This fire alarm seminar is an overview of elevator fire alarm system interfacing fundamentals and the current requirements. It covers the terminology, life safety functions, and correct application of the overlapping codes/ installation standards for a wide range of elevator applications. There is a specific focus on sequence of operations, cab recall, power shunt-trip, firefighter communication, and fire sprinkler interfacing. Code applications are based on ASME 17.1, NFPA 72 and NFPA 13 for hydraulic; traction (Electric) Machine-Room-Less (MRL) elevators.

In 1861, Elisha Otis invented the first braking mechanism for the elevator, which made vertical travel within a building feasible and safe. A little over forty years later, the gearless traction elevator was developed, which allowed movement in buildings of significant height. Thus, along with the advent of inexpensive materials and advanced engineering and construction methods, the automatic elevator became a pivotal step that led to the surge of high-rise construction in the United States. Since its introduction, the elevator has seen numerous advancements, but its purpose remains the same: moving people!

Presentation Material:

The material will be presented in a PowerPoint format and available digitally/ paper.

Presentation by:

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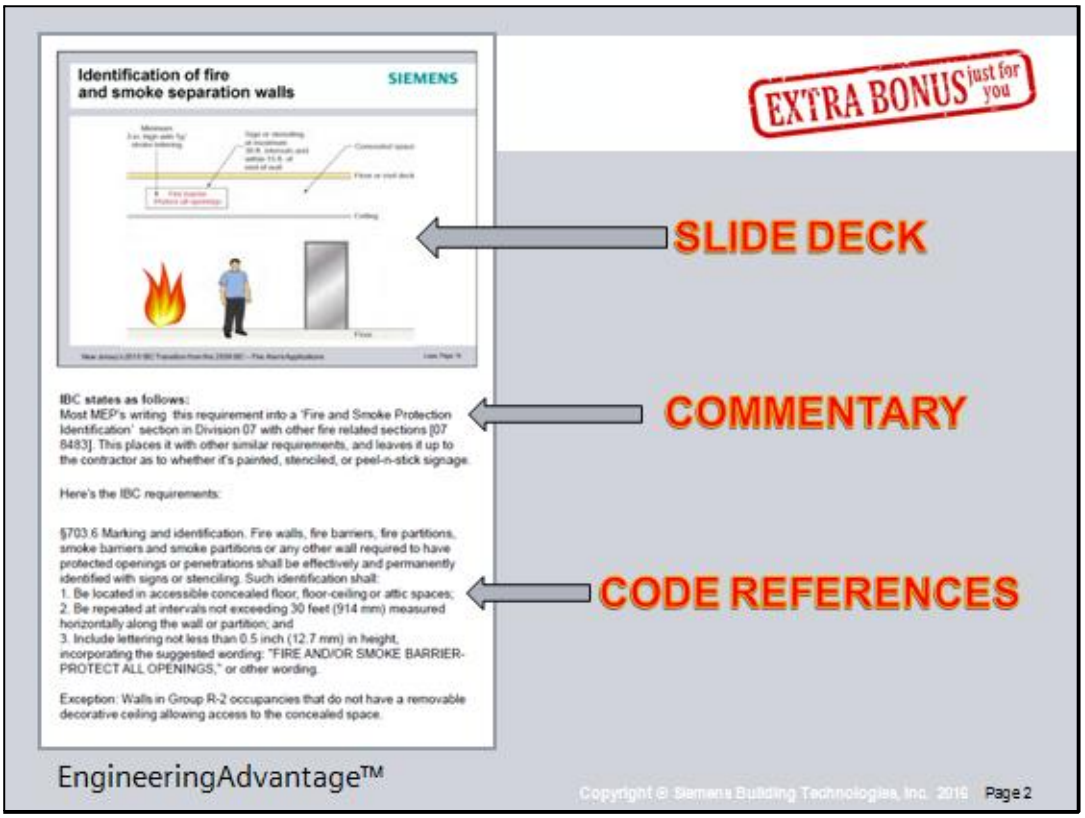
Identification of fire
and smoke separation walls
SIEMENS
EXTRA BONUS just for you
SLIDE DECK
COMMENTARY
CODE REFERENCES
IBC states as follows:
Most MEP's writing this requirement into a 'Fire and Smoke Protection Identification' section in Division 07 with other fire related sections [07 8483]. This places it with other similar requirements, and leaves it up to the contractor as to whether it's painted, stenciled, or peel-n-stick signage.
Here's the IBC requirements:
§703.6 Marking and identification. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
1. Be located in accessible concealed floor, floor-ceiling or attic spaces;
2. Be repeated at intervals not exceeding 30 feet (914 mm) measured horizontally along the wall or partition; and
3. Include lettering not less than 0.5 inch (12.7 mm) in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording.
Exception: Walls in Group R-2 occupancies that do not have a removable decorative ceiling allowing access to the concealed space.
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Today's Focus

Elevator Classifications

1. Passenger
2. Freight
3. Destination Elevators (new types elevators)
4. Fire Service Access Elevators (FSAE)
5. Occupants Evacuation Elevators (OEE)
6. Special Service
   - Private residence elevators
   - Limited use limited application (LULA)
   - Limited use limited access (Article 15 Handicap)Elevators

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There are many classifications of elevators, today we will discuss only passenger elevators.

Fire Service Access Elevator

IBC 2009, Section 403.6.1 added a new requirement to provide at least one fire service access elevator in buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access. The intention of the requirement is to provide a reasonably safe means to access a staging area near the fire for firefighting operations.

Specific requirements for the elevator, including the requirement for the elevator to open into a rated elevator lobby and have direct access to an exit enclosure through the lobby, are provided in Section 3007.

Occupant Evacuation Elevators

IBC 2009, Section 403.6.2 now permits passenger elevators, installed in accordance to Section 3008, to be used for occupant self-evacuation in high-rise buildings. Section 3008 provides specific requirements for occupant evacuation elevators including special provisions for the elevator lobby and signage.

While the use of occupant evacuation elevators is not mandated, they may be voluntarily installed to provide an additional means of egress for occupants in high-rise buildings, and to be exempt from the requirement to provide an additional exit stairway as required by Section 403.5.2.

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Interfacing Elevators with Fire Alarm Systems

Objectives

1. Understand and identify different types of elevators.
2. Understand common industry terms
3. Identify codes & standards associated with elevator emergency operation.
4. Understand equipment placement & elevator interfacing requirements of:
   - IBC 2015 edition
   - NFPA 72 2013 edition
   - NFPA 13 2013 edition
   - ASME A17.1 2013 edition

Presented for:

AFAA NEW JERSEY

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Various types of elevators are found in both low and high-rise buildings. Among these elevators are Hydraulic and Traction (Electric) Elevators with driving machines installed in dedicated spaces referred to as “Elevator Machine Rooms” while Machine-Room-Less (MRL) elevators have their hoisting machines installed directly inside the elevator hoistway. This presentation will clarify specific NFPA 72 (National Fire Alarm and Signaling Code) and NFPA 13 (Standard for the Installation of Sprinkler Systems) requirements associated with these elevators, both in buildings provided with “Building Fire Alarm Systems” and those without. Specific NFPA 72, NFPA 13 and ASME A17.1 code terms, such as Fire Emergency Operation (FEO), Dedicated Function FA System for Elevator Recall and Supervisory, Phase-I Emergency Recall Operation, Phase-II In-Car Emergency Operation, Designated and Alternate Recall levels and Shunt-Trip Function will be discussed and clarified. 2013 Editions of NFPA-72, NFPA-13 and ASME A17.1 will be presented.

The information in this guide has been provided in an attempt to assist in making this decision and should in no way be construed as a formal approval or certification.

Presenter Background

Jason Lupa, P.E. is a licensed Fire Protection Engineer, and an active firefighter Jason has 20 years of extensive experience in Fire Protection Engineering: project management, code consulting, fire protection system design, code enforcement, code writing and code training.

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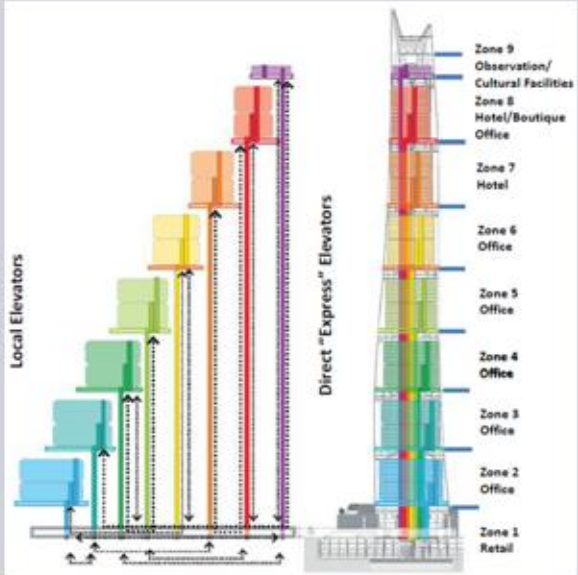
Why is Elevator Life Safety Interface Important?



- Buildings are being built taller with more complex elevator systems.
- New evacuation concepts.
- New code requirements.
- New Technology.

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Elevators in modern towers are designed to move 12.5 percent of a building's occupants within five minutes. That means a building can be completely evacuated within 40 minutes if the elevators are used.

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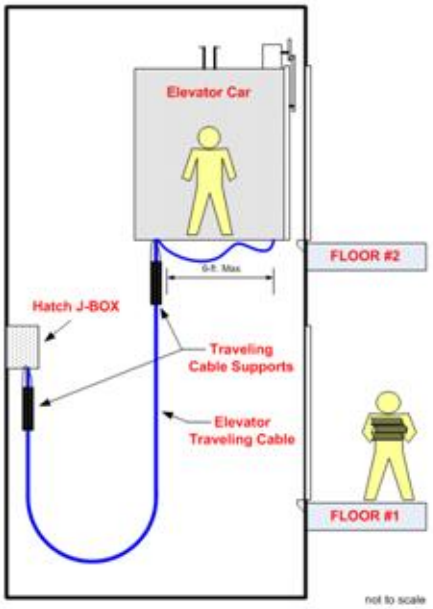
Elevator Terminology

Traveling cables are flexible connections for cab power & communication circuits.

Normally installed by elevator contractors.

It is important to coordinate fire alarm circuits for the cab, such as speaker, and firefighter telephone.



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Car (elevator) - The load-carrying unit, including its platform, frame, enclosure, and car door or gate.

Car Counterweight - A set of weights roped directly to the elevator car of a winding-drum type installation. In practice, this weight is equal to approximately 70 percent of the car weight.

Car Operating Panel - A panel mounted in the car containing the car operating controls, such as call register buttons, door open and close, alarm, emergency stop and whatever other buttons or key switches are required for operating.

Car Operating Station - A panel mounted in the car containing the car operating controls, such as call register buttons, door open and close, alarm emergency stop and whatever other buttons or key switches are required for operation.

Compensating Chain - A welded-link chain used for hoist rope weight compensation. One end of the chain is attached to the underside of the elevator car, and the other end is fastened to the counterweight or stationary fastening in the hoistway.

Compounding Sheave - A pulley located on the car, and on the counterweight, under which the hoist cables run to double the capacity and reduce the speed of an elevator.

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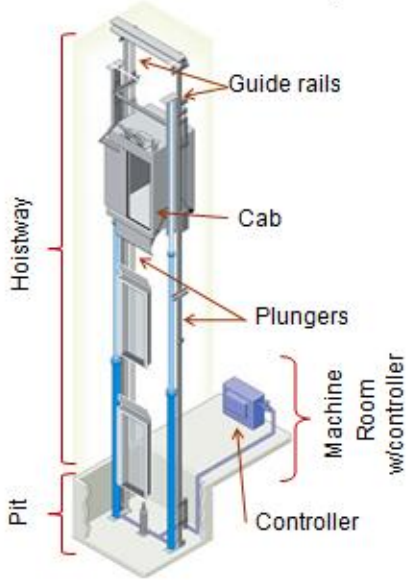
Elevator Construction: Hydraulic



Plunger hydraulic type systems are the most common and consists of an elevator car mounted on top of a long hydraulic piston. The piston is generally not telescopic, so there must be a hole in the ground as long as the distance the elevator travels, common in low-rises.

- Machine room is typically at the bottom, adjacent to the hoistway.
- Cab movement can be by holed, holess, telescopic and roped drives.
- Typical travel distance 30ft.

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Hydraulic elevators are supported by a piston at the bottom of the elevator that pushes the elevator up. They are used for low-rise applications of 2-8 stories and travel at a maximum speed of 200 feet per minute. The machine room for hydraulic elevators is located at the lowest level adjacent to the elevator shaft.

Hydraulic elevators have many two main types as follows:

1. Holed (Conventional) Hydraulic Elevators

They have a sheave that extends below the floor of the elevator pit, which accepts the retracting piston as the elevator descends. Some configurations have a telescoping piston that collapses and requires a shallower hole below the pit. Max travel distance is approximately 60 feet.

2. Hole-less Hydraulic Elevators

They have a piston on either side of the cab. It can be divided to 3 different types as follows:

a- Telescopic Hydraulic Elevators: In this configuration, the telescoping pistons are fixed at the base of the pit and do not require a sheave or hole below the pit and has 2 or 3 pieces of telescoping pistons. Telescoping pistons allow up to 50 feet of travel distance.

b- Non-telescoping (single stage) Hydraulic Elevators: It has one piston and only allows about 20 feet of travel distance.

c- Roped Hydraulic Elevators: They use a combination of ropes and a piston to move the elevator. Maximum travel distance is about 60 feet.

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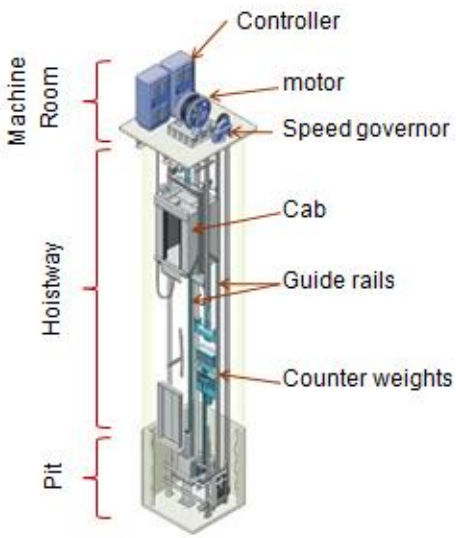
Elevator Construction: Traction



This type can be used in buildings of any height, common in high-rises.

- Cables transport the car, powered by an electric AC or DC motor.
- Motor turns one way, elevator moves up. Motor turns the other way, elevator moves down.
- The ropes are connected to a counterweight (40-50% capacity plus weight of the cab).
- Cab movement can be by geared, gearless, or drum drives.

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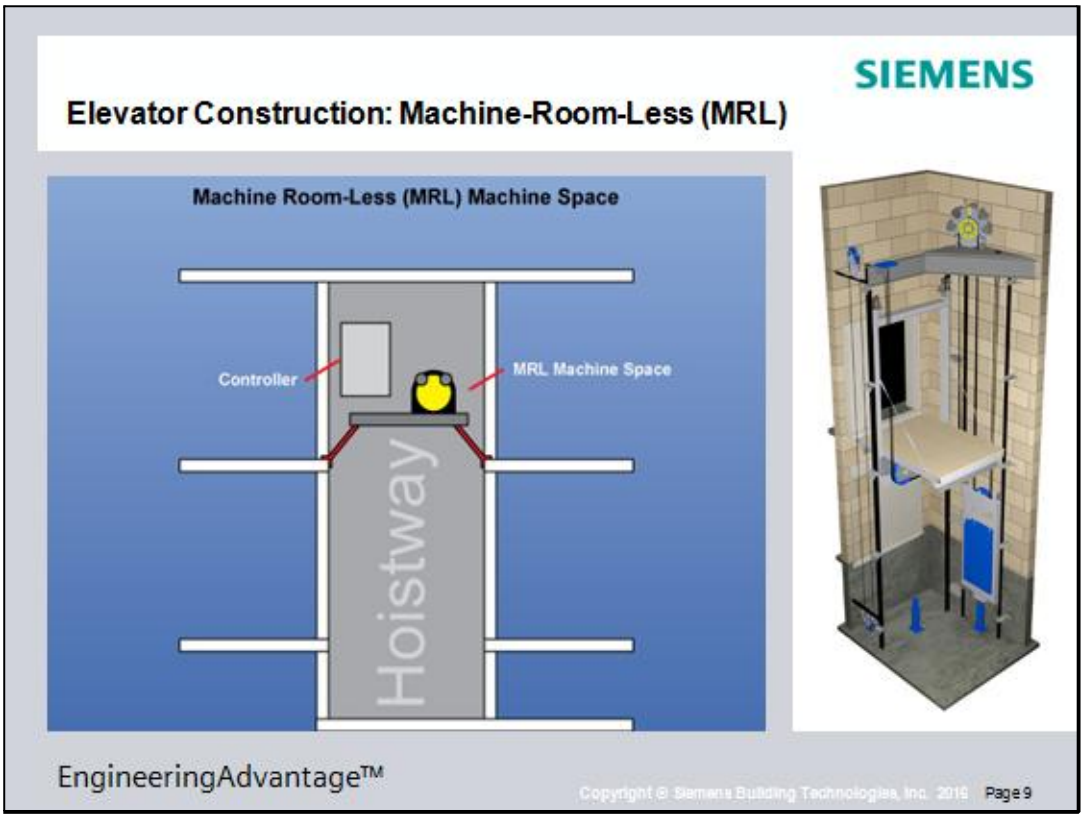
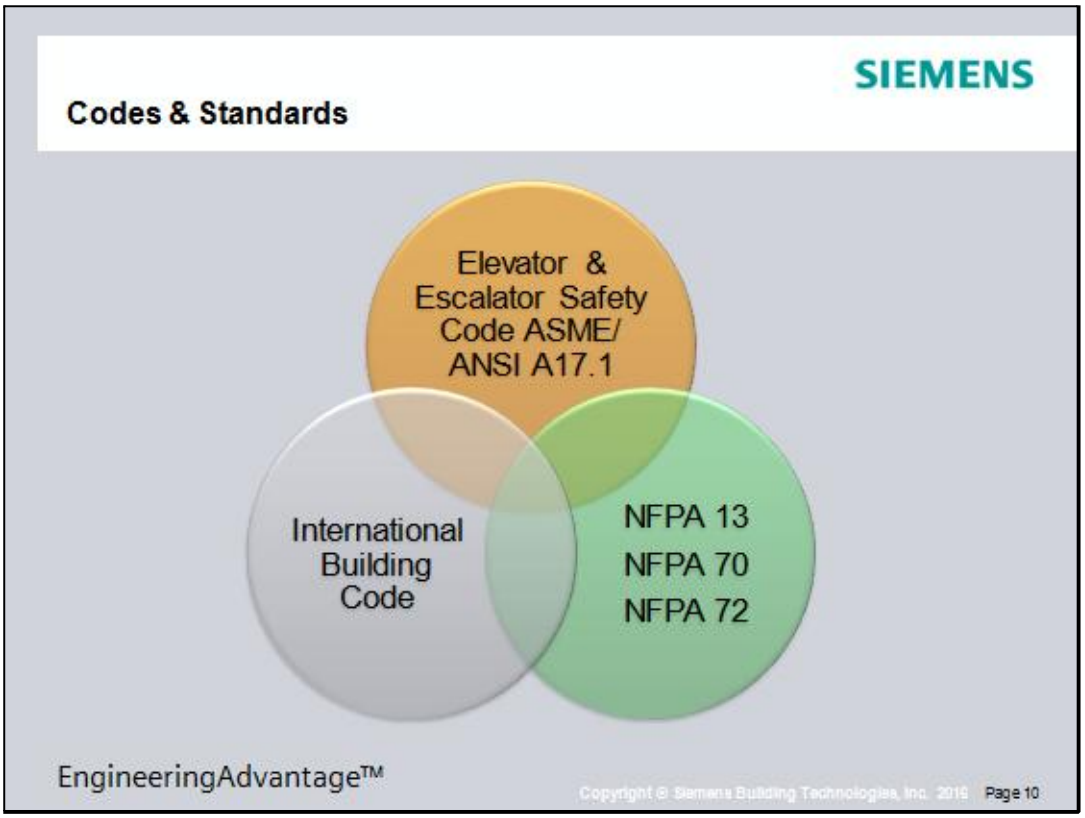
Geared traction machines are driven by AC or DC electric motors. Geared machines use worm gears to control mechanical movement of elevator cars by "rolling" steel hoist ropes over a drive sheave which is attached to a gearbox driven by a high-speed motor. These machines are generally the best option for basement or overhead traction use for speeds up to 3 m/s (500 ft/min).



Machine room less elevators do not have a fixed machine room on the top of the hoistway, instead the traction hoisting machine is installed either on the top side wall of the hoistway or on the bottom of the hoistway. The motor is installed using a permanent magnet which "sticks" the motor permanently and work with Variable Voltage Variable Frequency (VVVF) drive. Some of the hoisting machines are using gearless synchronous motors instead conventional induction motors. This design eliminates the need of a fixed machine room and thus saves much building's space. All traction MRL elevators are gearless traction.

While the hoisting motor is installed on the hoistway side wall, the main controller is installed on the top floor next to the landing doors. This controller is situated behind a locked cabinet which have to be unlocked using a key for maintenance, repair or emergency purposes. Most elevators have their controller installed on the top floor but fewer elevators have their controller installed on the bottom-most floor. Some elevators (like those in Japan) may have the hoisting motor located on the bottom of the elevator shaft put, thus it is called as "bottom drive MRL" elevator. Some elevators (like Otis and Schindler) have the controller cabinet installed within the door frame instead on the wall to save space.

MRL options include adjacent or remote full control room, closet control space, control space in hoistway, machine space in hoistway or at least part of controls mounted in elevator jamb. Machine space in hoistway has same requirements as a machine room: GFIC, HVAC and lighting. Some components such as smoke detector, heat detector and sprinkler depend on the model of elevator.



Like other systems within a building, elevators are regulated by the building code. In the International Building Code (IBC)1, Chapter 30 establishes the primary criteria for elevators, while other sections of the IBC supplement the primary criteria with special provisions, such as requirements for accessible means of egress, elevator lobbies, and shaft enclosures for hoistways. In addition to the provisions in the IBC, elevators must also comply with the requirements in the American Society of Mechanical Engineers' (ASME) A17.1, Safety Code for Elevators and Escalators2, and ICC/ANSI A117.1, Accessible and Usable Buildings and Facilities3, which are referenced by the IBC

Per ASME A17.1 section 2.27.3, Firefighter emergency operations (FEO) are required in all automatic elevators with a rise of over 80″.

Enabling Codes:

- ASME A17.1, *Safety Code for Elevators and Escalators*
- Local building codes

Supporting Codes/Standards:

- NFPA 72, *National Fire Alarm and Signaling Code*
- NFPA 13, *Standard for the Installation of Sprinkler Systems*
- NFPA 70, *National Electrical Code*

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Codes & Standards: Federal Projects

Department of Defense Sites

Unified Facilities Criteria (UFC)

- 3-600-01, Section 6-30
- Breakdown by elevator type, etc.

Non-Military Sites

GSA PBS P-100 Facilities Standards for the Public Buildings Service, Section 7.10

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Enabling Codes:

- ASME A17.1, *Safety Code for Elevators and Escalators*
- Local building codes

Supporting Codes/Standards:

- NFPA 72, *National Fire Alarm and Signaling Code*
- NFPA 13, *Standard for the Installation of Sprinkler Systems*
- NFPA 70, *National Electrical Code*

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Elevator Life Safety Functions: Phase I - automatic

Phase I: Elevator Recall

ASME 2.27.3.2 describes the automatic emergency recall operations initiated by the fire alarm system:

- ❑ Recalls to the cab(s) to the Designated Level when a fire event threatens the elevator system
- ❑ Recalls to the Alternate Level when a fire condition is detected at the designated level lobby

Unless otherwise required by the AHJ, only the elevator lobby, elevator hoistway, and elevator machine room initiating devices are the only automatic equipment which initiates an elevator recall.
REF NFPA 72 [2013] 21.3.3

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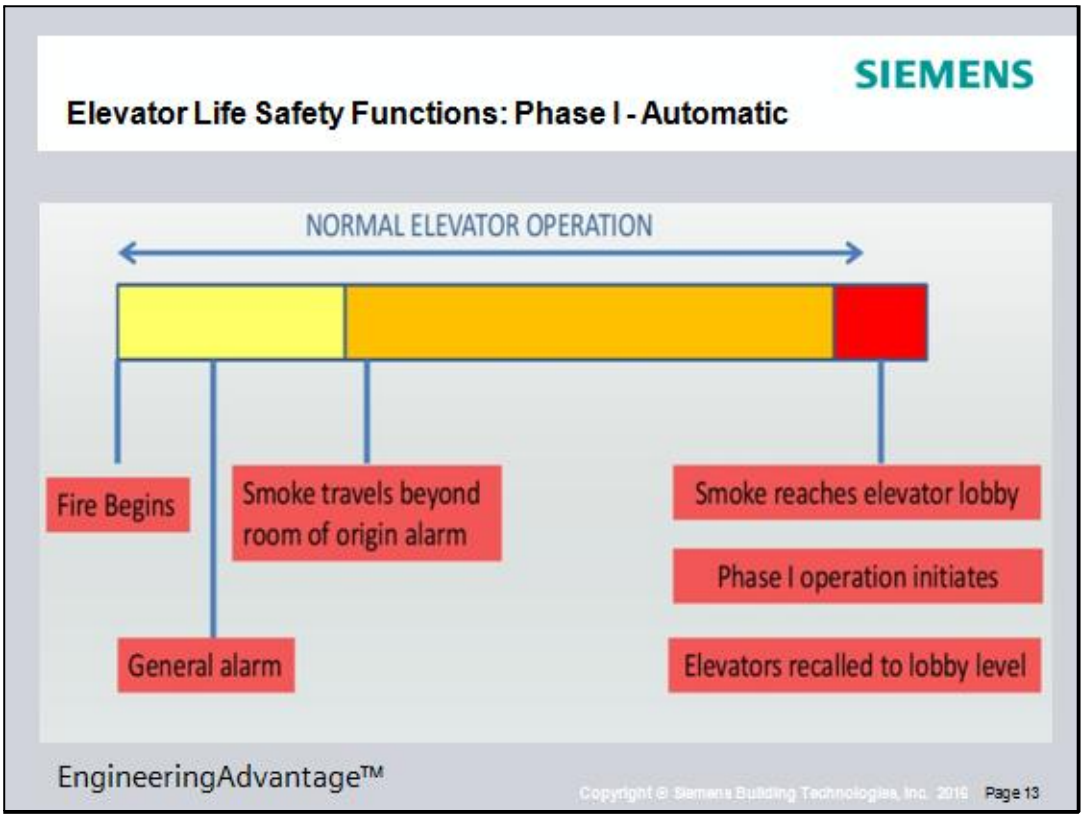
The Firefighter emergency operations (FEO) involves several phases of action, but essentially, it removes control and accessibility of the elevator cabs from the public and gives it to the firefighters. By giving firefighters total control of a facility's elevators, they have an additional tool to fight the fire. In a high rise situation, this tool is critically important. A second, equally important result is the consideration for public safety. By removing public access to elevators, the possibility of injury or death due to getting trapped in a non-operational cab or actually being delivered to the involved floor is removed.

Operation of elevator on Phase I Recall is covered by ASME A17.1, Rule 2.27:

- Recalls to the Designated Level when a fire condition is detected in the hoistway, elevator machine room, or respective lobbies
- Recalls to the Alternate Level when a fire condition is detected at the designated level lobby

Only the automatic detectors located in elevator lobbies, hoistway and machine rooms are permitted to initiate the recalling of elevators. In no case should an elevator be recalled by a manual pull station or by detectors located in other areas of the building unless mandated by AHJ.

All initiating devices used to initiate firefighters' service recall must be connected to the building fire alarm system. Locally powered smoke detectors and stand alone heat detectors are not permitted to be used.



The Phase I FEO involves several automatic phases, but essentially, it removes control and accessibility of the elevator cabs from the public if they become threatened by fire and gives it to the firefighters. This provides both occupant safety and provides firefighters an additional tool to fight the fire – a very critical in a high rise situation,

ASME 17.1

2.27.3.2 Phase I Emergency Recall Operation by Fire Alarm Initiating Devices (FAIDs)

2.27.3.2.1 In jurisdictions not enforcing the NBCC, smoke detectors or other automatic fire detectors in environments not suitable for smoke detectors (fire alarm initiating devices) used to initiate Phase I Emergency Recall Operation shall be installed in conformance with the requirements of NFPA 72,and shall be Located

(a)at each elevator lobby served by the elevator

(b) in the associated elevator machine room, machinery

space containing a motor controller or driving machine, control space, or control room

(c) in the elevator hoistway, when sprinklers are located in those hoistways

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Elevator Life Safety Functions: Phase I - Manual

Phase I: Elevator Recall

Firefighters can also manually initiate Phase I Recall from the 3-position key switch main lobby (primary floor).

If the building has a Fire Command Center, the elevator annunciator panel will also have a manual key switch.

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Another means of activating Phase One is manually by key switch. Manual recall accomplishes the same, but is activated manually by a person that keys a switch that initiates the recall function. Labeled “FIRE RECALL” and its positions marked “RESET,” “OFF,” and “ON” (in that order), with the “OFF” position as the center position.

The key switch is usually located in the elevator lobby of the Primary level. If the facility has an elevator annunciator panel, a switch will be located there as well. Firefighters arriving at a facility may need to use the elevator before Phase One is automatically activated. By using the key switch, firefighters can initiate Phase One manually. As long as the switch is in the ‘On” position, the cabs will remain in Phase One operation.

Per ASME 17.1 Chapter 2.27.3.1.1, if not co-located, each elevator car would have its own Phase I switch.

Chapter 2.27.3 Firefighters’ Emergency Operation shall apply to all automatic elevators except where the hoistway or a portion thereof is not required to be fire-resistive construction (see 2.1.1.1), the rise does not exceed 80 in., and the hoistway does not penetrate a floor.

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Elevator Life Safety Functions: Firefighter Hat

PHASE I

Firefighter hat is **SOLID** upon elevator lobby smoke detector activation.

Firefighter hat is **FLASHES** upon elevator machine room OR hoistway smoke detector activation

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Another FEO safety feature is referred to as the 'Fireman's Hat' or 'Flashing Hat'. If a smoke detector in the elevator hoistway or machine room activate, the FEO lamp in the cab will begin to flash. This alerts the firefighters that are using the cab that fire may be present in the hoistway or machine room, making the use of the elevator a risk to their safety.

The elevator vendor supplies, powers and controls the firefighter hat. The fire alarm interfaces with a form C relay.

The firefighter's hat is a visual only indicator that the elevator is in recall mode (phase I operation) or is unsafe for firefighters (Phase II operation). It flashes upon:

- Actuation of any automatic devices located in the elevator machine room, elevator machinery space, elevator control space, or elevator control room
- Actuation of any automatic devices located in the hoistway

So the steady firefighter hat light indicates a device associated with the elevator has activated and a flashing light alerts firefighters that the elevators are no longer safe for them to use. This is important because the firefighter override key will control the elevator even in recall mode. Firefighters are taught not to use the elevator when the light is flashing, but still have the ability , if the situation requires.

Who makes connections between the fire alarm system and the elevator controller? Generally, the elevator contractor/maintainer will make these connections

The "flashing fire helmet" indicator light is present on the control panel of all elevators installed from 2004 to the present (and in older elevators whose controls have been made compliant with current building and elevator codes), which have automatic fire sprinklers in the hoistway and/or machine room.

If firefighters are alert and know the elevators in the buildings in their response area, they are unlikely to become trapped between floors by an elevator power shunt trip.

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When is Phase I required?

In 1973 ASME 17.1 established a distance a cab had to travel of 25' before Phase I was required.

In 1992 ASME 17.1 revised the a distance a cab had to travel to over 80" before Phase I was required.

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Per ASME A17.1 section 2.27.3, Firefighter emergency operations (FEO) are required in all automatic elevators with a rise of over 80″. If the facility has or is required to have a fire alarm system, then the elevator recall initiating devices are part of that system. This system has the added responsibility of notifying the occupants and the fire department of alarm conditions. If a reporting fire alarm system is not required, the elevator recall initiating devices can be part of a stand alone fire alarm system whose sole purpose is to initiate an FEO sequence. Except for activating an internal sounder, this system, which is to be plainly marked "Elevator Recall Control and Supervisory Panel", does not notify occupants when activated, nor does it notify the fire department. However, it is located in a public space, generally near a security desk or the elevator lobby of the building's main egress floor.

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Elevator Life Safety Functions: Phase II

Phase II: Emergency In-Car Operation

This manual override is initiated by firefighters after Phase I has been activated. Under Phase II operation, they can use an in-cab keyswitch to operate the elevator, the elevator has electricity. Key removable in Off position only.

FIREFIGHTERS' OPERATION

To operate car	Insert fire key and turn to "ON" Press desired floor button
To cancel floor selection	Press "CALL CANCEL" button
To close power-operate door	Press and hold "DOOR CLOSE" button
To open power-operate door	Press and hold "DOOR OPEN" button
To hold car at floor	With doors op-en, turn key to "HOLD"
To automatically send car to recall floor	With doors open, turn key to "OFF"

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Once Phase I is active, firefighters may override it and use the cabs by initiating Phase II. It is manually activated from inside the cab with a key switch. Once a firefighter is in the cab, he overrides Phase I by activating the cab FEO switch with another key. Then, he can manually operate the cab by pressing and holding the cab command buttons. To close the doors, he must press and hold the 'Door Close' button until the doors are closed. If he releases the button before the doors close, the doors will open again. Once the doors are closed, he selects the desired floor and the cab will take him to that level. Upon arrival, he must press and hold the 'Door Open' button. Again, if he releases the button before the doors are fully open, they will close again. Several elevator safeties are disabled, such as the automatic eye which could be tricked by smoke.

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Elevator Life Safety Functions: Control Panels

All elevator smoke and heat detector wiring must be monitored for integrity by a fire alarm control panel.

Locally powered 120 VAC smoke or heat alarms are not permitted for elevator life safety operations.

In facilities without a building fire alarm system, detectors are connected to a dedicated fire alarm control unit that is designated:
"elevator recall and supervisory control unit,"

REF ASME 17.1 & NFPA 72: 21.3.1

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NFPA 72 21.3.1 [2013] requires all initiating devices used for elevator recall service to be connected to the building fire alarm system.

NFPA 72 21.3.2 [2013] requires facilities without a building fire alarm system must connect elevator detectors to a dedicated function fire alarm control unit that is designated "elevator recall control and supervisory control unit," permanently identified on the dedicated function fire alarm control unit and on the record drawings. See also 3.3.102.2.1

Unless otherwise required by the AHJ, only the elevator lobby, elevator hoistway, and elevator machine room initiating devices are used to recall elevators for firefighters' service

Any actuated detector that has initiated firefighters' recall must:

- Be annunciated at the building fire alarm control unit, and
- All required anunciators

These devices shall activate the general notification appliances throughout the premises, but the AHJ can allow them to be supervisory.

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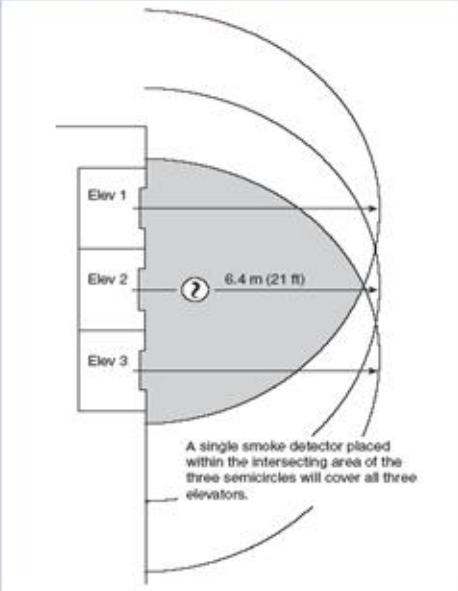
Lobby Detector Placement

A lobby smoke detector may be wall-mounted above the cab doors or ceiling-mounted within 21 ft of the centerline of each elevator door within the elevator bank under control of the detector.

A detector with proper coverage can protect several cabs, even if in different banks. It can also perform multiple functions such as recall and releasing smoke door holders for the elevator lobby.



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As required by **NFPA 72 2013 21.3.5***, the spot type smoke detectors for the use of capturing the passenger elevator shall be mounted within 21' centerline of the elevator door. In addition to these detectors, you will have smoke detector(s) in the elevator equipment room and at the top or bottom of the **elevator shaft.**

Lobby smoke detectors shall be located on the ceiling within 21 ft. (see NFPA 72 [2010] 21.3) of the centerline of each elevator door within the elevator bank under control of the detector. If the ceiling height exceeds 15 ft.. or is other than flat, the detectors should be located in accordance with NFPA 72. Smoke detectors shall not be installed in elevator hoist-ways except for the following two exceptions: (1) Where the top of the hoist-way is protected by automatic sprinklers, and (2) Where the detector is used to activate smoke relief equipment.

- Where approved by the AHJ, detectors for elevator recall may cause a supervisory signal in lieu of an alarm signal
- Where lobby detectors are used for other than initiating elevator recall, they must initiate an alarm signal

For lobby ceiling configurations exceeding 15 ft in height or that are other than flat and smooth, detector locations are determined per Chapter 17

- The 2007 and earlier NFPA 72 did not directly address elevator lobbies having high ceilings typically found at a mezzanine, atrium lobbies, industrial settings, etc.

- The 2010 NFPA 72, 17.7.3.1.4 states: If the intent is to initiate action when smoke/fire threatens a specific object or space, the detector shall be permitted to be installed in close proximity to that object or space. The Annex adds: When specific objects or spaces are threatened by smoke or fire, such as at elevator landings that have high ceilings in excess of 15 feet, detection should be placed on the wall above and within 60 inches from the top of the elevator doors. This allows the detector to be located where it may be readily installed, tested and serviced while also providing the necessary smoke detection coverage for the landing. Chapter 21.3.5 references Chapter 17 for proper detector placement in elevator lobbies which have ceilings exceeding 15'.

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Lobby Detector Placement – Unconditioned

Unless specifically designed/ listed for the expected conditions, smoke detectors shall not be installed in the following ambient conditions REF NFPA 72 - 2013 17.7.1.8:

1. Temperature below 32°F
2. Temperature above 100°F
3. Relative humidity above 93 percent
4. Air velocity greater than 300 ft/min

Elevator lobbies located outside may substitute the smoke detector with a heat detector. (NFPA 72 9.6.1.8.1.2)

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Smoke detectors should not be installed in outdoor locations or locations that are open to the weather (such as unenclosed elevator lobbies in open parking structures), because such environments can exceed the parameters of the detector listing (temperature, moisture, dust, etc.) and can result in unwanted alarms/ unnecessary recall of elevators. If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection is permitted. (NFPA 72 9.6.1.8.1.2). If conditions are harsh, then you must use an alternate type of detection (heat detector). The installation of a smoke detector in a parking garage elevator lobby is not required. Heat detectors are acceptable.

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Smoke Detectors in Hoistways

From NFPA 72, 3-9.3.4:

Smoke detectors shall not be installed in elevator hoistways.

Exception: Where the top of the elevator hoistway is protected by automatic sprinklers.

Exception: Where a smoke detector is installed to activate the elevator hoistway smoke relief equipment.

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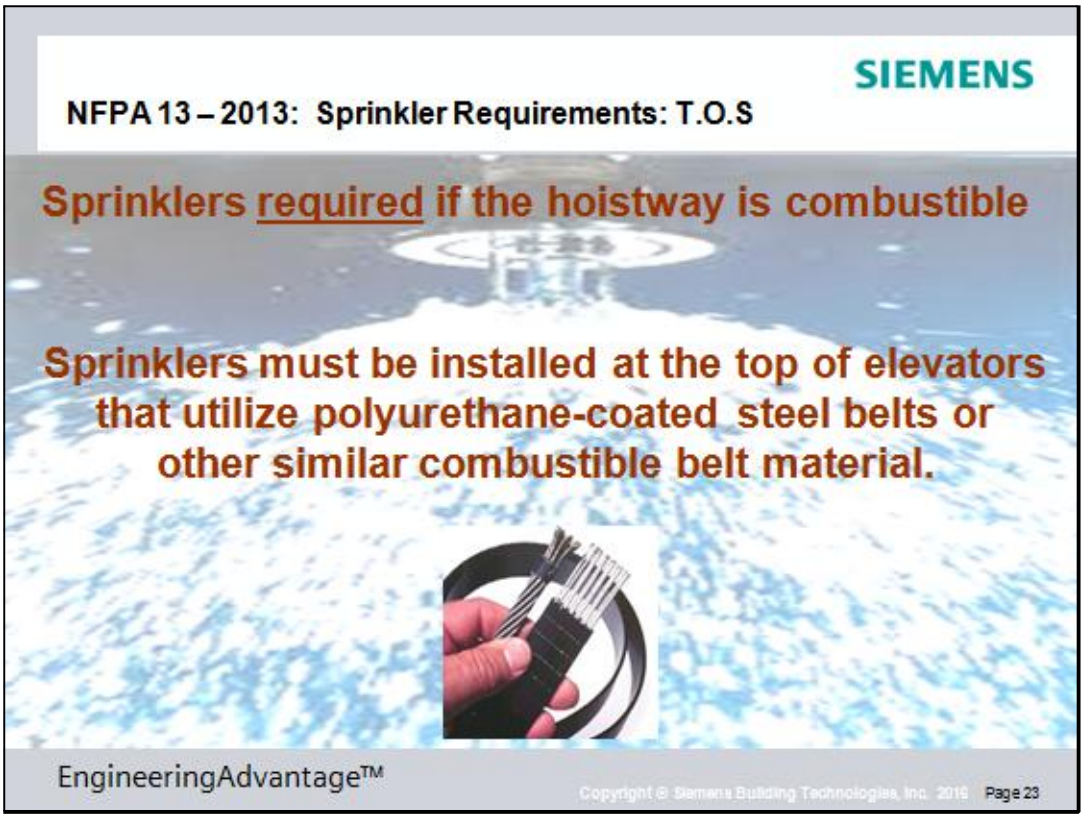
Maintenance and testing can be difficult in the hoistway, as well as possible misapplication. NFPA wants to limit their installation in hoistways.

Smoke detectors shall not be installed in elevator hoist-ways except for the following two exceptions:

(1) Where the top of the hoist-way is protected by automatic sprinklers.

(2) Where the detector is used to activate smoke relief equipment.



8.15.5.7 Combustible Suspension in Elevators.

8.15.5.7.1 Sprinklers shall be installed at the top and bottom of elevator hoistways where elevators utilize combustible suspension means such as noncircular elastomeric-coated or polyurethanecoated steel belts.

8.15.5.7.2 The sprinklers in the elevator hoistway shall not be required when the suspension means provide not less than an FT-1 rating when tested to the vertical burn test requirements of UL 62, *Flexible Cords and Cables, and UL 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords.*

IBC 703.4. Combustible or non-combustible construction can be summarized this way: If a wall or ceiling assembly contains only materials considered non-combustible such as drywall over steel studs or steel joists, the assembly is considered non-combustible. If any part of the assembly is combustible, such as drywall over wood studs or wood joists, the assembly is considered combustible.

NFPA 13 – 2010 edition

- 8.15.5.1 A sidewall spray sprinkler must be installed at the bottom of the elevator hoistway within 2 ft of the pit floor.
- 8.15.5.2 The sprinkler required at the bottom of the elevator hoistway by 8.15.5.1 is not required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids
- 8.15.5.3* Automatic sprinklers in elevator machine rooms or at the tops of hoistways to be of ordinary (135°F) or intermediate (175°F) temperature rating.
- A.8.15.5.3 ASME A17.1, Safety Code for Elevators and Escalators, requires the shutdown of power to the elevator upon or prior to the application of water in elevator machine rooms or hoistways.
- 8.15.5.4* Upright, pendent, or sidewall spray sprinklers to be installed at the top of elevator hoistways.
- A.8.15.5.4 Passenger elevator cars that have been constructed in accordance with ASME A17.1, Safety Code for Elevators and Escalators, Rule 204.2a (under A17.1a-1985 and later editions of the code) have limited combustibility.
- 8.15.5.5 The sprinkler required at the topof the elevator hoistway by 8.15.5.4 is not required where the hoistway for passenger elevators is noncombustible or limited-combustible and the car enclosure materials meet the requirements of ASME A17.1, Safety Code for Elevators and Escalators Materials exposed to the interior of the car and the hoistway, in their end-use composition, are limited to a flame spread index of 0 to 75 and a smoke developed index of 0 to 450, when tested in accordance with ASTM E 84, *Standard Test Method of Surface Burning Characteristics of Building Materials*
- *8.15.5.6 Sprinklers must be installed at the top and bottom of elevator hoistways where elevators utilize polyurethane-coated steel belts or other similar combustible belt material*

NEW!

SIEMENS

NFPA 13 – 2013: Sprinkler Requirements

NFPA 13 - 8.15.5.3

Fire sprinklers not required in hoistways or machine rooms when all of the follow is meet:

1. Used only for elevators
2. Protected by smoke detectors
3. Rated construction
4. No storage
5. Non-hydraulic

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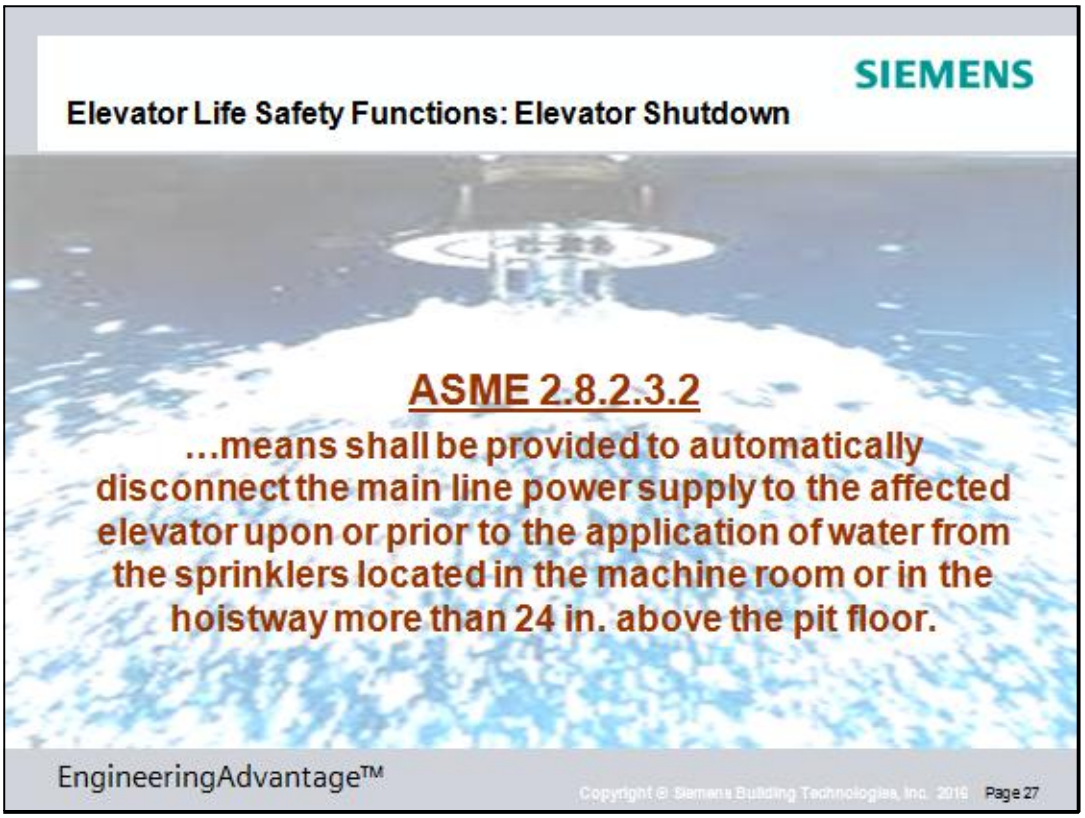
New sprinkler omission requirements were added for elevator machine rooms and other elevator associated spaces where certain criteria is met. Chapter

A sprinkler head located in the bottom of the elevator pit is in place to control the spread of fire caused by the ignition of trash and debris that has fallen through the door opening and collected over time.

In combustible elevator hoistways, building codes require sprinkler heads to be located at the top of the elevator hoistway, elevator machine room and sometimes the bottom of the hoistway. If a sprinkler head were to discharge water into the hoistway or machine room during operation, it is likely that the elevator would operate unpredictably because of water on the control devices, brakes, electrical components, etc. Before power shunt trips were required for sprinklered elevator hoistways and machine rooms, elevators that became wet from sprinkler discharge were known to run with doors open, to miss floor landings, to stop between floors, and to crash into the elevator pit or into the top of the hoistway.

A power shunt trip in an elevator is designed to remove power prior to a sprinkler discharge. It is activated through the fire alarm by either a dedicated sprinkler waterflow switch or heat detectors. The most common and economical application is the use of heat detection. Heat detectors in the machine room and at the top of the hoistway are required to be within 24" of each sprinkler head. These detectors are set at a lower temperature and are more sensitive to temperature change than the sprinkler heads, and will signal that sprinkler discharge is imminent. The elevator's main power shunt trip breaker will trip and stop the elevator car wherever it is, even between floors, so that it will not malfunction when the sprinkler discharges. This power shunt trip can only be reset manually at the elevator controller. Some jurisdictions may permit a delay in operation of the power shunt trip so that the elevator car can move to its primary recall floor level and open its doors. See NFPA 72 (2010) Article 21.4 and Appendix A.21.4.1; and NFPA 70 (2008) Article 620.51-B, for details.



Elevator Shunt Trip is a function that involves shunting the breaker that controls the elevator equipment prior to the release of the automatic sprinkler systems. This procedure is completed via the activation of heat detectors (addressable or conventional). Now keep in mind that not just any heat detector within the facility will be required to activate the elevator shunt trip procedure. The only heat detectors that will tell the fire alarm control panel to shunt the elevator breaker are the ones located in the elevator shaft or hoistway and elevator equipment room. Per NFPA 72 2013 edition section 21.4.2* the heat detectors that are in place to shunt the elevator power shall be installed within 24" of each sprinkler head within the area. On top of this section 21.4.1* states the heat detector used for shunt trip shall be set at a lower temperature and higher sensitivity than its adjacent sprinkler head.

One last thing, the activation of heat detectors can delay the shunt trip via programming for a delay time not to exceed the time it takes the elevator cab starting at the top level to reach the lowest level of exit discharge. The purpose behind this allowance is to increase the potential for elevators to complete their travel to the recall level. Make note that the requirements of A17.1/B44 Safety Code for Elevators and Escalators would still apply.

Now if you choose to use the method of waterflow or pressure switch to activate you elevator shunt trip, any time delay switches or capability will not be permitted per NFPA 72 2013 section 21.4.3.

SIEMENS

Elevator Life Safety Functions: Elevator Shutdown

Shunt Trip Operation – *sequence of operation*

- Smoke detector actuates, initiating elevator recall
- Elevators arrive at the recall floor and open doors
- Heat build-up causes heat detector to actuate
- Shunt trip operates, removing power from the elevator
- More heat build-up; sprinkler operates
- Fire controlled, elevator non-operational

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One final sequence of the FEO is the Shunt Trip. In facilities that have wet sprinklers in their elevator hoistway and machine room, code requires the placement of a heat detector connected to a fire alarm system. The purpose of the heat detector is to shut down the elevator's power via a shunt trip mechanism when activated. Beyond saving the equipment from electrical damage, wet brakes or an uncontrolled loss of power can have deadly results. Consequently, the heat detector must activate before the sprinklers do. The heat detector's alarm threshold must therefore be lower than that of the sprinkler head's. Once activated, the heat detector is programmed to initiate a shunt trip breaker that removes power from the elevator cab. To be effective (and per code), a heat detector must be placed within two feet of any sprinkler head in the hoistway or machine room.

Power Shutdown (Shunt Trip)

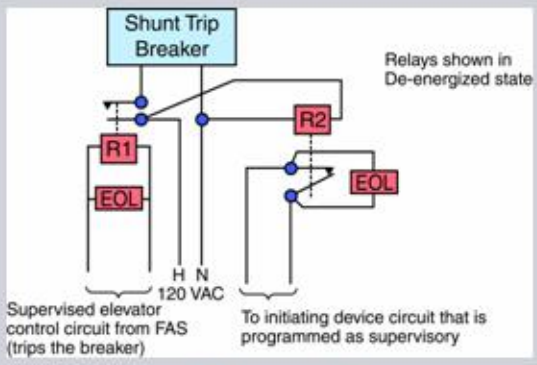
2.8.3.3.2 where elevator equipment is located or its enclosure is configured such that application of water from sprinklers could cause unsafe elevator operation, means shall be provided to automatically disconnect the main line power supply to the affected elevator and any other power supplies used to move the elevator upon or prior to the application of water.

SIEMENS

Elevator Life Safety Functions: Elevator Shutdown

ASME A17.1 section 2.8.3.3.2/2.8.3.3.4 requires a means to automatically disconnect the elevator's electrical power supply prior to discharge of water from a sprinkler located **more than 2 ft from the pit floor.**

No shunt trip required when pit sprinkler is within 2' of the floor!



Activated by either a heat detector or elevator sprinkler waterflow switch, a shunt trip breaker is utilized to remove power. The Codes do not indicate a specific location of shunt trip breaker.

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In the case of a sprinklered elevator hoist-way or motor room, ASME A17.1, Rule 102.2c(3) requires a "Means to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water.'" This is a performance based requirement. The most common system in use has been a shunt trip circuit breaker used in conjunction with heat detectors, the requirements for which are covered in NFPA 72,3-9.4. In no case can any type of time delay be used on the system. Sprinklers mounted in the pit, less than 2 ft above the floor are not required to be a part of this system. The heat detectors used should have both a lower temperature rating and a higher sensitivity ratings compared to the sprinkler heads used. The designer of the system should ensure that the heat detectors trigger before the sprinkler heads open. Heat detectors shall be installed within 2 ft of each sprinkler head. Smoke detectors shall not be used in the machine room or hoist way to activate sprinklers or to disconnect main power. The control circuit for the shunt trip circuit breaker shall be monitored for the presence of operating voltage. Loss of voltage to the control circuit shall cause a supervisory signal to be indicated at the building fire alarm panel or the "Elevator Recall Control and Supervisory Panel."

Most shunt trip breakers use a 120 volt coil. Some times a 24 volt DC circuit from the fire alarm system will tie to a 120 volt relay with 24 volt coil and when the alarm goes off it will power the coil and close the 120 volt coil and trip breaker to elevator. The 120v circuit must also be monitored by the FACP, in case someone accidentally turns off that breaker. Elevator breakers should not be able to be reset until Fire Alarm is reset.

Sprinkler Installation and Requirements

Sprinklers may be installed in elevator motor rooms and hoist-ways in accordance with the requirements of A17. 1. Rule 102.2 and the requirements of NFPA 13. Sprinklers at the top of the hoist-way shall be upright or pendant spray type, sprinklers in the pit shall be sidewall spray and mounted not more than 2 ft. above the pit floor. Branch lines in the hoist-way are not allowed to serve more than one floor level.

SIEMENS

Detector Placement: Heat Detectors

When heat detectors are used to shut down elevator power prior to sprinkler operation:

- They shall be placed within 24 in. of each sprinkler head.
- The detector shall have both a lower temperature rating and a higher sensitivity as compared to the sprinkler.

Provide a heat detector within 2' of each sprinkler head in the machine room and hoistway.

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Heat detectors used to shut down elevator electrical power prior to sprinkler operation, must be placed within 2 ft of each sprinkler and be installed in accordance with the requirements of NFPA 72. The use of Annex B, Engineering Guide for Automatic Fire Detector Spacing, is permitted.

A pit sprinkler located 2 ft or less from the pit floor does not require a heat detector within 2 ft of it

Waterflow alarm initiating devices may be used to initiate shutdown of elevator electrical power–NO retard is permitted

Heat detectors used to shut down elevator power prior to sprinkler operation must have both a lower temperature rating and a higher sensitivity as compared to the sprinkler

Spot-type heat detectors are required to include in their installation instructions, technical data, and listing documentation the operating temperature and response time index (RTI) as determined by the organization listing the device

1. Heats are required to be monitored for integrity by the fire alarm control unit.
2. Stand alone heat detectors for the shunt trip circuit are NOT permitted

SIEMENS

Should a Pit Heat Detector activate shunt trip???

NO!

Shunt trip by pit detector prohibited by code because it can trap firefighters. A sprinkler activation in the pit will not harm the elevator equipment.

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When sprinklers are installed in the hoistway all elevator electrical equipment, located less than 48” above the pit floor is required to be NEMA4 rated and the wiring listed for use in wet locations. Since this equipment is designed for wet conditions, a sprinkler discharge would not adversely affect the operation of the elevator; therefore shunt-trip activation and heat detection is not required in an elevator pit for those sprinklers installed within 24” of the pit floor. ASME A17.1 states that if a sprinkler head is installed within 24" of the elevator pit floor, it shall be exempt from the special arrangements of inhibiting water flow until the elevator recall function has occurred.

SIEMENS

Should a Pit Heat Detector activate shunt trip???

NO!

NFPA 72 requires automatic fire detection when sprinklers are installed in elevator pits to initiate elevator recall to the alternate level.

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When sprinklers are installed in elevator pits, automatic fire detection shall be installed to initiate elevator recall in accordance with 2.27.3.2.1(c) of ANSI/ASME A.17.1/CSA B44, *Safety Code for Elevators and Escalators, and the following shall apply:*

(1) Where sprinklers are located above the lowest level of recall, the fire detection device shall be located at the top of the hoistway.

(2) Where sprinklers are located in the bottom of the hoistway (the pit), fire detection device(s) shall be installed in the pit in accordance with Chapter 17.

(3) Outputs to the elevator controller(s) shall comply with 21.3.14.

21.3.8* Smoke detectors shall not be installed in elevator pits

to initiate elevator recall unless the smoke detector is listed for the environment.

Since there is no real ceiling at this location to allow installation using the spacing provisions of Chapter 17, the provisions of 17.7.3.1.3 and 17.4.10 should be considered, which allows detectors to be placed closer to the hazard in a position where the detector can intercept the smoke or heat. Also refer to A.21.3.14.2(3).

SIEMENS

Should a Pit Heat Detector activate shunt trip???

NO!

Per NEC 620. 21-24 the pit is NOT considered a wet location unless sprinklered. Therefore typical a weatherproof heat detector is provided.

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Theoretical Sequence of Events for Firefighter's Service and Main Line Power Disconnection

1. Smoke causes a smoke detector in the elevator machine room to activate.
2. Phase I Fire Recall is initiated.
3. Elevators associated with that motor room or hoist-way are called to the designated or alternate level and shut down with doors open.
4. Heat buildup in the fire area causes a heat detector to actuate.
5. Shunt trip circuit breaker actuates, causing elevator main line power disconnection.
6. Further heat buildup causes a sprinkler head to operate.

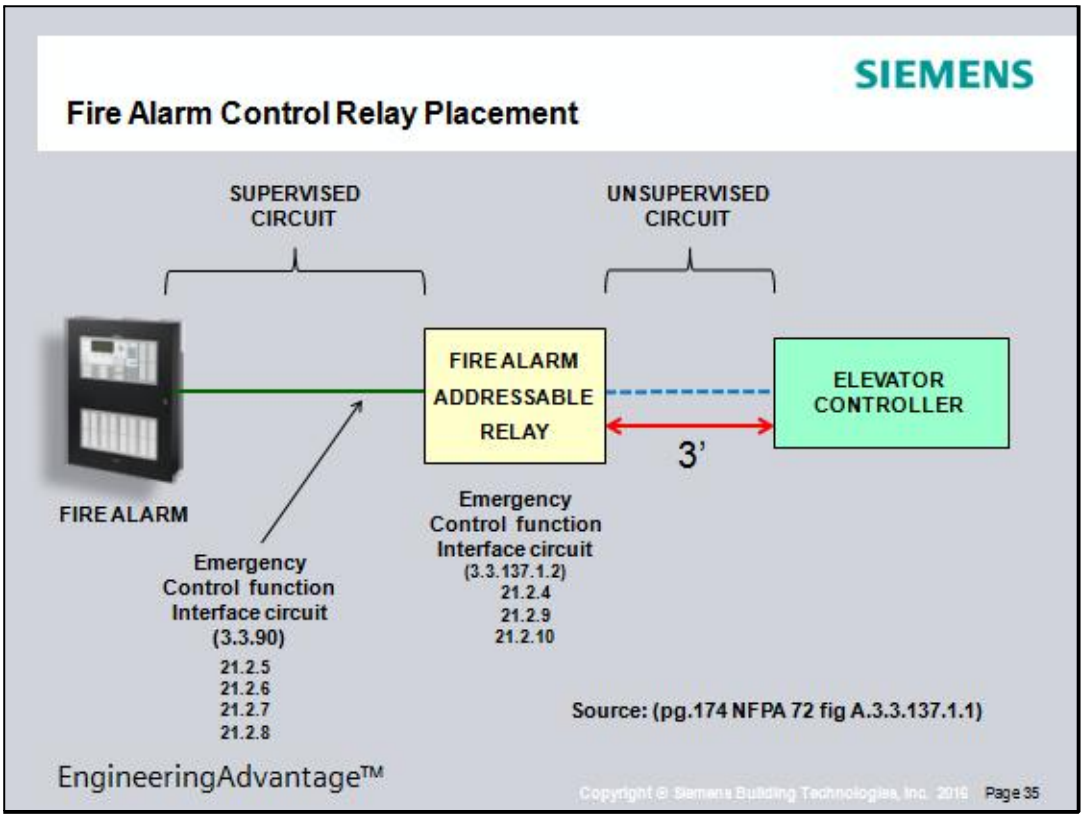
Designated Level- The main floor or other level that the AHJ determines best serves the needs of emergency personnel for fire fighting or rescue purposes.

Alternate Level- The floor designated by the AHJ to serve as the recall level if the designated floor detector activates first.

A17.1. Rule 102 states that only equipment which is used directly in connection with the operation of the elevator may be installed

in the elevator machine room, machinery spaces and hoist-way.

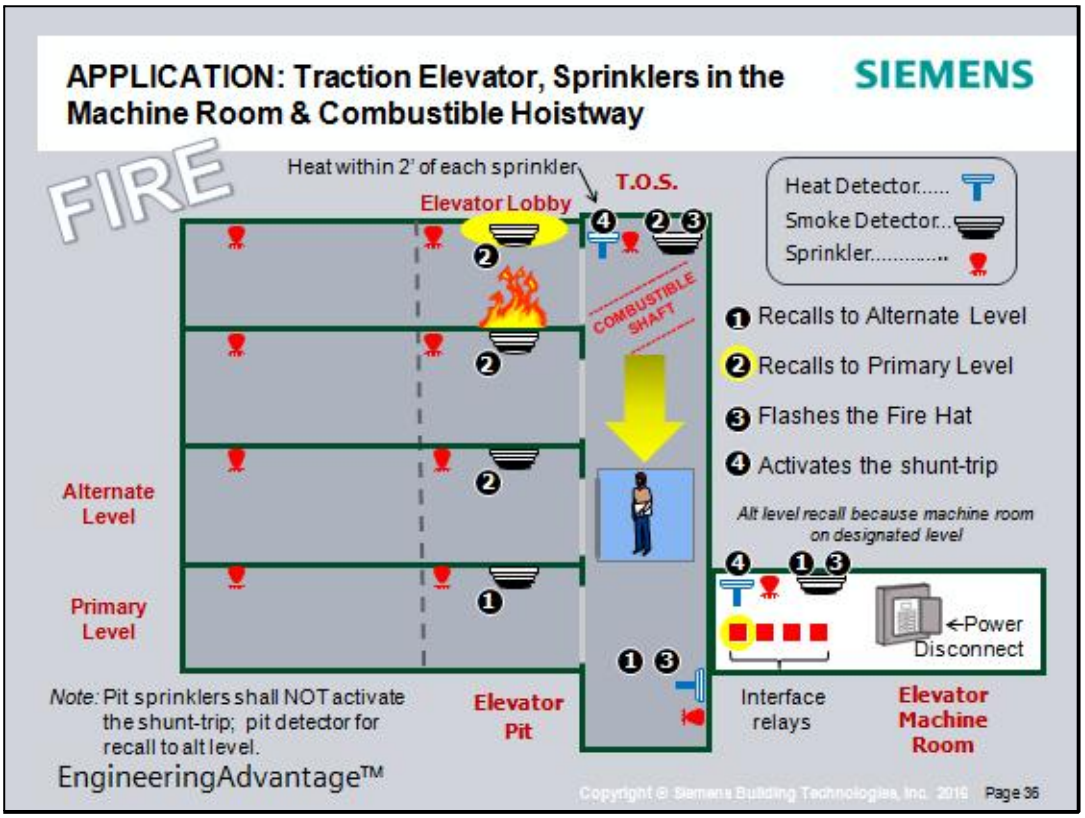
NFPA 72 states that Elevator Firefighter's Service shall be connected to the building. fire alarm system. If there is no building fire alarm system, the elevator "fire alarm initiating devices" shall be connected to a dedicated fire alarm system control panel designated as the "Elevator Recall Control and Supervisory Panel". This should be located in a normally occupied area, monitored for integrity and have primary and secondary power sources. It should have audible and visible indicators to annunciate supervisory and trouble conditions. This panel shall be permanently identified on the panel and on the record drawings.



This represents the Emergency Control Function interface between the fire alarm system emergency control function interface device and the component controlling the emergency control function. The circuit from the control panel (solid green) to the relay be is supervised by the FACP. The circuit from relay to the controller is not supervised (dashed blue). The Key point to audience is to remind them about the 3 ft maximum distance.

NFPA 72 in Chapter 6 defines “fire safety functions” as “building and fire control functions that are intended to increase the level of life safety for occupants or to control the spread of the harmful effects of fire.” Some of the more typical fire safety functions include elevator recall, elevator power shut down, door release, door unlocking, HVAC shutdown and smoke damper control. These functions are typically initiated by a Form C relay which can be wired either normally open or normally closed.

Section 6.16.2.2 requires a fire alarm relay used to initiate control of protected premises fire safety function must be located within 3 feet of the controlled circuit or appliance. The intent is to limit the distance between the relay and the device it is controlling since that circuit is not supervised and a cut will prevent the fire safety function from being accomplished. An example of this is a normally open relay that upon closing singles the elevator controller to initiate recall of the cab.



Typically four (4) relays are required for elevator interface, each must be within 3' of the controller or breaker:

<u>ELEVATOR CONTROLLER INTERFACE RELAYS</u>
- Relay #1 – primary recall
- Relay #2 – secondary recall
- Relay #3 – fire hat

<u>ELEVATOR POWER SHUNT TRIP BREAKER INTERFACE RELAY</u>
- Relay #4 – shunt trip

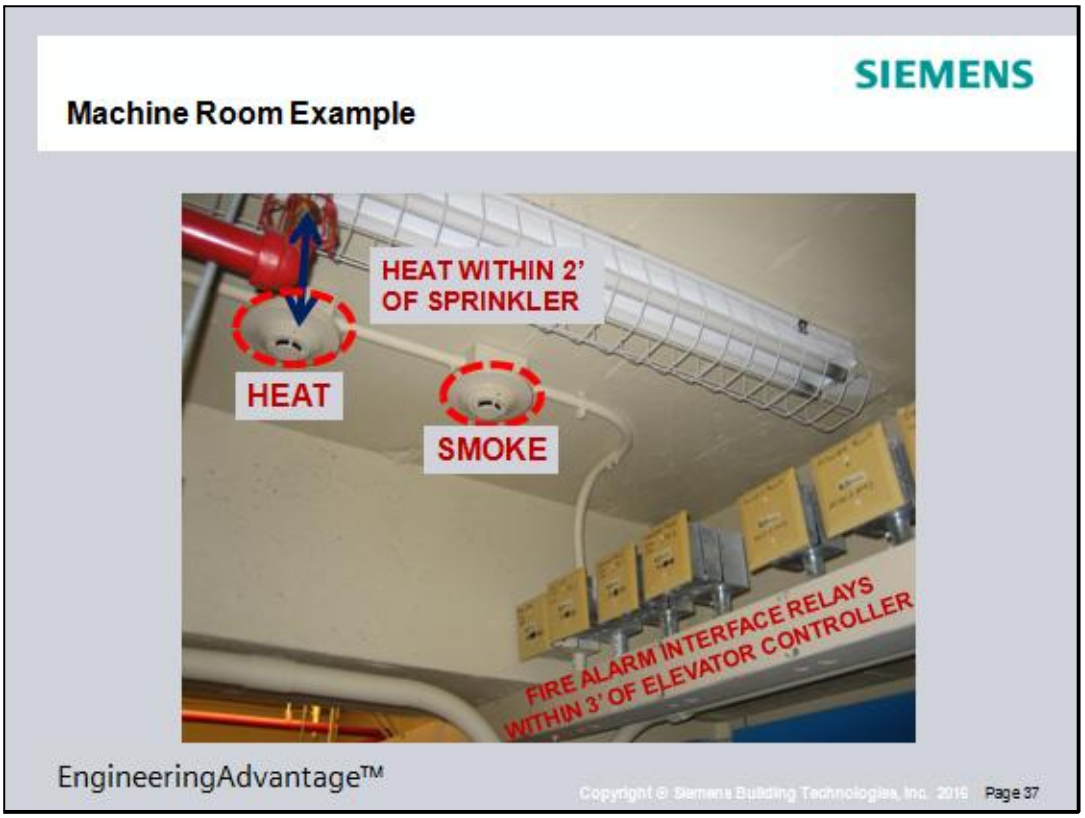
ASME A17.1 requires a steady firefighter's hat when relay #1 or #2 activate. Section 6.15.3.9 requires the hat to flash if an elevator machine room or hoistway smoke detector causes the recall. The elevator company programs the fire fighter hat to come on (steady) with relay #1 or #2 , along with the other required elevator functions. An input from Relay #3 overrides the steady light function and initiates flashing light function.

The fire alarm system provides three Form C contact relays and the elevator controller responds based on the sequence of relays pick. In logic (programming) terms, the fire alarm provides signals of the conditions and the elevator control makes control decisions based on those inputs.

Designated Level- The main floor or other level that the AHJ determines best serves the needs of emergency personnel for fire fighting or rescue purposes.
Alternate Level- The floor designated by the AHJ to serve as the recall level if the designated floor detector activates first.

A17.1. Rule 102 states that only equipment which is used directly in connection with the operation of the elevator may be installed in the elevator machine room, machinery spaces and hoist-way.

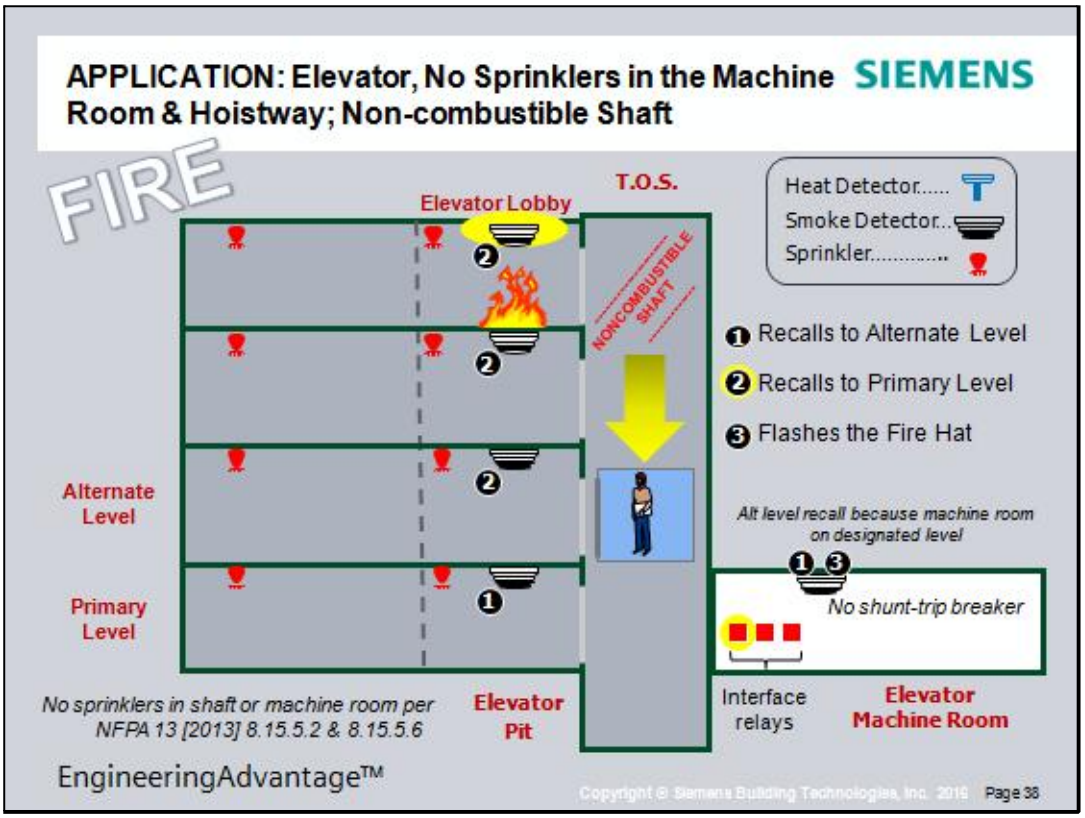
NFPA 72 states that Elevator Firefighter's Service shall be connected to the building. fire alarm system. If there is no building fire alarm system, the elevator "fire alarm initiating devices" shall be connected to a dedicated fire alarm system control panel designated as the "Elevator Recall Control and Supervisory Panel". This should be located in a normally occupied area, monitored for integrity and have primary and secondary power sources. It should have audible and visible indicators to annunciate supervisory and trouble conditions. This panel shall be permanently identified on the panel and on the record drawings.



Typically you will need the following: a smoke detector located in each elevator lobby; a smoke and/or heat detector in the elevator machine room (the heat if there are sprinklers); a heat detector located at the top of the elevator shaft (if there is a sprinkler at the top); a smoke detector located at the top of shaft (if there is a sprinkler anywhere in the hoist way); a set of relays located in the elevator machine room to control the elevators (primary, alternate, shunt); a visual warning ("firefighter's hat") indicating if elevators are unsafe to use; and a control panel (the panel can be the building's fire alarm panel or a dedicated panel if there is no FA panel).

The AHJ is permitted to allow machine room and hoistway smoke detectors to initiate a supervisory signal instead of an alarm signal.

Only the automatic detectors located in elevator lobbies, hoistway and machine rooms are permitted to initiate the recalling of elevators. In no case should an elevator be recalled by a manual pull station or by detectors located in other areas of the building unless mandated by AHJ.



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ELEVATOR CONTROLLER INTERFACE RELAYS

- Relay #1 – primary recall
- Relay #2 – secondary recall
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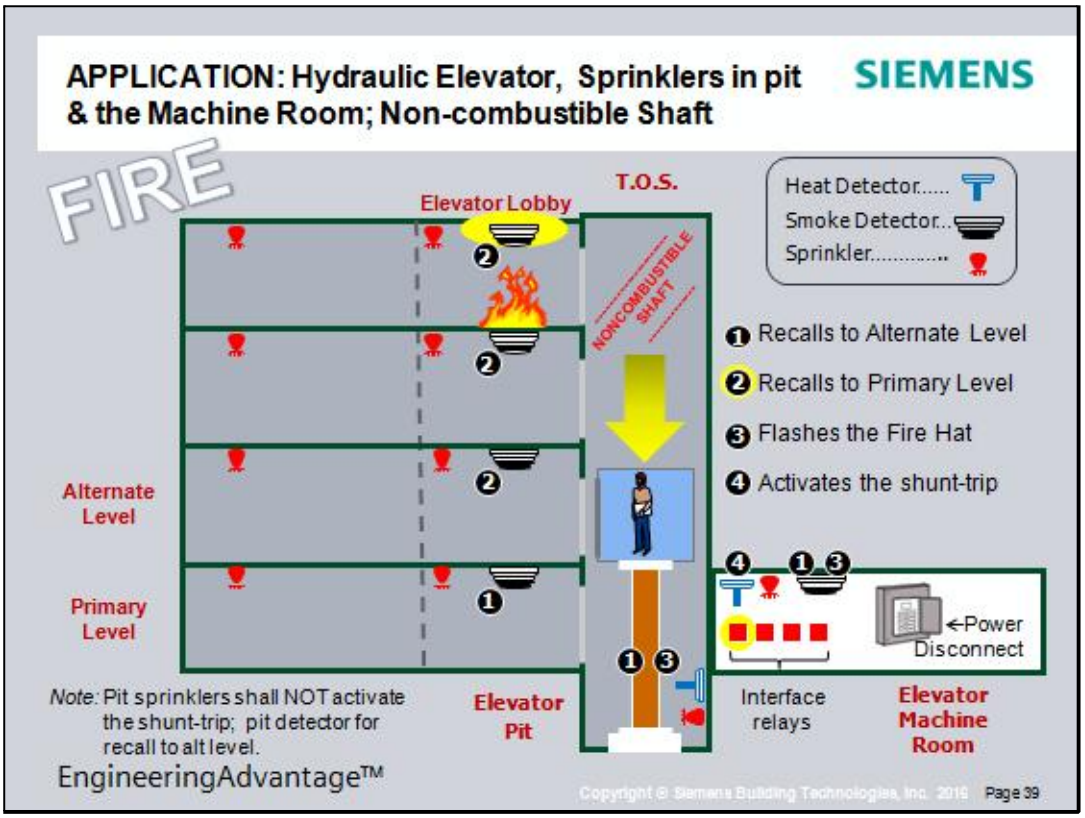
The fire alarm system provides three Form C contact relays and the elevator controller responds based on the sequence of relays pick. In logic (programming) terms, the fire alarm provides signals of the conditions and the elevator control makes control decisions based on those inputs.

Theoretical Sequence of Events for Firefighter's Service and Main Line Power Disconnection

1. Smoke causes a smoke detector in the elevator machine room to activate.
2. Phase I Fire Recall is initiated.
3. Elevators associated with that motor room or hoist-way are called to the designated or alternate level and shut down with doors open.
4. Heat buildup in the fire area causes a heat detector to actuate.
5. Shunt trip circuit breaker actuates, causing elevator main line power disconnection.
6. Further heat buildup causes a sprinkler head to operate.



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ELEVATOR CONTROLLER INTERFACE RELAYS

- Relay #1 – primary recall
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ELEVATOR POWER SHUNT TRIP BREAKER INTERFACE RELAY

- Relay #4 – shunt trip

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Machine room-less Elevators

CONTROLLER

CONTROLLER

CONTROLLER

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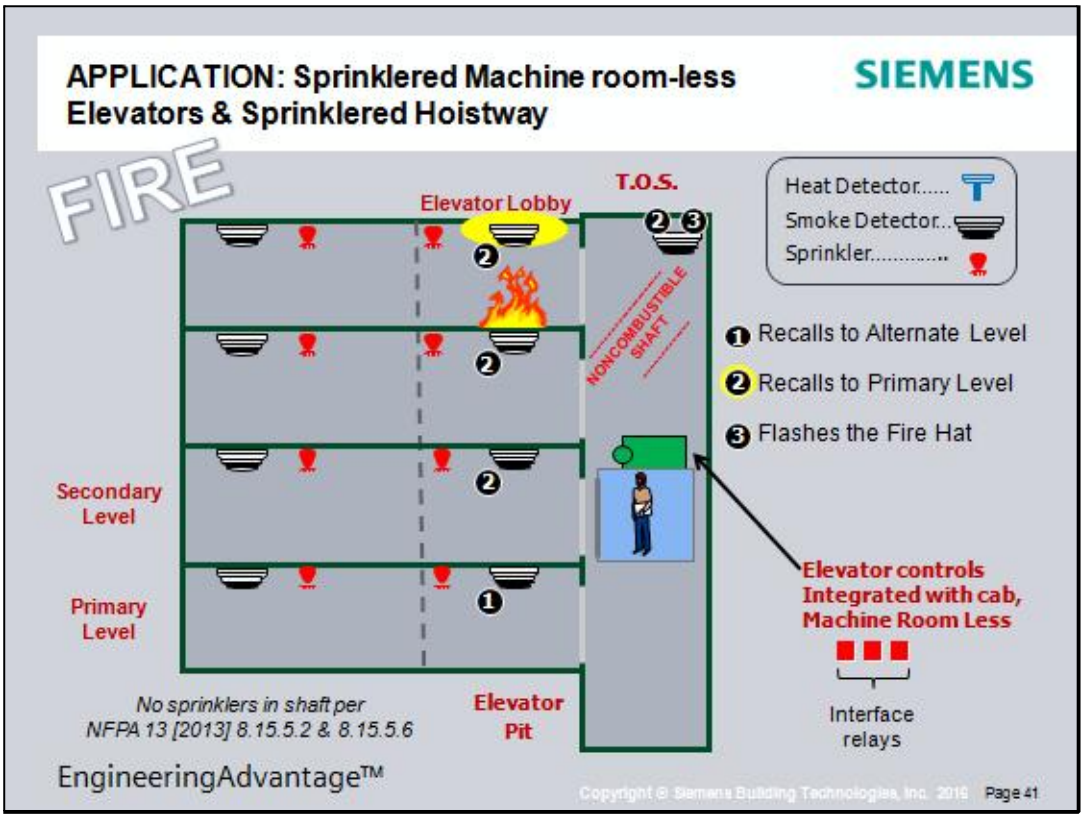


Since there is no suppression in the hoistway and MRL, shunt trip is not required.

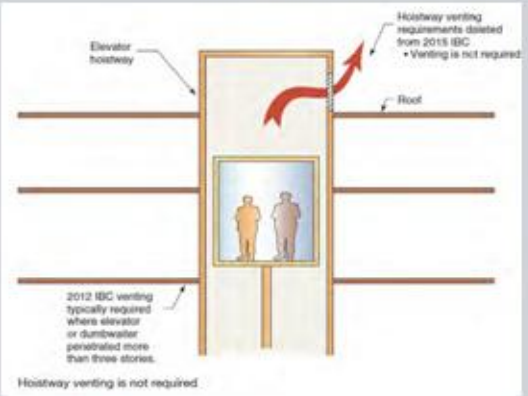
IBC, 703.4. Combustible or non-combustible construction is defined this way: If wall and ceiling assemblies contain only materials considered non-combustible such as drywall over steel studs or steel joists, the assemblies are considered non-combustible. A hoistway entirely of such assemblies is considers non-combustible. If any part of an assembly is combustible, such as drywall over wood studs or wood joists, the assembly and therefore the hoistway are considered combustible.

NEW!

SIEMENS

Elevators smoke relief venting

The IBC [2009] 3004.1 requires hoistway vents of elevators and dumbwaiters for R-occupancies penetrating more than three stories to provided with a means for venting smoke and hot gases has been removed. IBC [2012] & IBC [2015] DELETED this requirement.



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- Deleted requirements in 2012 edition
- Conflicts with hoistway pressurization
- Intent conflicts with need for traditional elevator lobbies

SIEMENS

Testing Elevator Interfaces

- Test the system end-to-end, where possible.
- Special elevator inspection required, requires coordination with other trades.
- Follow the control sequence.
- Annual functional tests are required on all fire safety control functions and respective initiating devices.

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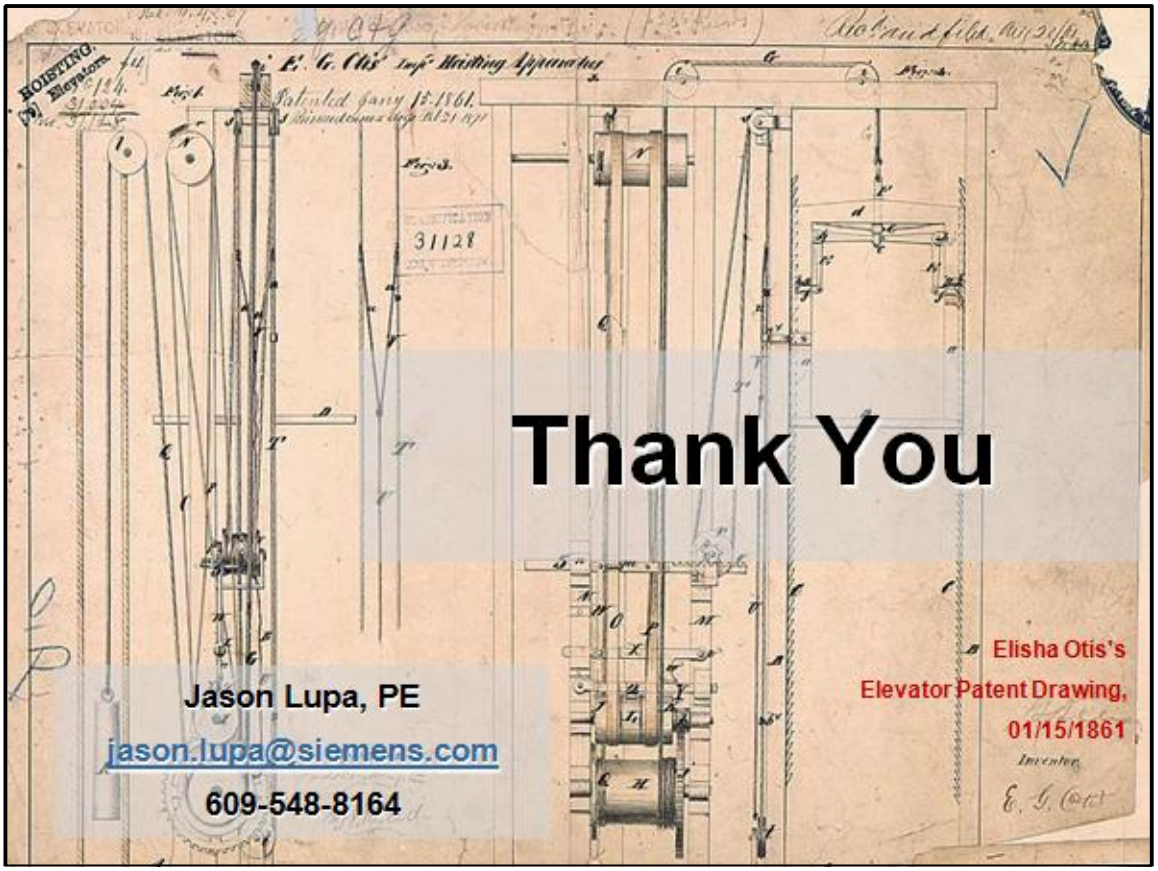
In summary, the elevator's FEO are automatically activated by a commercial fire alarm system. The issuance of the elevator operating permit depends upon proper integration between the elevator control panel and the fire alarm system. There are additional criteria that apply to less common circumstances, so be sure to employ an experienced fire alarm contractor that will proactively coordinate the electrical and elevator interfacing requirements. A properly coordinated integration between the two systems can make the difference between passing the first inspection and incurring additional costs due to subsequent re-inspections.



This presentation does not attempt to address all the requirements relating to elevators. Most of the requirements associated with elevators—essentially those in ASME A17.1—pertain to the fabrication of elevators and associated equipment and accessories, of which elevator manufacturers are acutely aware. Specifications for elevators in the construction documents should require compliance with ASME A17.1 and with ICC/ANSI A117.1, and ADA Standards. Since elevators vary among manufacturers, design professionals should consult manufacturer representatives when designing and specifying elevators, especially if custom designs are proposed for elevator cars, entrances, call stations, and call signals.