.</b></p>	<p><b>Beware of locations containing swamp coolers.</b></p>																				
<p><b>17.7.1.11, smoke detectors during construction</b></p>	<p><b>Construction dust and debris have a bad effect on smoke detectors.</b></p>	<p><b>Most commonly, smoke detectors are bagged during construction, replaced by temporary heat detectors and placed back in service after construction cleanup.</b></p>																				
<p><b>17.7.2.2, photoelectric detector sensitivity</b></p>	<p><b>Photoelectric smoke detectors suffer from manufacturing variability in sensitivity and drift over years of use. Limited field compensation is permitted.</b></p>	<p><b>Modern analog addressable fire alarm control units automatically compensate for drift and indicate trouble when the adjustment limit is reached.</b></p>																				
<p><b>17.7.3.1.2, location factors</b></p>	<p><b>Nominal 30-ft c-c mounting should be adjusted, based upon the following factors:</b></p>																					

	<ul style="list-style-type: none"> <li>(1) Ceiling shape and surface</li> <li>(2) Ceiling height</li> <li>(3) Configuration of contents in the protected area</li> <li>(4) Combustion characteristics and probable equivalence ratio of the anticipated fires involving the fuel loads within the protected area</li> <li>(5) Compartment ventilation</li> <li>(6) Ambient temperature, pressure, altitude, humidity, and atmosphere</li> </ul>	
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<p><b>17.7.3.2.1, avoid the dead zone</b></p>	<p><b>For spot-type smoke detectors, avoid the dead zone where the wall meets the ceiling.</b></p>  <p><i>FIGURE A.17.7.3.2.1 Example of Proper Mounting of Smoke Detectors.</i></p>	
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<p><b>17.7.3.2.2, underfloor mounting</b></p>	<p><b>There are right ways and wrong ways to mount spot smoke detectors under a raised floor.</b></p> <p>A.17.7.3.2.2 Figure A.17.7.3.2.2 illustrates underfloor mounting installations.</p>  <p><i>FIGURE A.17.7.3.2.2 Mounting Installations Permitted (top) and Not Permitted (bottom).</i></p>	
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<p><b>Exhibit 17.35, Sampling Gas Detector pictoral</b></p>		<p><b>Your author has used sampling-type toxic gas detectors because of the high cost of the detector elements. The long pipe runs and mechanical elements make these systems unattractive without more experience.</b></p>
<p><b>17.7.3.6.2, maximum transport time</b></p>	<p><b>Maximum air sample transport time shall not exceed 120 seconds.</b></p>	<p><b>For a home fire, the Fire Chief stated that the 6-second delay due to 911 dispatch problems caused a substantial increase in damage. 120 seconds is a big number.</b></p>
<p><b>17.7.3.6.8, labeling</b></p>	<p><b>Sampling system piping must be labeled, “SMOKE DETECTOR SAMPLING TUBE – DO NOT DISTURB”</b> <small>(1) At changes in direction or branches of piping (2) At each side of penetrations of walls, floors, or other barriers (3) At intervals on piping that provide visibility within the space, but no greater than 20 ft (6.1 m)</small></p>	
<p><b>Beam Detectors</b></p>		
<p><b>Codespeak</b></p>	<p><b>English</b></p>	<p><b>Action Required</b></p>
<p><b>17.7.3.7, 60-ft spacing</b></p>		
<p><b>17.7.3.2.7, stratification</b></p>	<p><b>The smoke plume tends to peter out above 20-ft.</b></p>	<p><b>Follow manufacturer’s installation instructions. Units at multiple heights are desirable.</b></p>
<p><b>7.7.4.1, avoid HVAC diffusers</b></p>	<p><b>Spot-type smoke and heat detectors must not be closer than 36-in to HVAC supply or return diffusers.</b></p>	<p><b>Six foot separation is a rule of thumb for some designers.</b></p>



<b>17.7.4.3, duct smoke detectors</b>	<b>Duct smoke detectors are required separately. They do not replace area smoke detectors.</b>	
<b>17.7.5, smoke detectors for smoke control</b>	<b>Area smoke detectors shall be used instead of duct smoke detectors.</b>	
<b>17.7.5.3, smoke control charter</b>	<b>The purposes of smoke control systems are as follow:</b> <small>(1) Prevention of the recirculation of dangerous quantities of smoke within a building (2) Selective operation of equipment to exhaust smoke from a building (3) Selective operation of equipment to pressurize smoke compartments (4) Operation of doors and dampers to close the openings in smoke compartments</small>	<b>Your author has witnessed numerous failed tests of smoke control systems and no successful tests.</b>
<b>17.7.5.4.2, duct smoke detectors</b>	<b>The physics and operation of duct smoke detectors are discussed.</b>	<b>Duct smoke detector placement is in response to HVAC Codes and chosen by the HVAC designer. Programming fire alarm and HVAC computer response is between the technician and the AHJ.</b>
<b>17.7.5.6, door release service</b>	<b>Many alternative mounting and location schemes for smoke detectors are approved for release of magnetic door holds.</b>	<b>The simplest scheme is one detector on the center line of the opening, on each side.</b>
<b>17.7.6.1, little value to combination detectors</b>	<b>The Code states that there is little value to detectors which combine smoke detection with fix-temperature heat detection.</b>	<b>The newer combination detectors add carbon monoxide and infra-red detection.</b>
<b>17.7.6.2, high rack storage</b>	<b>Multiple levels of detectors should be used in high-rack storage areas.</b>	
<b>17.7.6.3.4, HVAC mechanical rooms</b>	<b>Normal spacing of spot type smoke detectors shall be applied in HVAC mechanical rooms used as an air plenum.</b>	<b>Your author had never considered placing a smoke detector in an</b>

		<b>HVAC mechanical room use as plenum.</b>
<b>17.7.7, video image smoke detection</b>	<b>Listed video image smoke detection systems are permitted. A drawing of a 32-camera system is included.</b>	<b>These systems failed an earlier analysis by the author. They may have been improved.</b>
<b>17.7.7.4, restriction of video system controls and software</b>	<b>The headend unit for a video image smoke detection system shall be restricted under the same rules that apply to the fire alarm control unit.</b>	
<b>17.8.1, Ultraviolet, visible and infrared detection systems</b>	<b>Listed systems respond faster to fires in certain locations, including fuel loading racks, aircraft hangers, electrostatic paint booths, petrochemical plants, wood processing and woodworking plants.</b>	<b>Closely study manufacturers' application literature before using in a design. Especially, check on detector deterioration and recalibration requirements.</b>
<b>17.8.3.2.1, flame detector limitations</b>	<b>Extraneous radiant emissions have interfered with flame detectors, including sunlight, lightning, x-rays, gamma rays, cosmic rays, arc welding, EMI, RFI, hot objects and artificial lighting.</b>	
<b>17.8.5, analytics video flame detection</b>	<b>The listing agency is responsible for defining the characteristics and proper application of these systems.</b>	<b>Your author is very hesitant on the use of innovative technology in life safety systems.</b>
<b>17.9.3, multi-criteria detectors</b>	<b>This section refers to detectors containing two or more of fixed or analog heat, ionization or photoelectric and software. Follow manufacturers' instructions.</b>	<b>Newer multi-criteria detectors include carbon monoxide and infra-red.</b>
<b>17.9.4, multi-sensor detectors</b>	<b>Detector containing a selection of photoelectric, analog heat, ionization, carbon monoxide, carbon</b>	<b>Still no infra-red. But, such are</b>

	dioxide and software.	commercially available (Apr, 16).
Sprinkler Waterflow Codespeak	English	Action Required
<p><b>17.12.2, 90-second limit on indication</b></p>	<p>The mechanical switch only must respond to the flow of a single sprinkler within 90-seconds. This is what one looks like:</p> <p><b>EXHIBIT 17.53</b></p>  <p><i>Vane-Type Waterflow Switch. (Source: Potter Electric Signal Company, LLC, St. Louis, MO)</i></p>	<p>This is more a reflection of entrainments in the piping system than the switch condition.</p>
<p><b>17.13, other automatic extinguishing systems</b></p>	<p>The fire alarm must recognize and log the operation of suppressions systems as indicated by one or more of the following: flow of water in foam systems, pump activation, differential pressure, pressure (e.g., clean agent, carbon dioxide and wet / dry chemicals) and mechanical operation of a release mechanism.</p>	
<p><b>17.14, hand pull stations</b></p>	<p>Only fire alarm hand pull stations shall be painted red.</p>	
<p><b>17.14.6, single or double action</b></p>	<p>Hand pull stations may be either single- or double-action. Passive and battery-operated sonalert protective covers may be installed</p>	
<p><b>17.14.8.4, within 5-ft of each exit doorway on each floor</b></p>		<p>There is no flexibility in this rule and considerable resistance from Owners and Architects.</p>

<b>17.14.8.5, not more than 200-ft apart</b>	<b>Long hallways require additional hand pull stations every 200-ft.</b>	
<b>17.14.8.6, both sides of 40-ft opening</b>		<b>This is for malls and theaters.</b>
<b>17.15, fire extinguisher monitor</b>	<b>Not required, but if provided must be connected to the fire alarm control unit as a supervisory signal.</b>	
<b>17.16, tamper switch</b>	<b>A listed fire alarm device that transfers contacts when the sprinkler valve begins to close and only transfers back when the valve is full-open.</b>	
<b>17.16.2, pressure supervisory switch</b>	<b>This is a monitor on a water tank installed because limited utility or well water is available. A reduction in pressure indicates a malfunction and records the event.</b>	
<b>17.16.2.2.2, dry pipe sprinkler system</b>	<b>A pressure supervisory switch monitors both over-pressure and under-pressure on a dry pipe sprinkler system.</b>	<b>Usually monitoring of the dry sprinkler air compressor is present.</b>
<b>17.16.3, water level supervisory switch</b>		<b>The picture shows this in a water tower</b>
<b>17.16.5, room temp switch</b>	<b>Trips at 40F, probably for freeze protection, as sprinkler piping.</b>	
<b>Notification Devices</b>		
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<b>18.1, emergency communications system</b>	<b>The notification component of a fire alarm is now a designated emergency communication system, consistent with the renaming of NFPA-72. Criteria are quantity, audibility, intelligibility and visibility. ADAAG and local accessibility codes expand and clarify requirements.</b>	<b>This restates the importance of AHJ interpretations.</b>
<b>18.1.2, scope</b>	<b>This chapter applies only to notification devices, not informational content.</b>	

<p><b>18.2, purpose</b></p>	<p><b>The purpose shall be to initiate emergency action and provide information to users, emergency response personnel and occupants.</b></p>																							
<p><b>18.3.2, nameplates</b></p>	<p><b>Notification appliances must indicate electrical requirements, rated audible (dB) or visible (cd) performance.</b></p>																							
<p><b>18.3.4, guards</b></p>	<p><b>Provide listed mechanical protection where needed</b></p>	<p><b>This includes exposure to damage as well as vandalism by youths.</b></p>																						
<p><b>18.4.1, use visible if sound ambient over 105dB</b></p>	<p style="text-align: center;"><i><b>TABLE A.18.4.1.2</b></i> <i><b>Permissible Noise Exposures</b></i></p> <hr/> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;"><i><b>Duration (hr)</b></i></th> <th style="text-align: center;"><i><b>L<sub>A</sub> (dBA)</b></i></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">8</td><td style="text-align: center;">90</td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">92</td></tr> <tr><td style="text-align: center;">4</td><td style="text-align: center;">95</td></tr> <tr><td style="text-align: center;">3</td><td style="text-align: center;">97</td></tr> <tr><td style="text-align: center;">2</td><td style="text-align: center;">100</td></tr> <tr><td style="text-align: center;">1.5</td><td style="text-align: center;">102</td></tr> <tr><td style="text-align: center;">1</td><td style="text-align: center;">105</td></tr> <tr><td style="text-align: center;">0.5</td><td style="text-align: center;">110</td></tr> <tr><td style="text-align: center;">0.25</td><td style="text-align: center;">115</td></tr> <tr><td style="text-align: center;">0.125 (7.5 minutes)</td><td style="text-align: center;">120</td></tr> </tbody> </table> <hr/> <p><i>Source: OSHA, 29 CFR 1910.5, Table G-16, Occupational Noise Exposure.</i></p>	<i><b>Duration (hr)</b></i>	<i><b>L<sub>A</sub> (dBA)</b></i>	8	90	6	92	4	95	3	97	2	100	1.5	102	1	105	0.5	110	0.25	115	0.125 (7.5 minutes)	120	<p><b>Sound sources over 110dB are illegal, per OSHA.</b></p>
<i><b>Duration (hr)</b></i>	<i><b>L<sub>A</sub> (dBA)</b></i>																							
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<p><b>18.4.2, general evacuation cadence</b></p>	<p><b>On .5sec, off .5sec, On .5sec, off .5sec, On .5sec, off .5sec, Off 1.5sec Repeat</b></p>	<p><b>The same cadence is used for a single-stroke bell or chime. Note that voice notification is much simpler.</b></p>																						
<p><b>18.4.2.4, synchronization within evacuation zone</b></p>	<p><b>The same signal, with multiple start points, heard simultaneously, is very confusing. Adjacent zones, with different start points can produce this confusion.</b></p>																							

<p><b>Exhibit 18.8, speech intelligibility meter</b></p>		
<p><b>18.4.5.1, sleeping area</b></p>	<p><b>In sleeping areas, alarm sound levels must be 15dB above ambient or 75dB at pillow level and include a 520Hz square wave. (Normal sounders are 3150Hz sine wave.)</b></p>	<p><b>Voice notification systems easily accommodate this with tone generators in the fire alarm control unit.</b></p>
<p><b>18.4.7, exit marking audible notification appliance</b></p>	<p><b>Not covered in this course.</b></p>	<p><b>Your author has not encountered these devices and they don't quite make sense.</b></p>
<p><b>18.4.8, location of audible appliances</b></p>	<p><b>Not lower than 90-in above finished floor and not closer than 6-in to the finished ceiling.</b></p>	

<b>18.4.10.2.1, areas not requiring voice intelligibility</b>	(1) Private bathrooms, shower rooms, saunas, and similar rooms/areas (2) Mechanical, electrical, elevator equipment rooms, and similar rooms/areas (3) Elevator cars (4) Individual offices (5) Kitchens (6) Storage rooms (7) Closets <b>18.</b> (8) Rooms/areas where intelligibility cannot reasonably be predicted.	<b>Your author is strongly opposed to reducing life safety. This list is a bad idea.</b>
<b>Visible Characteristics</b>		
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<b>18.5 visible device mounting height</b>	<b>Normally mount visible notification devices 80 – 96-in above finished floor. The AHJ can accept deviation.</b>	
<b>18.5.3.1, flash rate between 1Hz and 2Hz</b>	<b>Maximum light pulse duration shall be 20 milliseconds.</b>	
<b>18.5.3.2, LED's accepted</b>	<b>LED visual notification units do not provide the short, bright light of the xenon strobe. They are accepted by the code.</b>	<b>Consult the AHJ if you wish to pursue this.</b>
<b>18.5.3.6, synchronization</b>	<b>Strobes which are simultaneously visible must be synchronized. Non-synchronized strobes may initiate epileptic seizures.</b>	<b>Sounds easy but requires attention. This is an installer responsibility but often botched.</b>



**Tables  
18.5.5.4.1(a) and  
(b), visible  
notification  
device spacing**

**TABLE 18.5.5.4.1(a) Room Spacing for Wall-Mounted Visible Appliances**

Maximum Room Size		Minimum Required Light Output [Effective Intensity (cd)]	
		One Light per Room	Four Lights per Room (One Light 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.

**TABLE 18.5.5.4.1(b) Room Spacing for Ceiling-Mounted Visible Appliances**

Maximum Room Size		Maximum Lens Height*		Minimum Required Light Output (Effective Intensity); One Light (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.

**Use small strobes in small rooms, large strobes in large spaces. Common strobe ratings are 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177 and 185 cd.**

**18.8, textual**

**NFPA 72 has decided not to use the word**

<b>audible appliances</b>	<i>speakers.</i>																																																	
<b>18.8, textual and graphical visible appliances</b>	<b>These are annunciators, panel displays (LED and LCD), CRT's, screens and signs.</b>	<b>Legacy technology is an engraved map with red LED's poked through.</b>																																																
<b>Table 18.9.4.7, position and character height</b>	<p><b>I find this table indecipherable.</b></p> <p><i>TABLE 18.9.4.7 Visual Character and Graphic Symbol Heights Based on Height and Distance</i></p> <table border="1"> <thead> <tr> <th colspan="2">Height of Character or Symbol Above Ground or Finished Floor</th> <th colspan="2">Horizontal Viewing Distance</th> <th colspan="2">Minimum Character or Symbol Height</th> </tr> <tr> <th>in.</th> <th>m</th> <th>ft</th> <th>m</th> <th>in.</th> <th>mm</th> </tr> </thead> <tbody> <tr> <td>40 in. min. to ≤70 in.</td> <td>1.02 m to 1.78 m</td> <td>&lt;6</td> <td>1.83</td> <td>½ in.</td> <td>16 mm</td> </tr> <tr> <td></td> <td></td> <td>≥6</td> <td>1.83</td> <td>½ in., plus ¼ in. per foot of horizontal viewing distance beyond 6 ft</td> <td>16 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 1.83 m</td> </tr> <tr> <td>&gt;70 in. to ≤120 in.</td> <td>1.78 m to 3.05 m</td> <td>&lt;15</td> <td>4.57</td> <td>2 in.</td> <td>51 mm</td> </tr> <tr> <td></td> <td></td> <td>≥15</td> <td>4.57</td> <td>2 in., plus ¼ in. per foot of horizontal viewing distance beyond 15 ft</td> <td>51 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 4.57 m</td> </tr> <tr> <td>&gt;120 in.</td> <td>3.05 m</td> <td>&lt;21</td> <td>6.40</td> <td>3 in.</td> <td>75 mm</td> </tr> <tr> <td></td> <td></td> <td>≥21</td> <td>6.40</td> <td>3 in., plus ¼ in. per foot of horizontal viewing distance beyond 21 ft</td> <td>75 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 6.40 m</td> </tr> </tbody> </table>	Height of Character or Symbol Above Ground or Finished Floor		Horizontal Viewing Distance		Minimum Character or Symbol Height		in.	m	ft	m	in.	mm	40 in. min. to ≤70 in.	1.02 m to 1.78 m	<6	1.83	½ in.	16 mm			≥6	1.83	½ in., plus ¼ in. per foot of horizontal viewing distance beyond 6 ft	16 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 1.83 m	>70 in. to ≤120 in.	1.78 m to 3.05 m	<15	4.57	2 in.	51 mm			≥15	4.57	2 in., plus ¼ in. per foot of horizontal viewing distance beyond 15 ft	51 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 4.57 m	>120 in.	3.05 m	<21	6.40	3 in.	75 mm			≥21	6.40	3 in., plus ¼ in. per foot of horizontal viewing distance beyond 21 ft	75 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 6.40 m	<b>Your author does National Electrical Code labeling. The minimum character height is 1/8" and 3/8" is used for headings.</b>
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<b>18.10, tactile appliances</b>	<b>These are for the deaf and hard of hearing.</b>																																																	
<b>18.11, standard emergency service interface</b>	<b>This is a standard for devices issued to first responders for wayfinding and information. The intent is commonality to support immediate use and zero learning curve.</b>	<b>Your author has seen articles relating to Wi-Fi tablets issued to first responders. This is the first NFPA step on a standardization effort.</b>																																																
<b>In-Building Fire Emergency Voice / Alarm Communications</b>																																																		
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>																																																
<b>3.3.85.1.2, definition</b>	<b>In-building fire emergency voice / alarm communications system is dedicated manual or automatic equipment for originating and distributing voice instructions, as well as alert and evacuation signals."</b>																																																	

<p><b>24.4, messages</b></p>	<p><b>Messages should be approved by the AHJ. Messages should not be limited to English. Recognition to be made of minority groups and transient isolated groups .</b></p>	<p><b>Note the application for notification of response to weather, natural disaster, toxic spill or terrorism event.</b></p>
<p><b>24.4.1, automatic response</b></p>	<p><b>The intent of the system is to provide automatic response to initiation signals, such as future broadcast and internet messaging. 30-second delay is permissible in locations constantly attended by trained operators. Zoning of unique messages is appropriate.</b></p>	<p><b>This section is expanded wording for fire alarms, to accommodate emerging technology.</b></p>
<p><b>24.2.1, emergency evacuation signal</b></p>	<p><b>Evacuation messages shall be preceded and followed by a minimum of two cycles of the emergency evacuation signal, On .5sec, off .5sec, On .5sec, off .5sec, On .5sec, off .5sec, Off 1.5sec Repeat</b></p>	
<p><b>Two-Way, In-Building Wired Emergency Services Communications Systems</b></p>		
<p><b>Codespeak</b></p>	<p><b>English</b></p>	<p><b>Action Required</b></p>
<p><b>24.8</b></p>	<p><b>These systems are for communication among fire fighters, other first responders and designated building users.</b></p>	<p><b>Think emergency telephone handsets, repeaters for handi-talkies.</b></p>
<p><b>24.8.9,10, half-duplex, full-duplex</b></p>	<p><b>Either half-duplex (push to talk) or full-duplex (common talk) ae acceptable.</b></p>	
<p><b>24.8.11, locations</b></p>	<p><b>If provided, then a two-way telephone station or jack shall be provided at each of the following:</b></p>	

	<ul style="list-style-type: none"> <li>(1) Each floor level</li> <li>(2) Each notification zone</li> <li>(3) Each elevator cab</li> <li>(4) Elevator lobbies</li> <li>(5) Elevator machine room(s)</li> <li>(6) Emergency and standby power room(s)</li> <li>(7) Fire pump room(s)</li> </ul>	
<b>24.8.17, mounting height</b>	<b>Telephone or jacks shall be between 36 – 66-in above finished floor with at least 30-in clear space in front.</b>	
<b>Two-Way Radio Communications Enhancement Systems</b>		
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<b>24.9</b>	<b>Building concrete and steel interfere with fire fighter radios. Repeaters or bi-directional amplifiers are recommended.</b>	<b>The AHJ, fire fighters communications officers and building designers must work together to define needs and response alternatives.</b>
<b>Area of Refuge Emergency Communications Systems</b>		
<b>Codespeak</b>	<b>English</b>	<b>Action Required</b>
<b>24.10</b>	<b>Area of Refuge must be provided for persons unable to use stairs. The International Building Code, adopted by most States, referencing NFPA 101, The Life Safety Code, specifically requires such areas and communications</b>	<b>Upon consultation with the Architect, designate locations and show devices on plan drawings. Your author favors “clean faceplate” devices with a push-to call / talk button. Typically a handset is provided at the fire alarm control unit and at</b>

		<b>the annunciator at the fire fighter entrance.</b>
<b>24.11, Elevator Emergency Communications</b>	<b>Not covered by this course.</b>	<b>This is an Elevator Code item, handled by the mechanical designer. Designated pathways may be required on electrical drawings.</b>
	<b>End of file</b>	