FIRE AND RESCUE DEPARTMENTS
OF NORTHERN VIRGINIA
FIREFIGHTING AND
EMERGENCY OPERATIONS
MANUAL

ELEVATOR AND ESCALATOR EMERGENCIES

Third Edition

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INTRODUCTION

The NOVA *Elevator and Escalator Emergencies* manual was designed for use as a reference for all fire department personnel in Northern Virginia. This manual reviews elevator and escalator features, their operation, and the safe and effective tactics that should be used to address the variety of emergencies personnel may encounter in these spaces.

All NOVA fire and emergency medical system personnel have the potential to respond to elevator and escalator emergencies, regardless of geographic response area. With the increased frequency of residential elevators, as well as advances in elevator technology, all personnel should be ready and prepared to operate at these types of incidents.

The key changes made to the third edition of the NOVA *Elevator and Escalator Emergencies* manual involve significant content reorganization to improve document structure.

GLOSSARY

The following key terms and definitions were used in this manual.

Brake – A brake is an electro-mechanical device used to prevent the elevator from moving when the car is at rest and no power is applied to the hoist motor (see Figure 1).

Figure 1. Brake and brake shoe.

Buffer – The buffer stops a descending car or counterweight from moving beyond its normal limit by storing or absorbing and dissipating the car or counterweight's kinetic energy (see Figure 2). When a normal or final terminal stopping device fails, the car will stop on a buffer. Buffers are either oil or spring type.

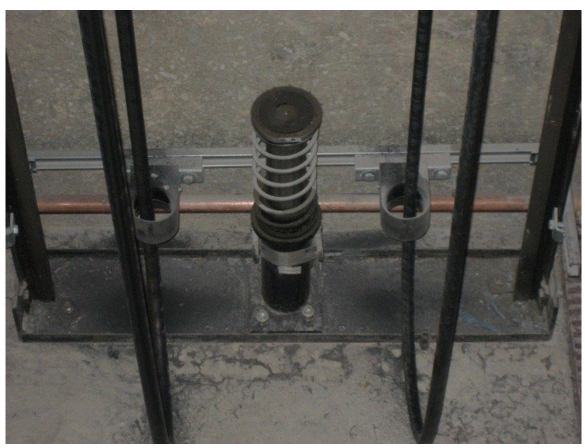

Figure 2. An example of a buffer.

Car operation station – A car operation station is a panel mounted inside the car containing the car operating controls (see Figure 3).

Figure 3. Example of a car operation station inside the elevator car.

Compensation chain – This chain balances an elevator car's load. The hollow, black flexible tubes are filled with solid metal balls and are connected to the elevator car and the counterweights. The weight of these cables balances the elevator car's load.

Code – A code is a system of regulations pertaining to the design, manufacture, installation, and maintenance of elevators, dumbwaiters, escalators, and moving walks. The American Society of Mechanical Engineers (ASME) sponsors and publishes the most widely recognized and used code for elevator and escalator safety: ASME A17.1. The National Bureau of Standards and the American Institute of Architects also sponsor this code.

Controller – A controller is a device or group of devices that control the direction, speed, and safety mechanisms on the elevator (see Figure 4). Some controllers will indicate the elevator's location in the hoistway.

Figure 4. Controller.

Control room – The control room is an enclosed space outside the hoistway that is intended for full-body entry and contains the motor controller. The room may also contain electrical or mechanical equipment used in conjunction with the elevator, dumbwaiter, or material lift, but not with the electric driving machine or hydraulic machine.

Control space – The control space can be located inside or outside the hoistway. It contains the motor controller and is intended to be entered with or without full-body entry. This space may contain the electrical or mechanical equipment used in conjunction with the elevator, dumbwaiter, or material lift, but not the electric driving machine or hydraulic machine.

Counterweight – The counterweight is a set of weights roped directly to the elevator car in a winding drum installation (see Figure 5). In practice, this weight equals approximately 70% of the car's weight. It is designed to reduce the work required by the electric motor to move the elevator car.

Figure 5. Example of a counterweight.

Door operator – The door operator is a motor-driven device mounted on the top of the car that opens and closes the car and hoistway doors (see Figure 6). This motor keeps the doors closed unless power is secured. It is imperative to secure power in order to disengage power from the motor and open the elevator door.

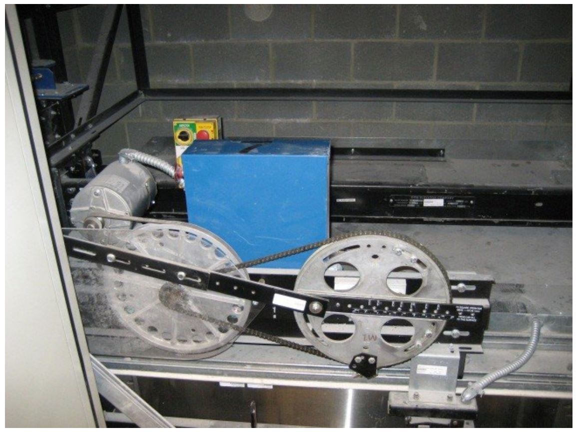

Figure 6. Door operator.

Door lock – A door lock is any type of mechanical lock designed to prevent a hoistway door from opening on the landing side.

Escutcheon tube – The escutcheon tube is the cylindrical keyhole on the hoistway door that elevator drop keys pass through to reach the hoistway door locking mechanism. Escutcheon tubes are commonly referred to as elevator door key holes.

Elevator door vane – The elevator door vane is a piece of steel mounted on the car cab door that runs between the hoistway door's two rollers as the elevator goes up and down the hoistway (see Figure 7). When the elevator stops at a floor and the car door opens, the car door vane pushes against one of the rollers, opening the hoistway door lock and moving the hoistway door together with the car door.

Figure 7. Elevator door vane.

Emergency stop switch – The emergency stop switch is located in the elevator car. When manually operated, it removes electric power from an electric elevator's driving machine motor and brake or from a hydraulic elevator's valves or pump motor.

Final limit switch – This switch is located in the elevator shaft. It prevents the elevator from descending or ascending too low or too high in the shaft (see Figure 8). When tripped by the elevator, it cuts power to the elevator motor.

Figure 8. Final limit switch.

Guide rails – Guide rails involve steel T-section with machined guiding surfaces installed vertically in a hoistway to direct the course traveled by an elevator car and elevator counterweights.

Governor – A governor is a small device typically located in the penthouse that applies a brake to the cable moving the elevator car; it serves as a mechanical speed control mechanism (see Figure 9).

Figure 9. Governor.

Governor rope – A governor rope is the wire rope attached to an elevator car frame that drives the governor and, when stopped by the governor, initiates setting the car safety.

*Inspection station (*or *inspection controls)* – A control panel on top of an elevator car that, when activated, removes the car from normal service and allows the car to only be run from the car top station at inspection speed (see Figure 10).

Figure 10. An example of an inspection station.

Interlock – An interlock is an electro-mechanical device on the hoistway door that locks the hoistway doors (see Figure 11). It is usually found on the header beam over the hoistway opening. The interlock prevents the elevator car from moving until the hoistway door is locked. It also prevents the hoistway door from opening on the landing side unless the car is stopped or being stopped within the landing zone. The elevator key or rescue tool will trip this mechanism.

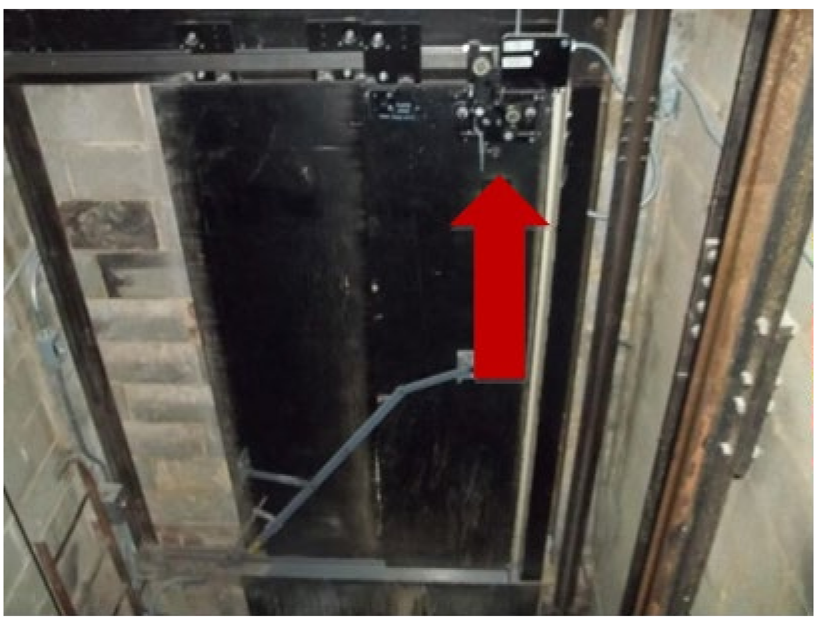

Figure 11. Interlock device.

Landing zone – This term refers to the area of the hoistway that extends from a point 18 in. below and 18 in. above the landing.

Mainline disconnect – This is an electrical disconnect usually found inside the machine room near the entrance door (see Figure 12). Pulling the side lever down removes all operating power from the elevator.

Figure 12. Mainline disconnect.

Motor generator – The motor generator converts a building's alternating current to the direct current used by electric traction elevators.

Overspeed valve – The overspeed valve is installed in the pressure piping of a hydraulic elevator between the hydraulic machine and the hydraulic jack. The valve restricts and ceases oil flow from the hydraulic jack through the piping when such flow exceeds a preset value.

Relay – The relay is designed to interpret input conditions in a prescribed manner after specified conditions are met. It responds to and causes contact operation or creates change in associated electric control circuits.

Rope – Elevator ropes are made of hemp, saturated in lubricant, and wrapped in steel wire. They are typically 5/8" in diameter. Each rope can support the weight of the elevator car plus 10%.

Selector – The selector starts, stops, opens, and closes elevator doors at designated hoistways.

Sheave – The sheave is a wheel mounted in bearings that has one or more grooves over which a rope or ropes may pass. An electric motor powers the sheave, and as the wheel turns, the counterweights and elevator car move up and down the hoistway.

Traction machine – The traction machine is an electric machine through which the friction between the hoist ropes and the machine sheave is used to move the elevator car.

Traveling cable – The traveling cable is used for power transmission to the elevator car and communication between the controller and the elevator car. The cable is usually—if not always—black and hangs from the elevator car.

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ELEVATOR

Description

An elevator is a platform or enclosed platform that moves vertically or horizontally. It has the capability of being raised and lowered in a vertical shaft while carrying people or freight. Elevators became commonplace in the 1850s as steel and iron structural frames allowed taller construction. Modern-day elevators utilize a powered hoist system and associated operating equipment to raise and lower the elevator car.

Historically, elevators were mostly installed in commercial buildings and apartment buildings; however, in recent years, an increasing number of elevators have been installed in single-family dwellings and residential townhomes. This manual does not directly address residential elevators; however, much of the information provided here applies to private residential installations.

General Characteristics

Elevator design, manufacture, installation, and maintenance are regulated through local and national codes. The ASME sponsors and publishes ANSI A17.1, the most widely recognized and used code for elevator and escalator safety. The National Bureau of Standards and the American Institute of Architects also sponsor this code. ANSI A17.1 has been adopted by many states. Some states and cities have written their own codes, most of which are based on the standards identified in ANSI A17.1.

Hoisting Mechanism

The type of hoisting mechanism utilized to raise and lower an elevator's car is generally used to categorize the elevator's type. Four types of hoisting mechanisms are associated with elevators: hydraulic, traction, climbing, and pneumatic. Due to their rarity in the NOVA region, climbing and pneumatic hoist mechanisms are not discussed in this manual.

The power unit that applies the energy necessary to drive a hoisting mechanism is referred to as a driving machine. The type of driving machine utilized in specific elevator installations varies by the hoisting mechanism type, building specifications, and code requirements.

Hydraulic Elevators

Hydraulic elevators have piston support at the bottom that pushes the elevator up as an electric motor forces hydraulic fluid into the piston. The elevator starts moving as the piston releases the fluid through the valve. Hydraulic elevators have a maximum travel speed of 200 ft per min and are typically installed in low-rise buildings with two to eight floors. The hydraulic elevator machine room is located on the lowest level adjacent to the elevator shaft. These elevators are further divided into three categories: holed (i.e., conventional), holeless (often referred to as telescoping), and roped hydraulic.

Holed hydraulic elevators have a sheave that extends below the floor of the elevator pit. The sheave accepts the retracting piston as the elevator descends (see Figure 13). Some configurations have a telescoping piston that collapses and requires a shallower hole below the pit. The maximum travel distance for these elevators is approximately 60 ft.

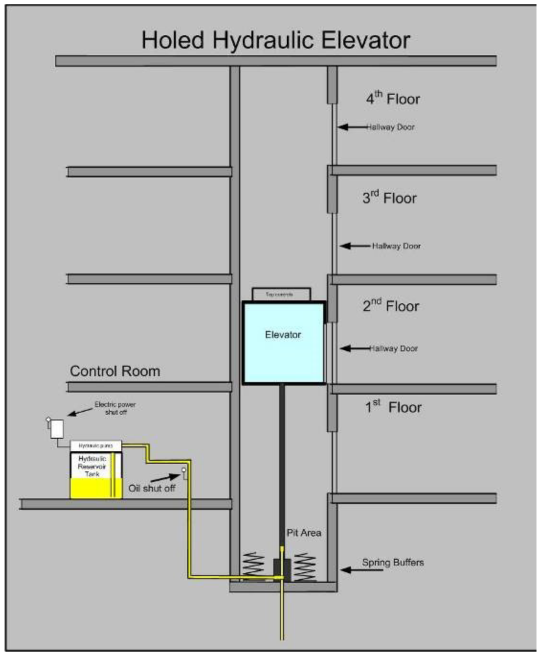

Figure 13. A holed hydraulic elevator.

Holeless hydraulic elevators have a piston on either side of the cab (see Figure 14). This type of elevator includes three distinct types:

- Telescopic hydraulic elevators. These utilize telescoping pistons fixed to the base of the pit that do not require a sheave or hole below the pit. Telescoping pistons allow up to 50 ft of travel distance.

- Nontelescoping (i.e., single-stage) hydraulic elevators. These utilize nontelescoping pistons and only allow about 20 ft of travel distance.

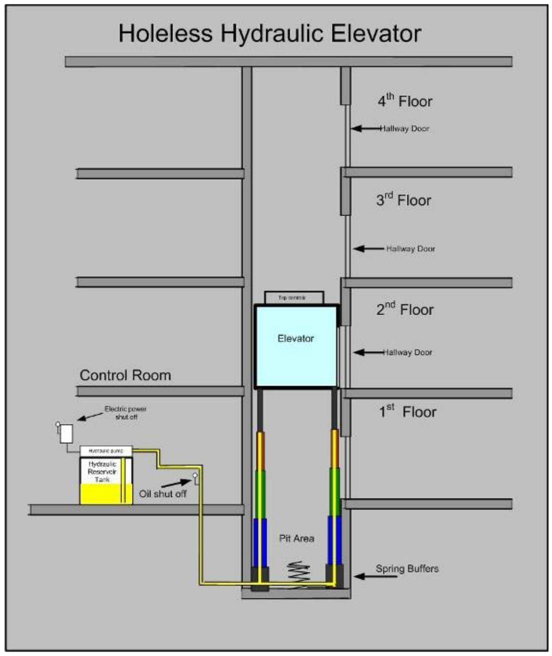

Figure 14. A holeless hydraulic elevator.

- Roped hydraulic elevators (see Figure 15) use a combination of ropes and a piston to move the elevator, allowing for a travel distance of about 60 ft.

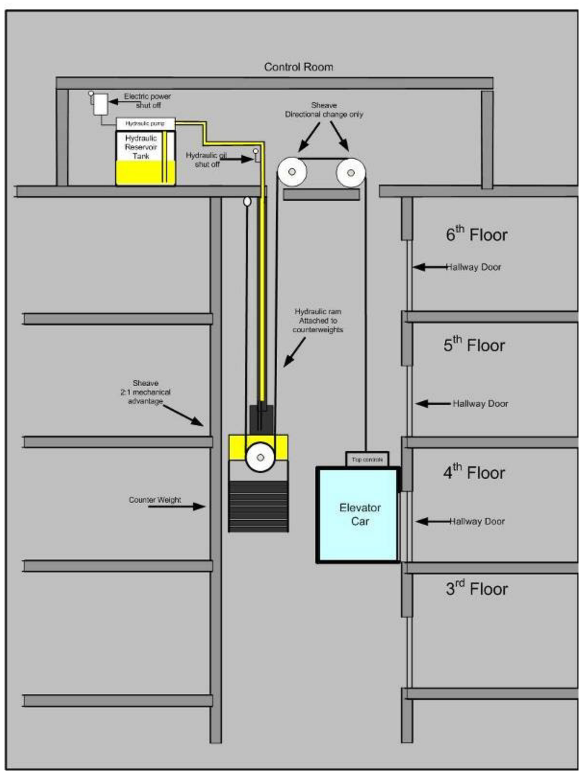

Figure 15. A roped hydraulic elevator.

Traction Elevators

Traction elevator cars are raised and lowered by rolling steel ropes over a deeply grooved pulley, commonly called a sheave. A counterweight balances the weight of the car. The counterweight makes the elevator more efficient by offsetting the weight of the car and occupants, thereby reducing the weight the motor must move. Sometimes, two elevators are built so that their cars always move synchronously in opposite directions, allowing them to serve as each other's counterweight.

The friction between the ropes and the pulley furnishes the traction that gives this type of elevator its name. These elevators are used for mid- and high-rise applications and have much higher travel speeds than hydraulic elevators. Traction elevator ropes and sheaves must be checked for wear on a regular basis. Wear reduces the traction between the sheave and the cables, creating regular slippage. Slippage reduces efficiency and can become dangerous if left unchecked.

There are two types of commonly utilized driving machines in traction elevator installations: geared driving machines and gearless driving machines.

Geared driving machines are used in low- and midrise applications. They have a gearbox attached to the motor, which initiates the wheel spin that moves the ropes. Geared traction elevators have a maximum travel speed of 500 ft per min and can travel to approximately 250 ft.

Gearless driving machines are used in high-rise applications. They have a drive motor and drive sheave that are connected in line on a common shaft. In this configuration, no mechanical speed reduction unit is located between the drive motor and the drive sheave. Gearless traction elevators have a maximum travel speed of 2,000 ft per min and can travel to 2,000 ft.

Machine Rooms

The machine room is the room or space housing the driving machine, controller, and electrical disconnect for a single elevator or group of elevators. Typically, elevator machine room entrances are located off a public corridor. It is common to find machine rooms for traction elevators on a building's rooftop penthouse or, for hydraulic elevators, through a mechanical equipment room. Elevator machine rooms can reside in a room or space containing other machinery and equipment essential to the building's operation if a substantial metal grille enclosure separates them from the other machinery and equipment.

Hydraulic Elevator Machine Rooms

Hydraulic elevator machine rooms (see Figure 16) are most often located close to the associated elevators on the ground floor or in the basement. However, it is possible for a hydraulic elevator machine room to be located above the shaft.

Elevator system components associated with hydraulic elevators and commonly found in elevator machine rooms include the following:

- an auxiliary electric panel,
- an electric motor,
- mainline disconnects,
- a hydraulic pump,
- a hydraulic fluid tank or reservoir,
- an overspeed valve, and
- a controller.

Figure 16. Example of a hydraulic pump and hydraulic fluid reservoir.

Traction Elevator Machine Rooms

Traction elevator machine rooms are usually located directly above the hoistway of the elevator they serve. For bottom-drive traction types, the machine room is usually located next to the elevator bank or at the bottom of the hoistway.

Elevator system components associated with traction elevators and commonly found in elevator machine rooms include:

- a geared or gearless driving machine,
- a drive motor,
- a drive sheave,
- a brake,
- mainline disconnects,
- electrical disconnects,
- a governor,
- a motor generator,
- a selector,
- a controller,
- a rope governor,
- light fixtures and a light control switch,

- fire alarm devices, and
- traction machines.

Machine-Roomless Elevators

Machine-roomless (MRL) elevators are a newer style of traction and hydraulic elevator being installed throughout the Northern Virginia region (see Figure 17). Manufacturers market these elevators as eco-friendly, cost-saving, and space saving, making them favorable among building engineers.

These belt-driven elevators utilize a gearless drive to move the elevator within the hoistway. Some installations provide little or no access to the hoisting mechanisms due to their location within the hoistway. Locating associated control rooms can also present challenges. MRL elevator control rooms can be installed anywhere in a building and do not typically utilize locations common to older style elevators.

Figure 17. Belt-driven MRL.

MRL elevator hoistway controls can be found in various locations dependent on the elevator's manufacturer and design. There may be one or two access doors, also known as a "control space," where the mainline disconnect and controls to operate the elevator with emergency power can be found. Having specific building and elevator system knowledge prior to an incident will increase operation efficiency.

Hydraulic MRL Elevators

Hydraulic MRL elevators contain hydraulic components within the elevator hoistway. There may or may not be a separate control room. Typically, rescuers will find a control space around the exterior of the hoistway doors. Elevator companies place these control spaces on different floors.

For example, it is common to find the thyssenkrupp control space located on the second floor, and Otis typically puts their control space on the fourth floor (see Figure 18.

Figure 18. Example of elevator controls located within the elevator control space.

Personnel should preplan for elevator operations, including identifying control space locations to reduce reflex time when dispatched to incidents. The control spaces will usually include the main power disconnect. Crews cannot access the manual lowering valve because the hydraulic reservoir is located at the bottom of the elevator pit (see Figure 19.

Figure 19. Hydraulic reservoir in the elevator pit of an MRL elevator.

Traction MRL Elevators

Traction MRL elevators do not have a dedicated machine room above the elevator shaft. These systems employ a smaller sheave than conventional geared and gearless elevators. The reduced sheave size, together with a redesigned motor, allows the machine to be mounted within the hoistway itself, eliminating the need for a bulky machine room on the roof.

The machine sits in the override space and is accessed from the top of the elevator cab when maintenance or repairs are required. The control boxes reside in a control room adjacent to the elevator shaft on the highest landing within approximately 150 ft of the machine.

Traction MRL elevators have a travel speed of up to 500 ft per min, and their maximum travel distance is up to 250 ft. These elevators have become increasingly popular in midrise applications because of their operation, reliability, and energy efficiency.

Traction MRL elevator designs vary by manufacturer; however, most systems incorporate flexible, flat, polyurethane-coated steel belts instead of stiff metal cables. The belts are about 30 mm wide (1 in.) and only 3 mm (0.1 in.) thick, yet they are as strong as woven steel cables and far more durable and flexible. The belts' thinness makes for a smaller winding sheave. As a result, the system requires a machine only one-quarter the size of traditional technologies.

Freight Elevators

Freight elevators are designed to move goods and materials throughout a building. Both traction and hydraulic hoisting systems lift freight elevator cars; however, traction systems are most common. Compared to passenger elevators, freight elevator cars travel at slower speeds, can carry much heavier loads, and often have more rugged interior finishes to prevent damage while loading and unloading cargo.

Freight elevators exist in almost every high-rise building as well as in department stores, factories, hotels, or other settings where heavy goods are moved frequently. These elevators typically incorporate heavy-duty steel doors and reinforced wall finishings.

Hoistway doors to freight elevators are often locked to prevent unauthorized use and may require a specific key to access the door opening mechanism. Some freight elevators have electronic doors that open automatically with the push of a button; others may need to be opened manually by physically moving the door with a lever or strap (see Figure 20). Hoistway doors may incorporate a small window (often referred to as a vision panel), which allows a view into the hoistway and, if removed, may provide access to the door-lock release mechanism.

Figure 20. Freight elevator with strap for manual opening.

Personnel should remain cognizant of the challenges and hazards associated with freight elevators. Elevator cars may not have interior doors or ceiling panels, leaving no barrier between occupants and the hoistway while the car is raised or lowered. Older freight elevators may lack emergency recall service. Personnel should proactively identify and familiarize themselves with freight elevators within their response area.

Elevator Cars

An elevator car transports passengers and cargo to the various floors of multistory buildings. Most passenger elevators are enclosed with floors or platforms made of steel or fireproofed wood. The interior components consist of automatic self-closing doors, an emergency telephone or intercom, lights, a fan, roof or side hatches, a floor indicator, a direction-of-travel panel, and a floor selection control panel.

The floor selection control panel consists of ERS (Phase 2), an emergency alarm, door controls, floor selection buttons, and fan and light switches (see Figure 21).

Figure 21. Controls within the elevator car.

Elevator car doors are the moveable portion of the car entrance that closes the opening between the car and the landing. A door operator opens and closes the elevator car doors. This motor-driven device is mounted on the top of the car.

There are several types of car doors. Single-sliding car doors slide horizontally to the left or right. Two-speed, double-sliding doors slide horizontally to the left or right, with one door sliding faster than the other.

Biparting or center-opening car doors consist of two panels that move horizontally away from each other when opening and toward each other when closing. Two-speed center-opening doors operate in a similar manner but incorporate a double set of doors with one section opening faster than the other.

Vertical biparting car doors, typically found on freight elevators, consist of two panels that move vertically away from each other when opening and toward each other when closing.

Other noteworthy elevator system components associated with elevator cars include the following:

- a car operation station,
- an elevator door vane,
- an emergency stop switch,
- a governor rope**,**
- a compensation chain,
- an inspection station and controls, and
- a traveling cable.

Hoistway

A hoistway is an enclosed vertical area through which an elevator car travels to reach multiple building levels. Hoistways are constructed of noncombustible material and should have a 2-hr fire rating. The material may be concrete block, reinforced concrete, brick, gypsum, terra cotta, or a combination of these. Typically, hoistways are ventilated and accommodate no more than four elevator cars.

The bottom of a hoistway is known as the pit. No personnel should enter the pit unless power to all elevators in the hoistway has been disconnected. The top of a hoistway terminates at the underside of the machinery space floor or grating or at the underside of the roof when the hoistway does not penetrate the roof.

When a portion of a hoistway passes a floor or landing without opening to it, that portion of the hoistway is referred to as a hoistway blind (also referred to as a blind shaft). Hoistway blinds are typically found in taller buildings where it is unreasonable for a single elevator to service all floors. For example, in a 30-floor building, one elevator may service Floors 1–15 while another services Floors 15–30. Hoistway blinds may also occur in an express elevator to a rooftop penthouse or restaurant.

If an elevator stalls in a hoistway blind and cannot be lowered, departments should request a technical rescue response (see Figure 22).

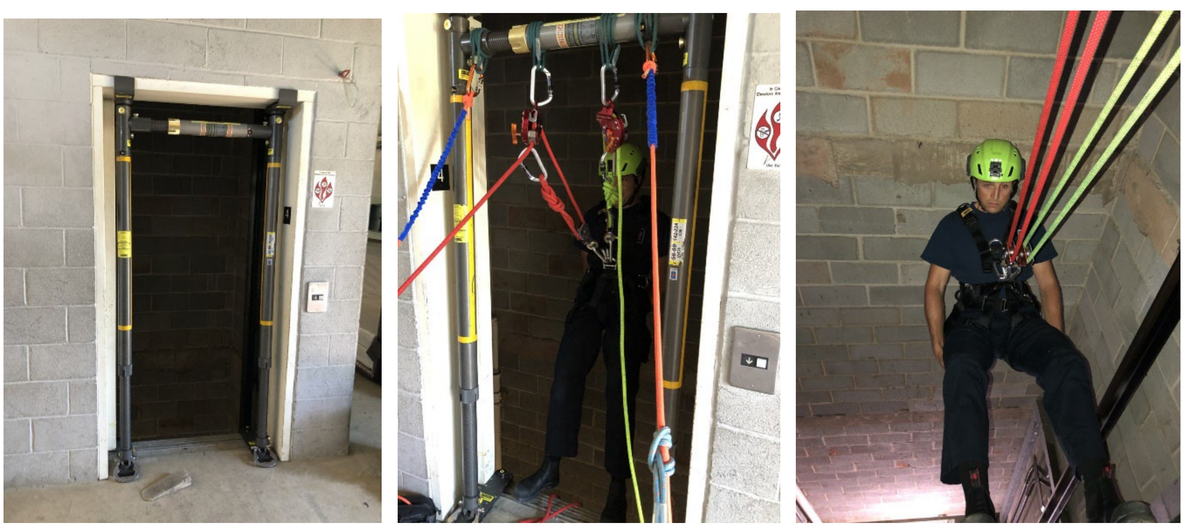

Figure 22. Technical rescue equipment configured to send rescuers down a hoistway blind.

Hoistway doors are located on each floor and separate the hoistway from the rest of the building. Like elevator car doors, hoistway doors may be biparting, two-speed center-opening, single-sliding, two-speed double-sliding, swinging, or vertical biparting.

When not being used to access an elevator car from a landing, hoistway doors are secured in the closed position by an interlock mechanism, which is an electro-mechanical device usually found on the header beam over the hoistway opening. The interlock mechanism prevents the elevator car from moving until the hoistway door is closed and locked. It also prevents the hoistway door from being opened on the landing side unless the car is within the landing zone and is either stopped or being stopped. The elevator key and or rescue tool are designed to bypass this mechanism.

Other elevator system components and features associated with hoistways include:

- a buffer,
- a counterweight,
- a landing zone,
- a final limit switch,
- guide rails, and
- a traveling cable.

Elevator Smoke Curtains

Smoke curtains provide smoke and draft control. These smoke containment assemblies serve as an alternative to the requirement for a separated, enclosed elevator lobby and are being installed in buildings throughout the region.

The Smoke Guard M400 system is a widely used device that utilizes a reinforced, transparent film that unrolls from a housing unit positioned above the elevator opening (see Figure 23). The film material is a .01-in. thick, polyimide transparent sheet with a 100-denier filament yarn applied for reinforcement. The film creates a smoke and draft control barrier that prevents smoke from migrating through the opening.

These systems can deploy within 10 seconds of a smoke detector or fire protection system activation. The film unwinds from the housing unit via cables. Flexible magnetic strips seal the film to the elevator doorframe. The system can sense objects in its path and will retract if an object blocks deployment. A rewind switch is located on both sides of the film, allowing occupants to rewind the film to move through the opening. If power is lost, occupants can push the film aside by applying force where the magnets attach to the frame.

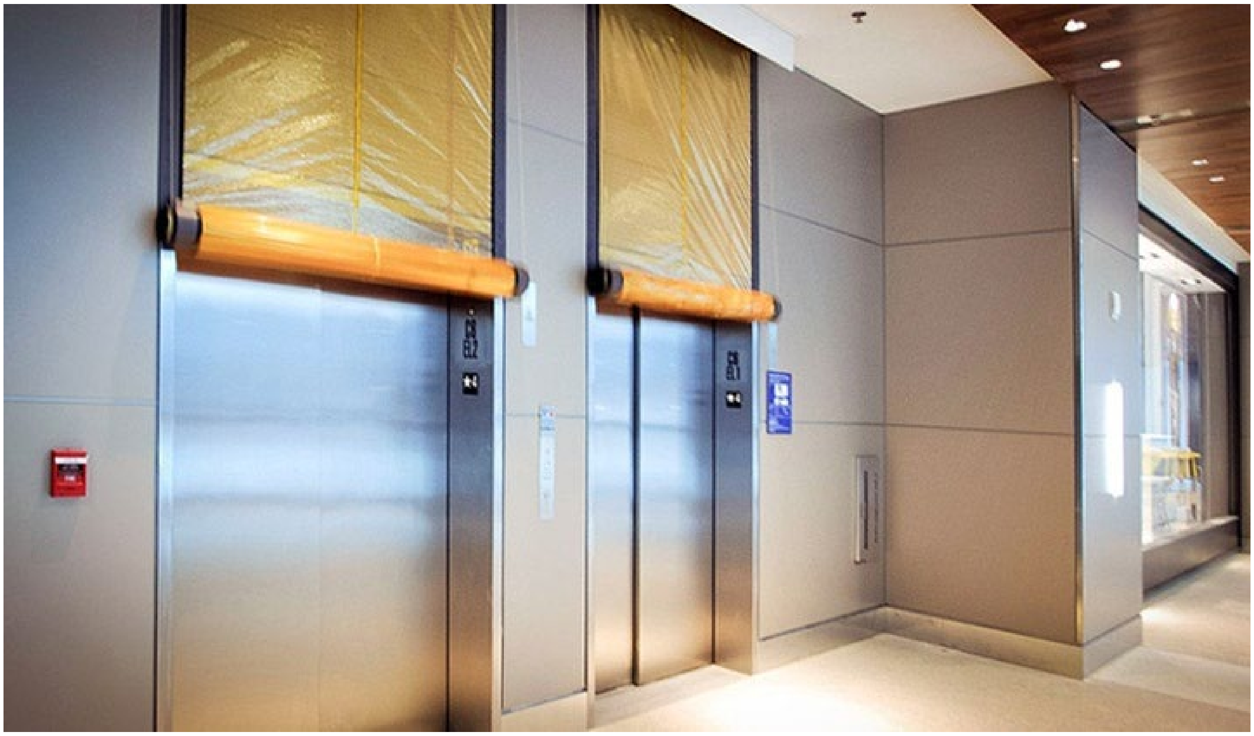

Figure 23. Elevator smoke curtain device activation.

Emergency Recall Service

Emergency recall service (ERS) is an elevator operating mode that overrides normal service and automatically moves elevator cars to predetermined floors, allowing any passengers to exit. The elevator cars then remain at the landing with their car doors open, providing emergency personnel priority use of the elevator.

Several terms describe ERS: “firefighter service,” “fireman’s service,” “firefighters’ operation,” “fire service,” or “fireman’s operation.” The International Fire Code and Virginia Fire Code use the term “emergency recall service,” so this manual will also use this term for consistency.

Independent service should not be confused with ERS. Independent service refers to the elevator operating mode typically used by maintenance staff or persons moving in or out of a building. Independent service lacks several of the safety features inherent to ERS.

Building fire alarms automatically activate ERS, or fire department personnel can manually activate it using elevator keys.

ERS Elevator Keys

During elevator incidents or events where tactics require elevator use, personnel should obtain elevator keys to activate and use ERS. Elevator keys are typically found in a building’s emergency key box (i.e., Knox box) located at the manager’s desk or in the elevator room.

Older elevator systems utilized manufacturer-specific elevator keys to activate ERS. The American Society of Mechanical Engineers 2007 edition of the ANSI A17.1 codified the FEOK1 service key (see Figure 24) as a universal key for firefighter emergency response to reduce rescue time during elevator incidents.

Figure 24. FEOK1 service key.

Personnel must familiarize themselves with the elevators in their response area through preplanning and building walk-throughs. Prior knowledge of what type of elevator keys are required and where the keys are located will lead to more efficient operations.

Once located, elevator keys can be used to activate Phase 1 ERS.

Phase 1 ERS

Building fire alarms automatically activate Phase 1 ERS, or personnel can manually activate it using elevator keys to manipulate controls at the lobby landing (see Figure 25).

Figure 25. Lobby-level controls for initiating Phase 1 ERS.

When Phase 1 is activated, elevator cars return to the lobby level or a terminal floor. If the alarm is activated from one of these locations, the car will go to a predetermined alternate landing with a means of egress. Elevator cars traveling away from the lobby level when Phase 1 is activated will reverse direction at the next landing without opening their doors.

During Phase 1, elevator cars at any landing other than the lobby level will immediately close their doors and return nonstop to the lobby. Emergency stop buttons are rendered inoperative in

Phase 1.

An elevator system's age and manufacturer, along with its building-specific installation characteristics, affect the hoistway disposition and car doors when an elevator reaches its recall location. As cars recall to the lobby, personnel may encounter situations in which all car and hoistway doors open and then close within an 8 s to 1 min time frame. Personnel may also encounter situations where all car and hoistway doors open, and then only the doors to those cars equipped with ERS remain open. Personnel may encounter elevator installations in which all elevator car and hoistway doors open upon recall to the lobby. Car lights in ERS-equipped elevator cars remain on while the lights in all other cars turn off.

Reasons for an elevator's failure to recall to the lobby or alternate landing may involve the inability of the car doors to close or the elevator's placement in the inspection mode prior to alarm.

To utilize an ERS-equipped elevator to access upper floors, personnel should leave the lobby control switch in the "on" position and remove the key. Personnel should then enter the elevator car and insert the key in the car's ERS switch located on the car's operating panel. Manipulating this switch to the "on" position activates Phase 2 of ERS.

Phase 2 ERS

In some installations, only one car in a bank will be equipped with Phase 2 ERS, and in other buildings, all cars will be equipped with this feature. An elevator car's interior ERS switch has three positions:

- "off" is the normal nonemergency operation;
- "on" allows the car to operate in Phase 2 ERS, and
- "hold" keeps the elevator car at a landing with the doors opened.

Some older installations have a "bypass" position instead of "hold." The "bypass" position quickly removes an elevator car from a dangerous area by allowing the car to descend a shaft with its doors open. This operation is inherently dangerous and is being phased out of use.

If an elevator car's fire helmet icon is flashing, the car has received a smoke detector activation from the elevator machine room, hoistway, or pit. Personnel should not use elevators in that hoistway.

To begin Phase 2 operations, personnel should turn the ERS switch to the "on" position (see Figure 26).

Figure 26. Interior elevator car controls used to initiate Phase 2 ERS.

Phase 2 ERS Controls

This section describes the function of interior car controls during Phase 2 ERS.

Prior to utilizing the elevator for fires on upper floors, crews *must* engage all elevator functions (e.g., door-open, door-close, floor selection, cancel) to ensure the elevator is operating correctly.

The “call cancel” (i.e., reset) button allows the operator to change floor selection or direction of travel prior to reaching the original selected floor. When the “call cancel” button is engaged, the elevator car stops at the next available floor landing. The doors remain closed. A new floor selection must then be made. It is recommended that the “call cancel” button be pressed when a car is initially placed into Phase 2 to clear the floor selection panel of any previous selections. This could be very important if the fire floor—or a higher location—had been selected.

When Phase 2 ERS is activated, personnel must hold the buttons for opening and closing doors until the desired action is complete. If a button is released before the door has fully opened or closed, the door will return to its last position.

The door-close button is used to close elevator car doors from the car’s interior. When an elevator car door has fully opened, this button must be pressed and held down until the car door has fully closed.

The floor selection button is used to select the desired destination.

The door-open button is used to open elevator car doors. It must be held down until a door has fully opened. If the door-open button is released before a door has fully opened, the door will return to the closed position. This feature ensures the release of the door-open button will automatically close the doors in the event the car inadvertently stops at the fire floor. Personnel leaving the elevator car must verify that the door has fully opened before exiting. If a member leaves the car before the door has fully opened, the door will automatically close behind them, isolating the car and placing it out of service.

The emergency stop button is rendered inoperative during Phase 1. During Phase 2, the emergency stop button will quickly stop an elevator car while ascending or descending to a selected destination.

After reaching the required floor, the last crew member should switch the fire service key to the "off" position, which will place the ERS back into Phase 1 and return the elevator to the main discharge floor (usually the lobby area). They should leave the key in the elevator for use by other companies.

Fire Service Access Elevators

Code requirements for high-rise buildings more than 120 ft high include the installation of fire service access elevators (FSAE). These elevators facilitate the rapid deployment of firefighters to upper floors to reduce the reflex time required for personnel to reach those areas and begin fire suppression operations.

FSAEs can function as standard elevators during normal operation; however, when used during fire operations, several unique features allow firefighters to safely use them in a fire-involved building.

A transitional elevator lobby between the FSAE and the rest of the floor is required (see Figure 27). This configuration allows firefighters direct access to a standpipe-equipped stairwell. Firefighters can launch a fire-floor attack from this stairwell while maintaining the integrity of the elevator lobby and limiting smoke migration to the elevator shaft and machinery.

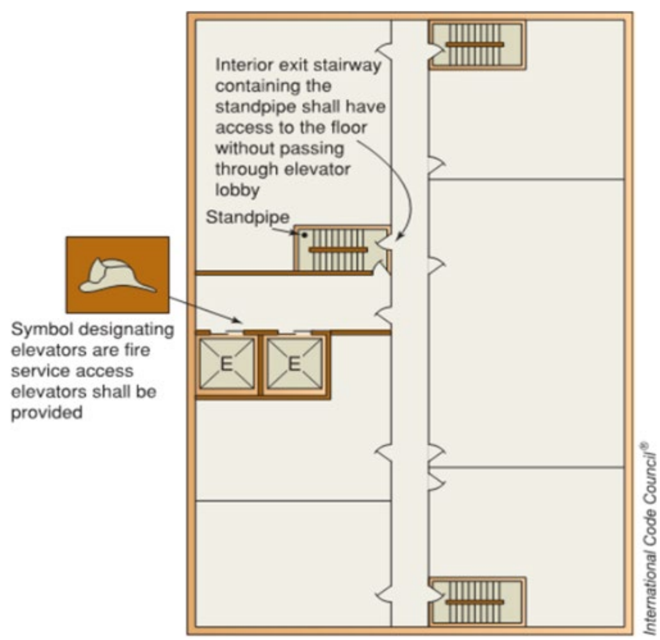

Figure 27. Typical FSAE configuration.

Other notable features of an FSAE include:

- Automatic activation of Phase 1 ERS when any fire protection system initiates an alarm.
- Continuous monitoring from the fire control room.
- Standby power system capable of running the elevator for 2 hours.
- Protected wiring and cables.
- Machine spaces without sprinkler protection.
- The presence of mechanisms to limit water infiltration into the shaft.
- A lighted hoistway when operating under firefighter control.

The at a right angle to the FSAE lobby.

ELEVATOR INCIDENTS

Elevator incidents and associated fire department operations vary according to the severity of the involved life hazard. Incidents in which passengers are inconvenienced but not injured by their elevator entrapment should be considered nonemergency incidents.

Emergency incidents may include passengers who are stuck in an elevator during fire operations; passengers who are injured, ill, or panicked in a stalled elevator; or victims who have fallen into the elevator shaft.

Upon arrival, officers should size up the incident by

- obtaining elevator keys if available,
- identifying the type of elevator involved,
- locating the position of the car relative to the hoistway opening,
- establishing communication with the elevator passengers,
- determining passengers' number and health status, and
- requesting additional resources based on size-up and department standard operating procedures.

Officers should use the information gathered to determine if the incident involves an emergency or nonemergency situation, perform a risk–benefit analysis, determine strategic goals and tactical objectives, and establish an action plan.

Officers should request assistance from a qualified elevator mechanic. A mechanic's name and contact information can typically be found on the company inspection card in the elevator control room or through on-site maintenance. If an officer determines the incident is an emergency, the arrival of an elevator mechanic should not delay fire department actions. If the situation involves a complex rescue, officers should consider requesting a technical rescue response.

Stalled Elevators

Stalled elevators with trapped passengers occur often, and removing affected passengers can be a simple operation. An elevator contains many electric safety devices that are in place to protect passengers. Unless a general power outage has occurred in the building, a stalled elevator generally results from electrical part failure. Common electric failures may include:

- faulty interlocks on hoistway doors,
- blown fuses,
- shorted electric cables,
- open switches, or
- breaks in operating circuits.

Locating Stalled Elevator Cars

Upon arrival, personnel should attempt to contact the reporting party or a building representative with the information needed to expedite the process of locating the stalled elevator car and securing passenger status.

Personnel should take the following actions to inform their search for a stalled elevator car:

- Review computer-aided dispatch information.
- Talk to on-scene building occupants or representatives.
- Contact elevator passengers via cell phone or elevator car phone.
- Check the floor indicator in the lobby (see Figure 28).
- Locate the fire control room and check the elevator floor indicator.

Figure 28. Floor indicator located in the lobby.

The elevator machine room can provide additional information. The controller, which is located in the machine room, may indicate the stalled car's location. Newer installations have an LED indicator (see Figure 29), which will display the car's location, and older installations have a dial or arrow traveling left or right along a metal rod. For hydraulic elevators, the level of the hydraulic fluid in the reservoir may indicate the relative height of the elevator car in the hoistway.

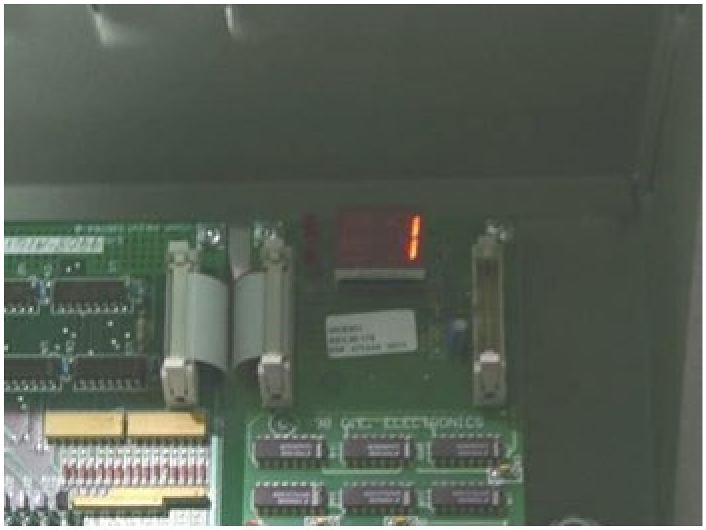

Figure 29. Example of a controller indicating car floor location.

If these actions and indicators fail to provide the information needed to locate the stalled elevator car, personnel should begin more extensive search operations by utilizing an adjacent operational elevator car to travel to each floor. Upon arriving at each floor, personnel can use a flashlight to look across the narrow space between the car and hoistway wall to locate the stalled car. Personnel can also speak loudly through the hoistway doors to contact elevator passengers.

In older installations and freight elevators, a hoistway door may have a glass panel. In this case, personnel can use a flashlight to look for the car or the location of the counterweight. The location of the counterweight can be used to approximate the car's position. For example, in a 10-story building, if the counterweight is located at the second floor, the car would be near the eighth floor.

If these actions fail to provide the location of the stalled elevator car, personnel may consider opening an adjacent hoistway door to look up, down, and across the hoistway. It is advised to only open the door enough to look in the hoistway. When doing so, power to the adjacent elevator must first be secured. Personnel must have a lifeline attached when working near an open hoistway door, especially if the door is fully opened and chocked.

After locating the stalled car, personnel must prioritize communicating with its passengers to determine their health status and number. Once communication has been established, personnel can reduce passenger anxiety levels by explaining that the fire department is working to mitigate the situation as swiftly and safely as possible.

Elevator passengers may have activated the emergency stop switch. This activation removes power from the hoisting machine and activates a loud alarm. The alarm has the tendency to cause panic, confusion, and hamper communication. It will also prevent self-rescue techniques. Consequently, passengers should be advised not to activate this button. If already activated, they should be advised to rest the switch.

After personnel have located the stalled elevator and communicated with passengers to assess their health status, officers should determine if the incident is nonemergency or emergency in nature.

Mitigating Procedures With Power On

Personnel can attempt several maneuvers to restore elevator operation and allow passengers to safely exit the elevator at a landing.

Personnel can instruct passengers to perform self-rescue techniques by

- engaging and disengaging the emergency call button several times,
- engaging the door-open button and floor button while personnel at the closest floor landing press and hold the hallway call button,
- pushing the interior doors closed to ensure they are in the fully closed position, and
- shaking the interior doors.

If self-rescue techniques fail to return the elevator to service or facilitate passengers exiting the car, personnel should attempt to move the elevator while the power remains on. Methods for moving the elevator include the following:

- pressing the lobby call button,
- activating ERS (Phase 1) in the lobby or fire control room,
- shaking hoistway doors on the floors the last occupant entered and those closest to where the car is currently located, and
- checking all hoistway doors to ensure they are closed.

If these procedures fail, personnel must determine if any car movement is present. If the car is moving up, down, or erratically, turning elevator power off while the car is moving may cause the car to travel upward until the counterweights reach their terminal position and strike the buffers. Passengers in the car may be severely injured or killed.

During nonemergency incidents, if an elevator car is in motion, personnel should await the arrival of an elevator mechanic before taking any further actions. No personnel should get onto or into an elevator car when car movement is present.

When the officer has confirmed the car is motionless, has exhausted all previously described attempts to remove the occupants with the power on, and has determined a rescue should be performed, they must adhere to the following sequence of actions to ensure the occupants' safe removal:

- Attempt to perform a hard reset of the system. This involves removing power via the mainline disconnect and waiting 30–60 s and then turning power back on to the system. Similar to a computer, this may reset the system and provide functioning capabilities. In this event, the elevator should remain LOTO (i.e., lockout/tagout) until building maintenance can have the elevator serviced by a technician. More explanation of LOTO appears in the next section.

- Shut down and secure power to the stalled elevator.
- Access the hoistway.
- Access the stalled car.
- Assist occupants out of the stalled car.
- Secure the scene to prevent further use of the problematic elevator.

Shutting Down and Securing Power

Once attempts to remove the passengers with the power on have failed, power-off procedures should be initiated. Personnel can turn the power off by sending a crew member to the elevator machine room to remove power from the mainline disconnect for the problem elevator. Once power has been removed, the disconnect must remain off until a certified elevator mechanic restores the elevator to proper working order. To ensure this power stays off, personnel must padlock the switch to lock out the mainline disconnect breaker (see Figure 30). This procedure is commonly referred to as LOTO. If no padlock is available, a member with a radio should remain at the panel until the rescue has been completed.

Figure 30. Example of a tag and a padlock for marking an elevator out of service and padlocking the power switch.

There are two power sources for each elevator (see Figure 31). The mainline disconnect, which delivers power to the driving motor, is usually found inside the machine room near the entrance door. It is imperative that personnel shut down power to the stalled elevator. Elevator power switch boxes and motors must be labeled in a manner that relates the motor to its respective switch (e.g., Switch 1, Motor 1). Elevator hoistways must also be numbered. The numbering system starts with the first hoistway on the left of the main building entrance and continues clockwise. If any doubt exists, personnel should shut down as many elevator power switches as required to ensure safe operation. Personnel should also allow passengers to exit any properly operating cars before removing power.

Figure 31. Two sets of electrical shut-offs for two elevators. The large disconnect boxes marked 1 and 2 on left are the mainline disconnects, and the small disconnect boxes marked 1 and 2 on right are the auxiliary electric shut-offs.

When the mainline disconnect lever is pulled down, it stops the car and removes operating power from the elevator. It does not remove the lighting or ventilation power. The other power source is an auxiliary system, which delivers power to the car lights, fan, and sound system. The auxiliary circuit breaker panel frequently resembles the normal breaker box found in most homes. During elevator rescue, this auxiliary power system should be left on to prevent panic of the occupants.

Auxiliary power may also be used to identify the correct elevator car and secure power with LOTO. If it is not possible to identify the affected elevator car's number, personnel may be able to identify the correct power source by turning auxiliary power on and off until the correct power unit is found. The number on the auxiliary power box will coincide with the number on the mainline disconnect. Auxiliary power should remain on, and the mainline disconnect should be turned off. This procedure should be communicated to the car occupants prior to turning the auxiliary power on and off.

After power to the elevator has been secured, personnel should gain access to the hoistway.

Opening Hoistway Doors

The following tools, procedures, or techniques can be used to open the hoistway doors:

- elevator keys;
- elevators pick tool;
- glass panel access;
- poling down, up, or across; or
- forcing entry.

Hoistway Doors With Keyhole Access

If a stalled elevator car is near the landing zone and the hoistway door has keyhole access, removing trapped occupants can be an easy operation involving the use of elevator keys to open the hoistway and car doors.

The fire service has typically purchased a ring of various elevator keys from a fire equipment dealer. Although some of these keys are useful, a few may be outdated for different response areas. Figure 32 shows a set of keys acquired from an elevator key company with more up-to-date keys.

Figure 32. Elevator hoistway keys. These are left separated and stored within a small bag for use.

Elevator keys are stored separately to facilitate use without the bulk of a ring carrying unneeded keys. The “drop-keys” have a plastic handle. This handle will break if the elevator moves unexpectedly and catches the key. It will also break before the user can put too much force on the elevator equipment. This can typically occur when the car motor is still engaged due to unsecured power. The rubber stops attached to the keys provide a way of marking insertion depth for users who have to open multiple hoistway doors. The stop can be set to the correct position after placing the key in the first escutcheon hole.

If companies choose to use a key ring set, it may be beneficial to attach small carabiners to each key to allow removal from the ring as needed. Departments should also consider having two sets of keys in order to facilitate access to the hoistway from above and below. Accessing the hoistway doors from above may provide access to the elevator car door interlock and the motor, which can assist with opening the elevator car door.

There are a few types of drop-over keys: the single drop-over, double drop-over, and triple drop-over. All three involve the same steps:

- Insert the tool until the leading edge drops behind the hoistway door.
- Turn the tool away from the leading edge of the hoistway door until it meets resistance.
- Apply pressure against the resistance to disengage the hoistway door lock (see Figure 33).
- Open the hoistway door by pushing it away from its leading edge.

Figure 33. Hoistway key gaining access to hoistway by overcoming door interlock.

On elevators equipped for drop-key use, personnel should attempt to open the hoistway door using the key before resorting to forcible entry. If the single drop-over does not entirely enter the keyhole, the car may be blocking its access. The double drop-over key will normally pass without interference.

Other types of elevator keys include lunar and T-shaped keys. Personnel should insert these keys at an angle with the leading edge of the key positioned down. The key should be pushed in until it meets resistance. Pulling down will release the lock, allowing the hoistway doors to be opened.

Hoistway Doors Without Keyhole Access

Stalled elevator cars at or near a landing zone without access to the hoistway door keyhole will require alternative, and often more extensive, operations.

The simplest alternative that will work on some hoistway doors without keyhole access involves using an elevator pick tool. An elevator pick tool (see Figure 34) is a hand tool used to open sliding-type elevator hoistway doors. Personnel can attempt to open the door with this tool by following these steps:

- Hold the point of the tool parallel to the hoistway door.
- Insert the point of the tool between the doorjamb and the top of the door.
- Rotate the tool 90° so that the point is perpendicular to the hoistway door.
- Move the tool toward the leading edge of the hoistway door to locate the locking arm. There are several items that may be encountered as the tool is moved along the top of the door. Trial and error will result in locating the locking arm. The location of the keyhole on a hoistway door in the same elevator shaft will aid in locating the locking arm.
- When the locking alarm has been located, keep the point of the tool perpendicular to the hoistway door and rotate the handle of the tool until it is at a 45° angle to the plane of the locking arm.
- Push up on the tool to raise the locking arm and disengage the hoistway door lock. This will allow the hoistway door to be opened by pushing it away from its leading edge.

The elevator pick tool is very effective if the locking arm mechanism can be reached.

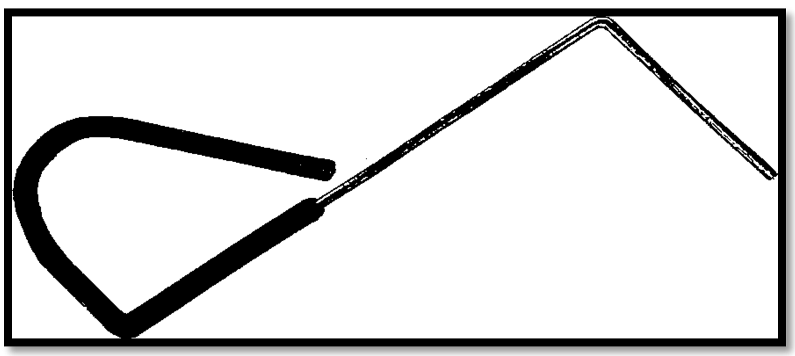

Figure 34. Elevator pick tool.

Use of a glass panel, when present, offers another method of opening hoistway doors without keyhole access. Glass panels provide a view of the shaft to determine the elevator car's location and, if removed, provide access to the door interlocks. A glass panel can be removed by unscrewing the molding or knocking out the glass panel. Once this is accomplished, personnel can reach into the hoistway and push the rollers or locking arms together to unlock the door. A poling tool may be needed to accomplish this task if the car is out of reach.

Poling

A more involved but also effective method for unlocking an elevator hoistway door involves using a poling tool to release the door from above, below, or adjacent (see Figure 35). Depending on the position of the person using the pole, this method is known as poling down, poling up, or poling across. Poling, especially poling across, is often used in high-rise buildings where two or more elevators occupy the same hoistway, and keyholes for hoistway door unlocking keys are few or nonexistent.

Figure 35. Examples of poling tools.

The poling procedure requires personnel to operate around open elevator shafts, presenting significant fall hazards and the need for life safety considerations. Full-bodied harnesses and lifelines should be utilized when a fall hazard of 6 ft or more exists. Company officers should consider requesting technical rescue resources as needed and operate within the procedures set forth by their jurisdictions.

Open hoistways should not be left unattended. Before leaving the area, personnel should close hoistway doors and confirm they are locked by gently applying pressure to ensure they will not open.

Poling Down

Personnel can begin poling-down procedures by accessing the stalled elevator's hoistway from a landing above the stalled elevator (see Figure 36). Personnel should identify the landing with keyhole access that is also above and closest to the stalled elevator. An elevator key is used to open the hoistway door and gain access to the hoistway interior. Hoistway doors on each floor between the initial hoistway access and the stalled elevator are then opened in a sequential manner. A fire department member who is secured by a properly anchored lifeline should kneel or lie in the prone position and use the poling tool or pike pole to push the rollers or locking mechanism together on the floor below. The rollers or locking mechanism are located on the upper portion of the hoistway door. This action will release the safety interlock that keeps the doors locked.

Another member on the floor below should open the doors from the hallway and chock them open. Personnel should repeat this scenario until the stalled car has been accessed.

Figure 36. Properly secured firefighters begin a poling-down operation.

Poling Up

To begin a poling-up procedure, personnel should identify the landing with keyhole access that is below and closest to the stalled elevator. An elevator key is used to open the hoistway door and gain access to the hoistway's interior. The aim is to open the hoistway doors on each floor between them and the stalled elevator above. A member who is secured by a lifeline uses the poling tool or pike pole to push the rollers or locking mechanism on the above hoistway doors together. Another member on the floor above opens the hoistway doors from the hallway and chocks them open. Personnel should repeat this scenario until they have accessed the stalled car (see Figure 37).

Caution must be used when performing poling-up procedures. Poling up places personnel in a more hazardous working position than poling down. Although anchored lifelines secure personnel poling up, leaning out into an open shaft is dangerous. This access procedure should be undertaken as a last option.

Figure 37. Properly secured firefighters performing a poling-up operation.

Poling Across

There are two ways to pole across. These operations may be performed from either the interior of an adjacent elevator car or from the top of an adjacent elevator (i.e., the rescue car). Operations from the rescue car's interior should be used for nonemergency operations. Car-top poling rescue is discussed in the Emergency Access Operations section and should only be performed under emergency conditions. Because of limited space between the hoistway and car doors, a poling tool is preferred over a pike pole.

An adjacent car (i.e., in the same hoistway) should be positioned at the landing closest to the stalled car with the car and hoistway doors opened. The mainline disconnect to the adjacent elevator must be shut off and the doors chocked open. A member should stand in the car door opening with a light and a poling tool. Using the poling tool, the member should connect the interlock rollers of the stalled elevator together. Depending on the doors' travel direction, the locking mechanism should either be pulled or pushed to connect. A firefighter should be stationed directly in front of the stalled car's hoistway door to prevent civilians from climbing or jumping from the stalled car (see Figure 38).

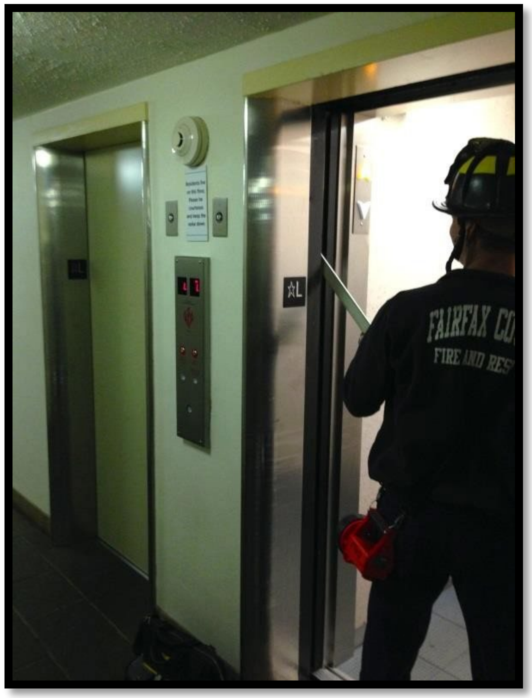

Figure 38. A firefighter using an unoccupied car to perform a poling-across operation.

Forcing Entry

Forcing entry into a hoistway and elevator can be a very costly approach and may not achieve the desired results. Repairs after forcing a door may cost several thousand dollars. Power to all cars in the affected hoistway must be removed and all other cars in that hoistway evacuated.

Any type of spreading tool that will fit into the opening between door panels or between the door and the doorframe may be used to force the door. The tool must be inserted as high as possible to apply a more direct force to the linkage and locking mechanism. Forcing a door may push the door off its tracks. It is possible for the doors to free-fall into the hoistway. Once the doors have been forced, it will be impossible to properly secure the hoistway opening before leaving the scene. This approach should be used as a last resort and only under emergency circumstances.

Car Positioning

After accessing the hoistway, the proximity and disposition of the stalled elevator car should be assessed to determine the safest and most efficient method of removing passengers. If the stalled car is at or near the landing, safe passenger removal can be easily accomplished. The further away from a landing a stalled elevator rests, the more complex and hazardous passenger removal operations become.

As the distance from the landing increases, the vertical opening between the car and hoistway door decreases, limiting access into and out of the elevator car. When passengers are removed from a stalled car between floors, they should be taken up and out of the car, if practical. Removing passengers to the landing above eliminates the possibility of a passenger falling down the shaft after exiting the elevator. If passengers are removed to the lower landing, the shaft opening should be blocked; a backboard or short ladder works well to cover the opening. If the opening cannot be secured, all members and occupants should be secured with harnesses and lifelines.

If a stalled elevator car platform is positioned within 3 ft above or below the landing, passenger removal can often be a simple and safe operation.

When an elevator car platform is more than 3 ft above the landing, it is inadvisable to remove passengers from the car. However, if passenger removal is prioritized over waiting for an alternative or the arrival of an elevator mechanic, officers should perform a risk–benefit analysis and determine the safest way to remove passengers.

Lowering a Hydraulic Elevator

Stalled hydraulic elevator cars can be lowered by manipulating the manual lowering valve to achieve a more advantageous position for passenger removal (see Figure 39). The manual lowering valve is typically found on a manifold at the oil reservoir; it is either a T-handle on top of the manifold or a circular knob. The valve should be manipulated until fluid can be heard returning to the reservoir. The car lowers as hydraulic fluid drains through the valve.

It is important for personnel to manipulate the lowering valve slowly while receiving feedback from crew members observing the car's descent. A crew member should slowly open the valve and watch for bubbles or hydraulic fluid movement within the hydraulic reservoir. The valve should be closed before the car becomes level with the landing to account for lag-time between the valve closing and the end of car movement. The car should not be lowered past the lowest floor landing and the final limit switch. If the car lowers past the desired location, it cannot be raised through manipulation of the manual lowering valve.

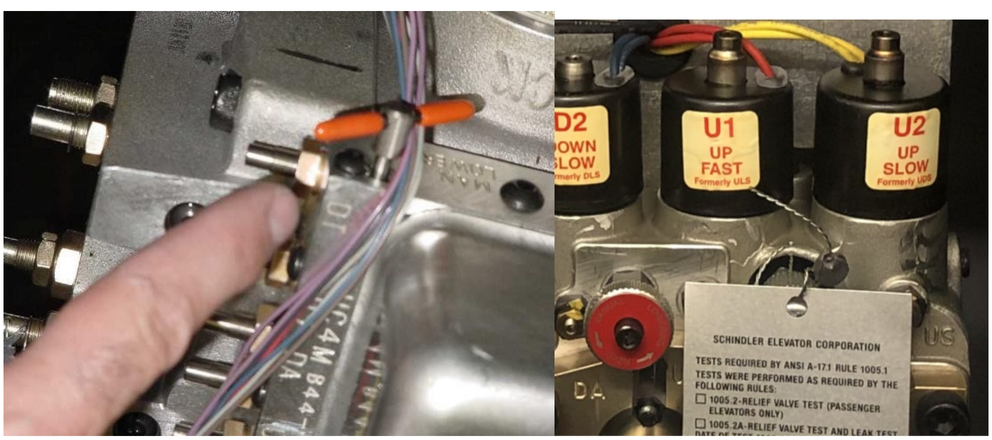

Figure 39. Manual lowering valve with a T-handle and circular valves.

To lower a hydraulic elevator car, personnel should perform the following steps:

- Confirm mainline disconnect LOTO procedures have been completed.
- Open hoistway doors at the landing below the stalled elevator.
- Inform passengers that the car will begin to descend.
- Slowly manipulate the manual lowering valve in the machine room.
- Actively communicate the descending car's progress from the landing.
- Request the lowering valve be closed before the car becomes even with the landing.

Opening Elevator Car Doors

With the hoistway door open, the elevator door will open with a minimum amount of pressure. The door may be opened by applying enough physical pressure to the door in the opening direction to overcome the friction from the mechanical door motor. Some doors may require the door motor's drive chain wheel to be pushed. This wheel is located on top of the car, so a crew member can use a tool to reach and gently turn the wheel a few inches as another firefighter applies pressure to open the car door.

Passenger Removal

If a stalled elevator car platform is positioned within 3 ft above or below the landing level (see Figure 40), personnel should take the following actions:

- Confirm mainline disconnect LOTO procedures have been completed.
- Block any hoistway opening beneath the car with a ladder or similar object if a gap exists.
- Open the car door.
- Enter the car and engage the emergency stop switch (if equipped).
- Assist passengers out of the car.

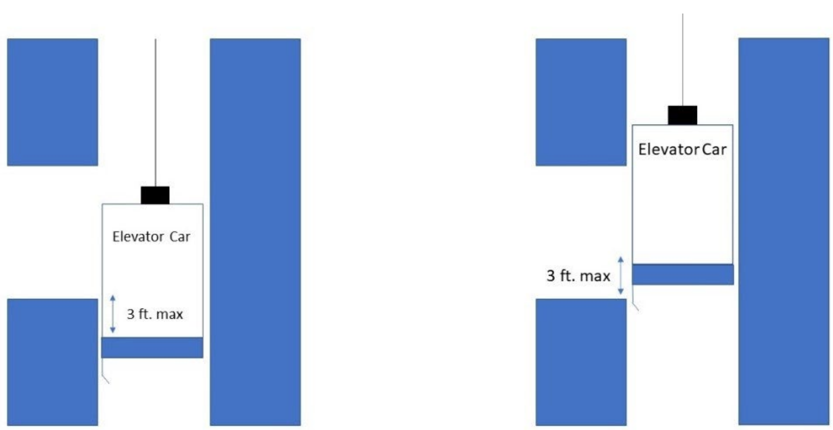

Figure 40. Car platform within 3 ft of landing.

If a stalled elevator car platform is found to be more than 3 ft above or below the landing level and the vertical space between the car and the hoistway allows for passenger removal, personnel should take the following actions:

- Confirm mainline disconnect LOTO procedures have been completed.
- Block open hoistway space beneath the car with a ladder or similar object.
- Open the car door,
- Extend a ladder with nonskid feet from the landing into the car.
- Enter the car and engage the emergency stop switch (if equipped).
- Assist passengers out of the car.

Securing the Hoistway

After removing passengers, personnel must close the hoistway and car doors and ensure the hoistway door locking mechanism has engaged. If the hoistway and car doors cannot be closed, auxiliary power to the car should remain off to indicate the elevator is out of service. At no time should personnel leave a hoistway door open if the elevator car is not in front of the landing; an unknowing person could fall down the open hoistway, causing severe injury or death.

EMERGENCY ACCESS OPERATIONS

The following sections address advanced elevator rescue procedures that require personnel to operate inside elevator shafts, hoistways, or pits. These spaces have limited means of entry and are not designed for continuous human occupancy. Due to the inherent physical and mechanical hazards, these spaces should be considered confined spaces.

If all other tactics have failed to provide access to a car and incident commanders choose to employ a tactic described in this section, they should strongly consider assigning personnel who are specifically trained, authorized, and equipped for confined-space operations. If such personnel are not already on-scene, these resources should be requested. Fire department personnel should not attempt these techniques unless authorized to do so by their respective departments.

These procedures should be carried out in collaboration with an on-site elevator mechanic.

Incident commanders should consider the following general operational guidelines when utilizing emergency access tactics and engaging in elevator-related confined-space operations:

- All personnel operating in the area should be minimally equipped with helmet and gloves.
- All personnel operating near open hoistway doors, within a hoistway, or in an elevator pit should be equipped with harnesses and be secured by lifelines.
- Personnel should avoid wearing loose-fitting clothing.
- Elevators should never be jacked up or moved in an upward direction to avoid freeing the car safeties and causing the car to move up or down depending on the car's live load.
- Only a certified elevator mechanic should release an elevator's machine brakes.

Top Hatch Removal

When a stalled elevator car is positioned between floors and is too far away from a landing to provide sufficient access between the hoistway door and the car's interior, passengers can be evacuated to the top of the car through the car's top hatch. They can then be moved from the top of the car through the hoistway door to the landing above the stalled car.

To perform a top-hatch removal, personnel should access the top of the stalled car through the hoistway from the floor above the stalled car. Depending on the distance from the landing to the car, personnel may achieve this by lowering a ladder to the car or by repelling.

After arriving on top of the car, personnel should open the top hatch and lower a ladder into the car. The ladder size needed depends on the car's interior height (see Figure 41). Personnel can climb down the ladder into the car and assist the passengers up the ladder and out of the car. Harnesses and lifelines should secure all persons (i.e., passengers and rescuers) in the hoistway.

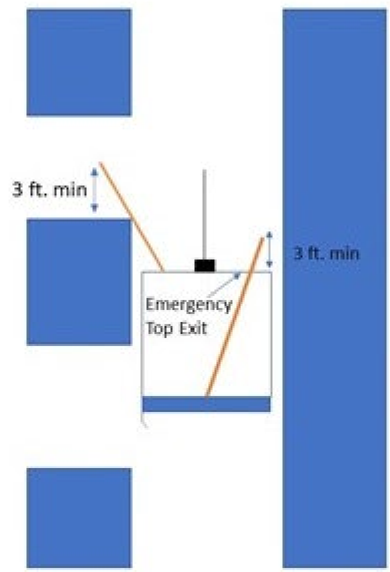

Figure 41. Car found more than 3 ft from hoistway.

Firefighters may find the top hatch bolted, padlocked, or welded shut to prevent unauthorized access. If personnel cannot accomplish forced entry to the top hatch, they must consider an alternate means of access.

Rescue Car Using Inspection Service

In shared or multiple hoistways, personnel can use an adjacent elevator as a rescue car by positioning it next to the stalled car utilizing the inspection service function. This elevator system function is designed to provide access to the hoistway and car top for inspection and maintenance purposes.

Personnel should take the rescue car to one floor below a hoistway door with elevator key access. At this point, the power to all elevators in the shared hoistway should be shut down. Using an elevator key to open the hoistway door, a rescue crew of two should enter the hoistway and step onto the top of the rescue car. Once on top of the rescue car, crew members should secure themselves to the car.

Personnel will find electric controls in the car-top inspection station that will allow them to switch the rescue car from normal mode to inspection service mode. Personnel must switch the car to inspection service mode before restoring main line power. Typically, there are four inspection station buttons that are used to move the rescue car through the hoistway: “STOP,” “UP,” “DOWN,” and “RUN.” The STOP button must first be pulled to activate inspection station power. Then, a direction button (i.e., UP or DOWN) and the RUN button must be simultaneously depressed and held down to move the rescue car in the desired direction. If either button is released, the rescue car will stop moving. Elevator car travel speed is reduced to 150 ft per min while in inspection mode.

Personnel must remember that the counterweights travel silently through the hoistway in the opposite direction of the car, and they pass within inches of the car. One member should be assigned to watch for the counterweights while the car is in motion. All members on the car top should be secured by lifebelts.

Once the rescue car is properly positioned relative to the stalled car, personnel should remove power to the rescue car. Passengers can be accessed via the side hatch (if present) or the top hatch. These hatches should be opened on the rescue car and the stalled car. Planks of sufficient length (i.e., 6 ft or longer) or a ladder should be used to bridge the gap between cars. A member enters the stalled car to assist with removal. A member in each car holds the ends of two 8-ft pike poles to form handrails. Another member assists the occupants. Everyone who enters the open hoistway, including firefighters, should be secured with lifelines.

Personnel utilizing inspection service should consider the following general operational guidelines:

- Control power to all other cars in the hoistway.
- Check the hoisting cables on electric traction elevators for slack before moving the car. If the cables show slack, the car may move without warning. An elevator mechanic should assess the situation prior to passenger removal.
- Position no more than three personnel on top of a car at the same time.
- Avoid standing close to the edge of the elevator car.
- Avoid standing too close to moving elevator system components.
- Task one fire department member with watching for and locating moving counterweight assemblies.
- Secure all personnel to the car when the elevator is moving.
- Prevent the car from moving beyond terminal landings.
- Return the rescue elevator to normal service.

The use of a rescue car in inspection service will not work if structural beams block access between the rescue car and the stalled car or if the rescue car cannot be vertically aligned with the stalled car.

If a stalled car exists in a single hoistway, this procedure is also not an option. Personnel may have to force entry through a hallway wall to access the hoistway and stalled car, or they may need to use a rope rappel or lowering system. These tactics should only be used after exhausting all other options.

Poling Across From the Rescue Car

To pole across from a rescue car, a member positioned on the rescue car's top uses a light and a poling tool to connect the stalled elevator's rollers or locking mechanism together. The door's direction of travel will determine whether to pull or push the rollers or locking mechanism. Next, a member located in the hallway at the stalled elevator opens the stalled elevator's hoistway door. Again, it is safer to remove occupants through the hoistway door on the floor above rather than the floor below.

FIRE OPERATIONS

Elevator use during actual firefighting operations presents a calculated risk. Statistical data from the Fire Department of the City of New York showed a relatively high rate of elevator failures during actual working high-rise fires. However, operations with firefighters climbing 20 or more floors to extinguish a fire pose significant disadvantages and safety risks (e.g., reflex time and physical exhaustion).

Personnel must use the stairs to access the fire floor for any fire occurring up through the sixth floor. If fire exists on the seventh floor or higher, the first-arriving company must evaluate the elevator and ensure it is operating properly and the shaft is free of smoke, fire, or water. If deemed functional, fire department personnel may use the elevator for operations.

Freight (i.e., oversized) elevators may be present in an area remote from the main elevator bank. Freight elevators should not normally be used during emergency operations. However, if the freight elevators are in an area not affected by fire, smoke, or the products of combustion, personnel can exercise judgment as to their use.

Most modern high-rise building systems alarm the fire floor as well as the floor above and below it. Consequently, alternative recall locations may be two floors above or below the lobby. The location of the elevators in this instance must be confirmed.

Smoke detectors will normally be found in elevator lobbies, machine rooms, hoistways, and pits. The activation of any smoke detector in these areas will activate the firefighter emergency operations system, which is indicated by the flashing firefighter helmet or “flashing hat” on the elevator car and lobby panels. If this symbol is flashing, personnel should not use the corresponding elevator car.

Heat detectors are typically found in elevator machine rooms and hoistways. The activation of a heat detector in these areas will remove power to the elevator before the sprinkler system activates. It should be noted that ERS will not work if a heat detector alarm is received for the elevator machine room or hoistway. In the event of a fire alarm triggered by heat detectors in the elevator machine room or hoistway, the fire alarm system may stop the elevator, even if it is between floors.

Elevator pressurization is an additional feature found in some high-rise buildings. This feature pressurizes the elevator shaft to prevent smoke entry.

Elevator Use During Fire Operations

Prior to using an elevator during fire operations, personnel should ensure the following:

- All recalled elevators are clear of passengers.
- The hoistway is clear of fire, smoke, and water.
- All personnel riding in the elevator are equipped with self-contained breathing apparatus (SCBA).

- A minimum of one crew member is equipped with a radio.
- A set of forcible entry tools is available for use.
- Phase 2 ERS is activated.
- The elevator is not overloaded.

During fire incidents, personnel should visually inspect the hoistway by looking between the car and hoistway doors prior to using an elevator. If evidence of fire, smoke, or water exists, personnel should not use elevators in that hoistway.

Crews should not overload the elevator. One crew member with tools and equipment can easily weigh over 200 lb. Each elevator has a nomenclature plate stamped with the maximum load limits. Given the space and weight restrictions, no more than two crews should use an elevator at one time. Additionally, personnel should remain cognizant of space within the car to ensure they have room to freely move into and out of the elevator or position for a forcible exit if the car malfunctions.

Phase 2 Fire Operations

Personnel should use an ERS key to manipulate the ERS switch to an “on” position and then press the door-close button. Personnel should then select a floor that is one or two levels above their current location. The car should stop at the selected floor. If the car fails to do so, personnel should press the stop button. If the car does not stop at the next available floor, personnel should attempt to stop the car by forcing the car doors open and interrupting the interlock relay switch. Once the car stops, personnel should slowly open the car to check if they are at or near a landing and can evacuate.

If the car is operating normally, it should deliver personnel to the selected floor, and the car doors should remain closed. Personnel must press and hold the door-open button until the doors are fully open; otherwise, the door will revert to closing. This is a built-in safety feature.

When the elevator doors have fully opened, the elevator car will remain at the selected floor with the doors open. The elevator car should not be returned to the lobby or street floor until the officer has determined that the unit has arrived at the proper location.

After confirming normal operations and control of the elevator, personnel should select a floor two levels below the anticipated fire floor and travel there via the elevator. They should then use the stairs for the remainder of their ascent to the fire floor.

Upon arriving via elevator at the final departure location, the emergency recall switch should be left in the “on” position if keeping the elevator at the landing two floors below the fire offers any operational value. If the elevator is not needed, the switch should be turned to “off” and the key left in the slot. The elevator will then return to the lobby as designed. This allows other crews and Lobby Control to use the elevator. For specific instructions on lobby control functions, refer to the most current edition of the NOVA *High-Rise Building Fires* manual.

If elevator doors open to a landing filled with fire or smoke, removing pressure from the door-open button should cause the doors to close. If the doors fail to close automatically, all personnel should don their facepieces then depress the door-close button while manually helping the doors to close.

If the car doors still fail to close, personnel should attempt to turn Phase 2 ERS to "off." This should automatically recall the elevator to the lobby. If this action fails to close the doors, personnel should evacuate the elevator and proceed to the nearest safe stairway. Noting the location of stairwells in relation to the elevator when boarding the car can be of vital importance if personnel must evacuate the elevator into fire or smoke conditions.

Due to internal building security, personnel may be required to force entry to access stairwells and other areas beyond an elevator landing. For this reason, crews should assign a member to remain with the elevator to ensure it does not move from the floor until personnel have assured safe access to the stairwell or fire area.

If an elevator car stalls while personnel are en route to a fire on an upper floor, the following procedures should be followed:

- Check the emergency stop button, engage, and reset to normal position.
- Prepare to don SCBA, but do not go on air until conditions require it.
- Communicate the situation to Command. If conditions require it, transmit a Mayday.
- Attempt to open the car door. If hoistway doors are close, consider escaping to a floor landing.

In rare instances, personnel may need to access the top of the elevator car through the top hatch and rappel or lower each other down the hoistway to a lower floor. This is an inherently dangerous tactic that should only be employed in life-threatening situations. If rope is not available, personnel can slide down fire department hose to the floor below. If more than one length of hose is needed, the sections should first be tied together and then coupled.

In addition to the possible repurposing of hoselines, personnel may need to consider the following elevator-related Mayday actions:

- Force open hoistway and car doors with power tools. Doors may have warped due to heat and may not operate normally.
- Positively pressurize the elevator shaft containing the stalled car to provide relief to the trapped members and facilitate the rescue.
- Apply hose streams into the shaft for protection until the rescue is complete. Hose streams can also cool cables in areas above the stalled car.

Once a car has been placed in Phase 2 ERS, it will continue in Phase 2 operation, regardless of the position of the lobby keyed switch. This feature may be used to restore other cars in the elevator bank to normal operation while the fire department continues to use the Phase 2 ERS car or cars.

If the Phase 1 emergency recall (i.e., firefighter) service was initiated automatically by a fire alarm device, the elevator cannot be returned to normal operation until the device has been cleared. For the occupants to use the elevators while the building is still in alarm, the system must be switched to bypass in the lobby. This will allow normal operations until the fire alarm system is reset.

Fires Involving Elevator Systems

This section outlines strategies for handling fire emergencies involving elevator systems.

Fires in the Pit Area

Normally, fires in the elevator pit are small in nature. The first-arriving engine can bring a portable water extinguisher along with the standpipe pack to address a pit fire. However, hydraulic elevator pit fires involving hydraulic fluid require a Class B extinguisher or a foam line.

Personnel should remove all passengers in associated elevator cars and control power to those elevators via the mainline disconnect. If the building is in alarm, the elevators may have been recalled prior to firefighter arrival. In this case, the affected car may need to be moved to an upper floor. This may require the use of Phase 1 and 2 ERS. Once the car has been taken to the desired floor, personnel should remove power at the mainline disconnect.

In most cases, firefighters should be able to extinguish small elevator pit fires from the lowest hoistway door using a handheld extinguisher. This method prevents firefighters from going into the pit area.

If necessary, firefighters can access the pit by disconnecting electrical power to all elevators in that hoistway then lowering an attic ladder through the lowest possible hoistway door. One firefighter should be designated as a safety person to monitor any car or counterweight movement. Additionally, the safety person can monitor wind currents, identify any flow paths, and be aware of stack effect within the elevator shaft as smoke can move swiftly to upper floors where it will affect a greater area of the building.

Fires in an Elevator Car

Although uncommon, fires can occur in elevator cars. The elevator car may have lacquered wood walls, wood flooring, and moving pads secured to the walls for protection. If an elevator car is being used to move a large quantity of material (e.g., commercial delivery goods, occupancy furnishings, household items), the interior car space may have a heavy fire load. The fire service has experienced building fires related to the deliberate ignition of flammable liquids inside elevator cars that were used to spread fire to other floors.

When confronted with a fire in an elevator car, personnel should remember that sprinkler systems do not protect the car's interior. The elevator rope (i.e., cable) consists of cold-rolled steel wrapped around lubricant-soaked rope (i.e., hemp). Failure can occur at temperatures above 800 °F.

High-heat fires can damage elevator components. Personnel should not enter a car until an elevator mechanic has deemed it safe. As in any elevator emergency, the power must be removed from the mainline disconnect in the control room.

The hoistway doors are typically 2-hr fire-rated, but they offer minimum smoke penetration protection.

Smoke and heat entering the shaft may enter the control room and could disrupt normal elevator system functioning. In this case, the fire floor should be accessed up the stairwell unless the building has two separate elevator banks and control rooms, and personnel can determine which bank is safe to use.

Stairwells adjacent to the elevator shaft may be within close proximity. Consequently, using that stairwell for fire attack may jeopardize the stairwell with intense heat and smoke. When possible, personnel should use an alternate stairwell for attack. If using a remote stairwell, personnel may need to add hose to the standpipe pack to make the stretch.

All floors must be checked for fire extension and open hoistway doors. The fire may have started on an upper floor and warped the hoistway doors open, and elevator recall may have sent the car to a distant location. An elevator fire on a lower floor will result in heavy smoke conditions on the upper floors. Stack effect will cause smoke to stratify at various levels in high-rise buildings, so personnel should exercise caution around hoistway doors. Firefighters have been killed by falling into elevator shafts from smoke-filled hallways.

ESCALATOR

An escalator system is basically a conveyor belt. It is a chain-driven system that rotates treads (i.e., stairs) in an enclosed loop rail. The system can travel in either direction and can be vertical or horizontal. An electric drive-motor rotates a drive gear that, in turn, rotates a guide chain with connected treads. In some installations, this same drive-motor also powers the handrail, but in other installations, a separate drive-motor powers the handrail. The handrail and tread system rotate at the same speed to provide stability to the rider (see Figure 42).

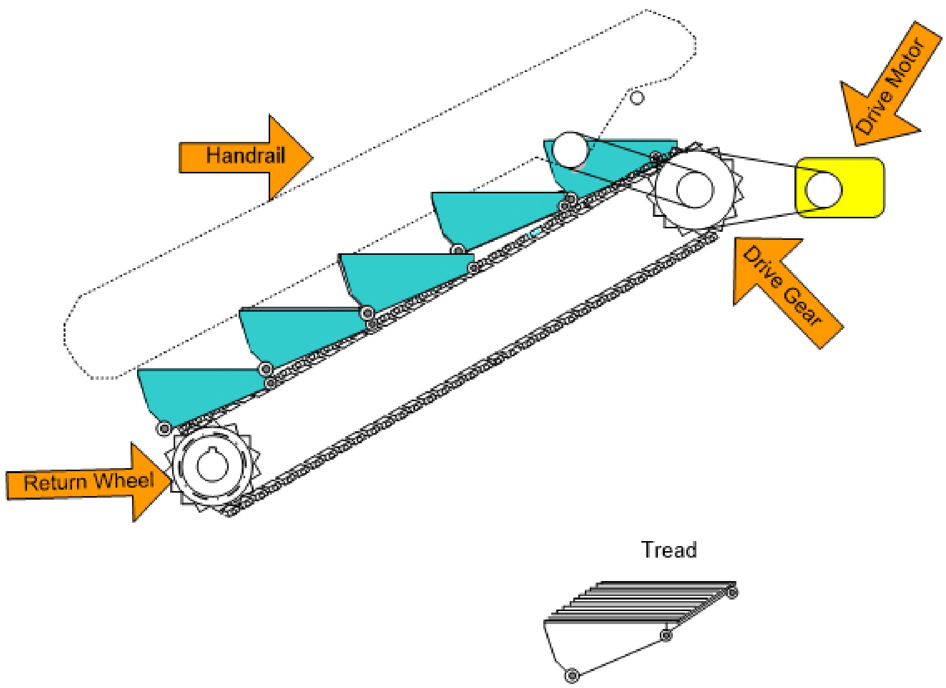

Figure 42. Parts of escalator.

Escalators present the possibility for two types of entrapment emergencies. In the first, a body part becomes caught by an unforgiving tread, causing tissue trauma. The second involves clothes or shoes getting caught in the treads. Both can cause falls. Whether the emergency involves an entrapment, fall, or mechanical malfunction, the officer should request response from an elevator or escalator mechanic if available.

Personnel should shut down power upon arrival if it has not already been done. The emergency shut-off is located at the bottom of the escalator under the handrail (see Figure 43). Some installations have an extra shut-off at the escalator's top. To remove power, the clear cover should be lifted and the button beneath it depressed.

Figure 43. Emergency shut-off for escalator.

To remove an entrapped foot at the landing plate, the screws holding the plate or comb plate should be removed, allowing the plate to be lifted (see Figure 44). If the screws cannot be removed, the stairs may be broken to free the entrapped foot. By hitting the step tread in the middle of the plate, personnel can break the cast metal into large pieces.

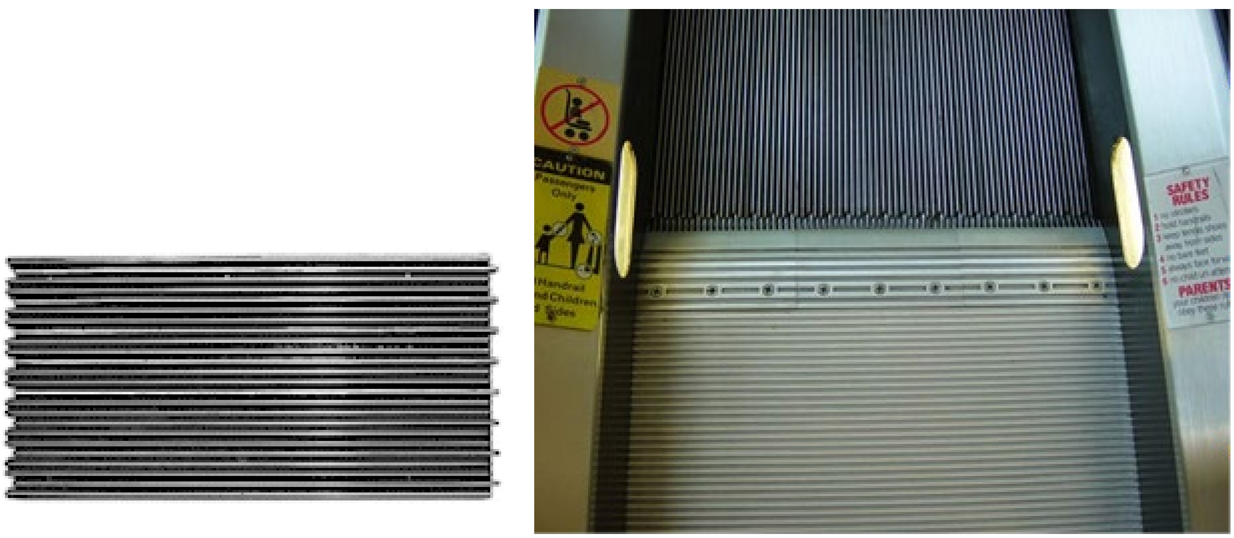

Figure 44. Removable plate on escalator.

Step treads are made of die-cast aluminum. Some treads may have steel reinforcement that requires cutting down the middle of the tread. A circular saw with a metal blade can be used if necessary.

To remove trapped fingers from the handrail, the wheel that controls the handrail should be disassembled or loosened. The location of the handrail motor is in the same location as the motors that drive the entire escalator.