Interfacing Fire Alarm, Sprinkler and Elevator Systems

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Interfacing to Elevators
ASME A17.1

Safety Code for Elevators and Escalators

Provides requirements for operational sequences for:

- Phase 1 - Emergency Recall Operation
- Power Shutdown - "Shunt Trip" Operation

ASME A17.1

Phase I - Emergency Recall Operation

The operation of an elevator wherein it is automatically or manually recalled to a specific landing and removed from normal service because of activation of firefighters’ service
**ASME A17.1**

*Power Shutdown (shunt trip)*

Mainline elevator power is disconnected from the elevator to eliminate potential problems as a result of sprinkler actuation in the hoistway or elevator machine room

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**Elevator Recall: Historical Perspective**

- 1973 ASME A17.1b (supplement to the 1971 Code)
- **Purpose:**
  - Prevent people from using elevators
  - Responding Firefighters to Account for Elevators
  - Stage Equipment (Hose lines, air tanks, etc.)
  - Evacuate Occupants with Mobility Restrictions
  - Prevent Car from being called to the Fire Floor
Elevator Recall: Historical Perspective

- Identified Designated Level
- Both Manual and Automatic Recall
  - Key Switch (only by firefighters)
  - Smoke Detectors in Lobbies
- Travel of 25’ above or below designated level
- 1981 introduced the “Alternate” Level
Elevator Recall: Historical Perspective

- 1984 introduced “only” lobby and machine room detectors were to initiate recall
- A17.1 referred users to NFPA 72E, Automatic Fire Detectors

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Elevator Recall: Historical Perspective

- Two “elevator zone circuits” were required to be terminated at the associated elevator controller
- In 1989, A17.1 required smoke detectors in hoistways ... only when hoistways had sprinklers
- First detector actuated determines the recall floor
- A17.1b, 1992 Supplement drops the 25 ft. criterion ... now applies to all automatic elevators regardless of travel distance
**Elevator Recall: Historical Perspective**

- **1993 edition of NFPA 72, National Fire Alarm Code** addressed cases where there was no required building fire alarm system ... "Elevator Recall and Supervisory Panel”

  NFPA 72, 2010 – 3.3.92.2.1* Dedicated Function Fire Alarm Control Unit. A protected premises fire alarm control unit which is intended to provide operation of a specifically identified fire safety function.

- **1996 edition of NFPA 72 introduced “other” fire detection as being permissible if environment was not appropriate for a smoke detector.**

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**Elevator Recall: Historical Perspective**

- A “third” control circuit was added to provide a warning of fire in the hoistway or elevator machine room

- The 2000 A17.1 was “harmonized” with the Canadian B44 Elevator Safety Standard

- NFPA 72 [2002] and A17.1 [2004] now both address new technology elevators ... machine room-less elevators
**Shunt Trip:** (Historical Perspective)

- First introduced in ASME A17.1 - 1984
- **Purpose:**
  - Remove Main-line Power prior to sprinkler activation
  - Prevent Elevator from Moving/Operating dangerously

*Note:* the requirement does not include circuits for ventilation, in-car lights and communication, pit receptacles and lights, etc.

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**Applicable Codes**

- Elevator & Escalator Safety Code
  - ASME/ANSI A17.1
- Building Codes and NFPA 101
- NFPA 13
- NFPA 70
- NFPA 72
"Out of Sync" Codes

ASME A17.1
- 3 – 4 Year Cycle with Yearly Addenda
- 2000
- 2004
- 2007

NFPA 72 and NFPA 13
- 3 Year Cycles

Confusion? ...

Can’t find all the information in one place!

Must use A17.1, NFPA 72 and NFPA 13 ...

... together!
Section 2.27
Emergency Operation and Signaling Devices

2.27.3.2 Phase I Emergency Recall Operation
by Fire Alarm Initiating Devices

Note: Section 2.27 applies to Electric Elevators and section 3.27 applies to Hydraulic Elevators ... section 3.27 says refer to 2.27. 3.27 "Emergency operation and signaling devices shall conform to 2.27......"

Section 2.8
Equipment in Hoistways, Machinery Spaces, Machine Rooms, Control Spaces and Control Rooms

2.8.3.3.2
(Shunt Trip / Power Disconnect requirement)
NFPA 72, 2010

- 2007 edition had 11 Chapters
- 2010 edition has 29 Chapters
  - Administrative Chapters
  - Support Chapters
  - System Chapters
  - Usability Chapters

NFPA 72, 2010 Chapter 21
Emergency Control Functions

21.1 Application. The provisions of Chapter 21 shall cover the minimum requirements for the interconnection of emergency control functions to the fire alarm system and emergency communications systems.

21.3* Elevator Recall for Fire Fighters’ Service.

NFPA 72, 2007 – Use to be in Chapter 6, Protected Premises
Chapter 8 – Installation Requirements

8.15 Special Situations

8.15.5 Elevator Hoistway and Machine Rooms
ASME A17.1 - 2007

2.27.3.2.1 In jurisdictions not enforcing the NBCC, 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 floor served by the elevator;

(b) in the associated elevator machine room, control space, or control room

(c) in the elevator hoistway, when sprinklers are located in those hoistways
NFPA 72 - 2010

21.3 Elevator Recall

21.3.7 If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted.

NFPA 72 - 2010

17.7 Smoke-Sensing Fire Detectors

17.7.1.8* Unless specifically designed and listed for the expected conditions, smoke detectors shall not be installed if any of the following ambient conditions exist:

(1) Temperature below 32°F
(2) Temperature above 100°F
(3) Relative humidity above 93 percent
(4) Air velocity greater than 300 ft/min
21.3 Elevator Recall

21.3.1 All initiating devices used to initiate fire fighters’ service recall shall be connected to the building fire alarm system.
21.3 Elevator Recall

21.3.2* In facilities without a building fire alarm system, initiating devices used to initiate fire fighters’ service recall shall be connected to a dedicated function fire alarm control unit that shall be designated as “elevator recall control and supervisory control unit,” permanently identified on the dedicated function fire alarm control unit and on the record drawings.

21.3.3 Unless otherwise required by the authority having jurisdiction, only the elevator lobby, elevator hoistway, and the elevator machine room smoke detectors ... shall be used to recall elevators for firefighters’ service.
21.3 Elevator Recall

21.3.5* A lobby smoke detector shall be located on the ceiling within 21 ft. of the centerline of each elevator door within the elevator bank under control of the detector.

Smoke Detector Location
21.3 Elevator Recall

21.3.5* A lobby smoke detector shall be located on the ceiling within 21 ft. of the centerline of each elevator door within the elevator bank under control of the detector.

Exception: For lobby ceiling configurations exceeding 15 ft. in height or that are other than flat and smooth, detector locations shall be determined in accordance with Chapter 17.
17.7.3.1.4* 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.
A.17.7.3.1.4 There are some applications that do not require full area protection, but do require detection to initiate action when specific objects or spaces are threatened by smoke or fire such as at elevator landings that have ceilings in excess of 15 ft. and for protection of fire alarm control units. In high ceiling areas, to achieve the desired initiation such as for elevator recall and protection of FACUs, detection should be placed on the wall above and within 6 ft. from the top of the elevator door(s) or FACU.
2.27.3.2 Phase I Emergency Recall Operation by Fire Alarm Initiating Devices

2.27.3.2.6 When activated, a fire alarm initiating device in the machine room, control space, control room, or hoistway shall cause the visual signal to illuminate intermittently only in car(s) with equipment in that machine room.
ASME A17.1 - 2007

2.27.3 Firefighters’ Emergency Operation - Automatic Elevators

FIG. 2.27.3.1.6(h) Visual Signal

“When flashing, exit elevator”

NFPA 72 - 2010

21.3 Elevator Recall

6.16.3.12.3 Visual Warning. For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following:

(1) Activation of the elevator machine room, elevator machinery space, elevator control space, or elevator control room initiating devices...

(2) Activation of the elevator hoistway initiating devices ...
21.3.12.1 Designated Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the designated level in response to the following:

(1) Activation of smoke detectors ... located at any lobby served by the elevator(s) other than the lobby at the designated level.

21.3.12.1 Designated Level Recall. Cont’d.

(2) Activation of smoke detectors ... located at any elevator machine room serving the elevator(s) except where the machine room is located at the designated level.

(3) Activation of smoke detectors ... located in the elevator hoistway serving the elevator when sprinklers are located in the elevator hoistway unless otherwise specified in 21.3.12.2(3).
21.3.12.2 Alternate Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the alternate level in response to the following:

(1) Activation of smoke detectors ... located at the designated lobby served by the elevator(s).

(2) Activation of smoke detectors ... located in the elevator machine room serving the elevator(s) if the machine room is located at the designated level.

(3) Activation of initiating devices identified in 21.3.12.1(3) if they are installed at or below the lowest level of recall in the elevator hoistway and the alternate level is located above the designated level.
Recall to Designated Level

Recall to Alternate Level

Warning to Elevator Cab

Activation of smoke detector(s) causes signal(s) to elevator controller
A listed relay or other listed appliance connected to the fire alarm system used to initiate control of protected premises fire safety functions shall be located within 3 ft of the controlled circuit or appliance.

The relay or other appliance shall function within the voltage and current limitations of the fire alarm control unit.

The installation wiring between the fire alarm control unit and the relay or other appliance shall be Class A, Class B, Class D, or Class X in accordance with Chapter 12.
Addressable Control Relays

Addressable Control Relays
NFPA 13 - 2010

8.15.5 Elevator Hoistway and Machine Rooms

8.15.5.4* Upright, pendent, or sidewall spray sprinklers shall be installed at the top of elevator hoistways.

8.15.5.5 The sprinkler required at the top of the elevator hoistway by 8.15.5.4 shall not be required where the hoistway for passenger elevators is noncombustible or limited-combustible and the car enclosure materials meet the requirements of ASME A17.1 ...
8.15.5 Elevator Hoistway and Machine Rooms

8.15.5.1* Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft above the floor of the pit.

8.15.5.2 The sprinkler required at the bottom of the elevator hoistway by 8.15.5.1 shall not be required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids.

ASME A17.1 - 2007

2.8 Equipment in Hoistways and Machine Rooms

2.8.3.3.2 ... means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water from the sprinklers located in the machine room or in the hoistway more than 24 in. above the pit floor.
21.4 Elevator Shutdown

21.4.1* Where heat detectors are used to shut down elevator power prior to sprinkler operation, the detector shall have both a lower temperature rating and a higher sensitivity as compared to the sprinkler.

21.4.3* If pressure or waterflow switches are used to shut down elevator power immediately upon or prior to the discharge of water from sprinklers, the use of devices with time-delay switches or time-delay capability shall not be permitted.
**Recommendation:** Use 165 °F, ordinary temperature rated sprinkler.

Use 135 °F, thermistor-based heat detector.

Or maintain a similar relationship based on ambient temperatures.

Note: Sprinklers in elevator machine rooms and hoistways must be of ordinary or intermediate temperature rating. (NFPA 13 [2010], 8.15.5.3)

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**NFPA 72 - 2010**

**21.4 Elevator Shutdown**

**21.4.2** If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 24 in. of each sprinkler head and be installed in accordance with the requirements of Chapter 17.
21.4 Elevator Shutdown

21.4.2 If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 24 in. of each sprinkler head and be installed in accordance with the requirements of Chapter 17. Alternatively, engineering methods, such as specified in Annex B, shall be permitted to be used to select and place heat detectors to ensure response prior to any sprinkler head operation under a variety of fire growth rate scenarios.

21.4.5 The initiating devices described in 21.4.2(HD) and 21.4.3(WFS) shall be monitored for integrity by the control unit required in Section 21.3.1 and 21.3.2.
**Background:**

Water from sprinklers in the hoistway and elevator machine room presents a hazard to safe elevator operation:

- "Shorts" on circuit conductors
  - Uncontrolled and dangerous elevator operation
- Wet brakes (traction elevators)
  - Uncontrolled stopping
**Shunt Trip Operation – (theoretical)**

- Smoke detector actuates, causing elevator recall
- Elevators arrive at the recall floor and open doors
- Heat buildup causes heat detector to actuate
- Shunt trip operates, removing power from the elevator
- Sprinkler operates

**Concern:**

*Potential of passengers becoming entrapped in the elevator if a heat detector or waterfall switch actuates (to cause “shunt trip”) prior to the completion of the recall function!*
Sprinkler/Power Shutdown Concerns:

- A17.1 Task Group addressed “Shunt Trip” and Sprinklers
- Risk Analysis was performed
- Concern of “over-temperature” of elevator controller
  - Equipment stops
  - Equipment runs erratically / uncontrollably
- Concern water from sprinklers may cause:
  - Brake Failure
  - Shorting out of an electrical safety or control circuit

Sprinkler/Power Shutdown Concerns:

- A17.1 Task Group Recommendations:
  - Exempt sprinklers from being installed in elevator machine rooms and the top of the hoistway
  - If sprinklers are installed in elevator machine rooms and/or the top of the hoistway, then the delay of the release of water from sprinklers will be required so recall can be completed first.
    - the "delay strategy"
21.4 Elevator Shutdown

A.21.4.2 Upon activation of the heat detector used for elevator power shut down, there should be a delay in the activation of the power shunt trip. This delay should be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level.
**Shunt Trip Operation - Delay Strategy**

**Sprinkler Valve**

- Electrically operated
- 24 VDC from Fire Alarm System
- Normally energized
- Held closed – Fails open

Underwriters Laboratories (UL) UL429, "Electrically Operated Valves"

**Fire Alarm System / Elevator Controller Relationship**

Diagram showing the relationship between elevator controllers and fire alarm system components.
21.4 Elevator Shutdown

21.4.4* Control circuits to shut down elevator power shall be monitored for presence of operating voltage. Loss of voltage to the control circuit for the disconnecting means shall cause a supervisory signal to be indicated at the control unit and required remote annunciators.
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