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Technical Instructions

Elevator Systems

Headquarters
U.S. Army Corps of Engineers
Engineering and Construction Division
Directorate of Military Programs
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TECHNICAL INSTRUCTIONS

Elevator Systems

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No.	Date	Location

This Technical Instruction supersedes EI 14M001, dated 01 April 1996.

(EI 14M001 text is included in this Technical Instruction and may carry EI 14M001 identification.)

FOREWORD

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FOR THE DIRECTOR OF MILITARY PROGRAMS.

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Chief, Engineering and Construction Division
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DEPARTMENT OF THE ARMY
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EI 14M001

CEMP-E

Engineering Instructions
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ELEVATOR SYSTEMS

Table of Contents

TABLES

ELEVATOR SYSTEMS

1. DESIGN CONSIDERATIONS. The criteria and guidance contained in this instruction are applicable to elevators serving ordinary occupancies that are less than 20 floors in height and less than 25,000 m^2 (250,000 ft^2) in area. Structures higher than 20 stories, or greater than 25,000 m^2 (250,000 ft^2) in area, or structures involving industrial or special occupancies is beyond the scope of this instruction and may require the services of a vertical transportation expert with specialized experience in the type of work involved.

a. Specific Occupancies.

(1) Barracks of six stories or less do not require elevator service.

(2) Elevator systems for medical facilities are addressed in the Architectural and Engineering Instructions (AEI) for Medical Design Standards.

(3) In administrative and laboratory occupancies less than four stories, and in mercantile, schools, and places of assembly, elevator service is normally provided for convience, handicap access, service or freight purposes, rather than for transporting the general population in the building.

b. Design and Traffic Analyses. Elevator system design and traffic analyses should be prepared by engineers with appropriate experience in the design of elevator systems. The following provides an overview of the analysis process, definitions of the terms involved, and minimum design parameters.

(1) Design Analysis. An elevator design analysis should be prepared for any facility in which an elevator is to be installed. During design analysis, the elevator system design criteria will be determined, including applicable codes, elevator selection and types, hoistway and car dimensions, clearances, loading capacity, finishes, power requirements, communication requirements and other parameters as described in this instruction.

(2) Traffic Analysis Exceptions. Structures with less than four floors generally do not require elevators for general occupant movement, but for handicap access and for service or freight service. In these cases, a traffic analysis is not required, but a design analysis should be prepared.

(3) Traffic Analysis. When a structure has four floors or more and passenger elevator service is required, a traffic analysis should be performed. Traffic analysis includes the development of the interval and five-minute handling capacity of each elevator or elevator group, as applicable. An elevator group is a set of elevators which serve the same floors. The traffic analysis figures are used to determine whether the proposed elevator system is adequate for the occupancy it serves.

(a) The interval represents the theoretical longest time between elevator dispatches from the main lobby. It is inversely related to the number of elevators in a group and is represented by the following formula:

$$\text{interval} = \frac{\text{round trip time for one elevator}}{\text{number of elevators in the group}}$$

The round trip time is calculated by adding together such factors as acceleration and deceleration rates, full-speed running time, door opening time, door closing time, and passenger entrance and egress times, multiplied by the probable number of stops. Acceptable intervals during peak periods for ordinary occupancies are as follows:

Administrative or laboratory - under 25 seconds.

Residential Building (e.g. apartment buildings and barracks) - 60-80 seconds.

For other occupancies such as schools, assembly buildings or mercantile, elevator service is typically provided only for disabled access or service purposes, rather than for transporting the general population in the building. If general passenger elevator service is to be provided, use an interval between 25 and 30 seconds.

Peak periods are those times of day when maximum usage is made of the elevator system. In an administrative or laboratory facility, the primary peak is typically during the lunch hour; secondary peaks occur at the beginning and end of the work day. Personnel tend to lunch in groups; they typically leave at the same time and return together. Morning arrival and evening departure times are more likely to be staggered.

(b) The five-minute handling capacity is the percentage of the population served by an elevator (or group) which can be transported in a five-minute period. It is calculated by multiplying the number of passengers carried on a round trip times 300 seconds (five minutes) and dividing by the interval. This figure is then divided by the population served by the elevator (or group). The number of passengers carried on a round trip is established by the designer for each project, but will not exceed the elevator (or group) capacity divided by 150 pounds per person. The population served by the elevator (or group) is calculated as described below. Acceptable five-minute handling capacities during peak periods for ordinary occupancies are as follows:

Administrative or laboratory - 16 to 18%.

Residential Occupancy - 5 to 7%.

For other occupancies such as schools, assembly buildings or mercantile, elevator service is typically provided only for disabled access or service purposes, rather than for transporting the general population in the building. If general passenger elevator service is to be provided, use an appropriate five-minute handling capacities between 10 to 16%.

(4) Population Served. Since the use of any structure may change over time, the population to be served by an elevator system is established for design purposes as the greater of two figures: the population figure obtained from the using agency, or the figure calculated based on typical occupancy for the floor area involved. The population figures for each floor in an elevator group are added together to obtain the total population served by that group.

(a) For administrative facilities, the net usable area on each floor should be calculated. This is the area where the population will be housed; therefore, the corridors, toilets, elevator cores, utility spaces, stairs, etc. should not be included. The net usable area may be divided by 9.3 m^2 (120 ft^2) per person to obtain the potential population under ordinary conditions.

(b) For laboratory spaces, the potential population may be determined by allowing 27 gross m^2 (400 gross ft^2) per person.

(c) For residential occupancy barracks, allow two persons per bedroom.

(d) For other occupancies such as schools, assembly buildings or mercantile, elevator service is typically provided only for disabled access or service purposes, rather than for transporting the general population in the building. If general passenger elevator service is to be provided, the governing codes should be consulted to determine the population served quantity.

c. Walking Distance. The maximum walking distance to the elevators should not exceed 45 to 60 m (150 to 200 ft).

d. Travel Distance and Number of Landings Served. The maximum travel distance for an elevator is 75 m (240 ft) and the maximum number of landings served by an elevator is 20 landings.

e. Environmental Factors. The design should consider the need to prevent or minimize environmental impacts, such as underground oil contamination or noise pollution.

(1) Due to the danger of electrolysis damage, in-ground pistons for hydraulic elevators should be protected by a sealed, schedule 80 PVC watertight cylinder with a waterstop ring embedded in the pit floor. Holeless hydraulics should be considered as an alternative to conventional hydraulic installations.

(2) Noise levels above 60 DBA should not be accepted outside of elevator machine rooms or inside of elevator cabs.

f. Loading Classifications. These include passenger, service and freight.

(1) Passenger-carrying cabs should be wider than they are deep to allow for easy passenger transfer. The following are typical loading capacities:

(a) Administrative or laboratory occupancy - 1360 to 1800 kg (3000 to 4000 lbs).

(b) Residential occupancy - 1140 to 1360 kg (2500 to 3000 lbs).

(2) Service elevators are rated for passenger carrying but are used primarily for service needs, defined as the daily transport of supplies and trash, as opposed to freight. When possible, separate service elevators are recommended. They should be deeper than they are wide. The size and weight of the materials to be handled determine the required platform size and handling capacity. The following are typical handling capacities:

(a) Administrative or laboratory occupancy - 1800 to 2250 kg (4000 to 5000 lbs).

(b) Residential occupancy - 1140 to 1600 kg (2500 to 3500 lbs).

(3) Freight elevators are not intended to carry passengers, nor are they recommended for service applications. They are used where freight loads need to be moved. Wide entrances are used, usually with vertical bi-parting freight doors. The size should be developed based on the needs; i.e., a freight car intended to move automobiles will be sized accordingly. The Elevator Code, ASME A17.1, describes different kinds of loadings (A, B, C-1, C-2 and C-3) that relate to the types of loads that need to be lifted. These loadings can be applied to passenger or service classification as well.

g. Security Considerations. These will be developed in conjunction with the user. In general, it is better to provide security access control independent of the elevator system. Security in an elevator system, if necessary, can be provided by conventional key lockouts or by card keys.

(1) Conventional keys are least desirable because they are easily duplicated and usually require considerable time to insert and actuate, thereby slowing the operation of the elevator.

(2) Card keys can be used, but should be applied in conjunction with a security computer so that the elevator system only passes the signal through and does not have to process it.

(3) If possible, the security arrangements should be made such that any security device in an elevator system need not be in use during peak periods.

h. Cost Factors. The elevator industry has developed standard elevator sizes, finishes, fixtures, etc. Use of these commercial standards whenever possible will reduce costs. The use of non-standard items (for example, an oxidized bronze finish on metalwork) increases both initial costs and maintenance costs.

(1) When developing life-cycle costs for an elevator system, refer to 10 CFR 436 for general requirements and 10 CFR 435 for energy consuming systems. The energy consumption of elevator systems is considered a process load and should not be included in the building energy use when determining compliance with energy use targets.

(2) The cost of routine and preventative maintenance for the various alternative systems should be considered in the life-cycle cost analysis.

i. Accessibility Requirements. Virtually all elevator projects require elevators that are accessible to the disabled. The minimum configuration is an elevator rated at 1140 kg (2500 lbs) with 1070 mm (3'-6") wide doors. Refer to paragraphs CODE ISSUES and CHAIR LIFTS AND WHEELCHAIR LIFTS for further accessibility information.

j. Clearances. The design of elevator systems is dependent on providing proper clearances around equipment and at the top and bottom of the hoistway.

(1) Most clearances are dictated by the Elevator Code, ASME A17.1. Other clearances have been established by elevator manufacturers based on their equipment. Care will be taken to consider several elevator manufacturers' requirements and design for the "worst case" to allow maximum opportunity for competitive bidding. The following represents some of the elevator code-related clearances which will be considered in design:

(a) Pit depth is based on the thickness of the platform, the safety plank, the run-by (set by code), and the buffer stroke (set by code based on speed), plus a minimum bottom-of-car clearance when the car is on compressed buffer.

(b) Top terminal over-travel is based on the cab height (determined by designer), shackle clearance (determined by elevator industry), crosshead thickness (determined by elevator industry), and run-by (determined by code).

(c) Clearance between the car sill and hoistway sill.

(d) Machine room height.

(e) Top and side emergency exits.

(f) Height of kickbase in cab.

(g) Area of safe refuge on top of cab.

(2) Clearances for items such as counterweight space, rail space, machine and controller size are based on the various manufacturers' equipment, and are also related to control and operation.

2. CODE ISSUES. Elevators will comply with the latest edition of ASME A17.1, Safety Code For Elevators and Escalators, with amendments, and the Uniform Building Code (UBC). The design should comply with state and local

codes as well, as determined by the military installation or project requirements. For elevators not located on a military installation or base, the elevator design may comply with the local building code in lieu of the UBC, if the local building code requires compliance to a national building code, such as the BOCA National Building Code or the Standard Building Code. The design will also comply with the elevator inspectors' manuals published by ASME and with ASME A17.3, Safety Code for Existing Elevators and Escalators, as applicable.

a. Accessibility. Unless the facility is specifically exempt from barrier-free design requirements, the elevator system design will comply with the Uniform Federal Accessibility Standards (UFAS), FED-STD 795. The design will also comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG), 36 CFR 1191, wherever the ADAAG requires accessibility equal to, or greater than, the UFAS.

b. Electrical Work. Electrical work will comply with the National Electrical Code, NFPA 70, and state or local codes if determined to be applicable to the project.

c. Miscellaneous Codes. The designer will be aware of any miscellaneous codes that affect the design or installation of elevators at the project location, and determine their applicability to the project.

3. ELEVATOR SYSTEM.

a. Loading Capacity. Loading capacity is a function of the desired platform size and/or maximum weight to be moved.

(1) For passenger service, Table 1-1 shows typical capacities.

(2) For combined freight and passenger service (i.e. equipment or supplies plus passengers) in defined space inside an elevator, the Elevator Code, ASME A17.1 gives the inside net cab area as it relates to capacity.

(3) Refer to paragraph "Loading Classifications" for further information.

b. Rated Speed. The rated speed of an elevator system is related to the application of equipment and its use.

(1) Hydraulic elevators are used in buildings up to four stories in height and have rated speeds of 0.25 m/s (50 fpm) to 0.75 m/s (150 fpm). The lower speeds are for freight duty with heavy capacity. The higher speeds are for passenger applications.

(2) Geared traction elevators have effective speeds from 0.5 m/s (100 fpm) to 2.0 m/s (400 fpm). The slower speeds are for freight operation, while the higher speeds are typically used for passenger service in mid-rise buildings.

TABLE 1-1 PASSENGER ELEVATOR SERVICE CAPACITIES

Nominal Capacity	**Passenger Capacity** [1]	**Passengers Per Trip (Normal Peak)** [2]
1140 kg (2500 lbs)	17	13
1360 kg (3000 lbs)	20	16
1600 kg (3500 lbs)	23	19

1800 kg (4000 lbs)	27	21
2250 kg (5000 lbs)	33	27
2730 kg (6000 lbs)	40	32
3180 kg (7000 lbs)	47	37
3640 kg (8000 lbs)	53	43

[1] Maximum passenger capacity.

[2] Peak passengers per trip (normal peak = 80% of passenger capacity; reduce by one for attendant-operated elevators).

(3) Gearless traction elevators have speeds from 2.0 m/s (400 fpm) to 10.0 m/s (2000 fpm). The highest speed likely to be used under these Design Guidelines would be 3.8 m/s (750 fpm). Gearless equipment should be used on administrative and laboratory structures with more than ten stories.

c. Sequence of Operation. Many different types of systems may be applied to control elevators. All new elevators will be microprocessor-controlled. A single-car system is referred to as "simplex", a two-car system as "duplex", and a system having three or more cars as "group supervisory operation". There are a number of sub-systems such as independent service, attendant service, etc., that can be added to the main control system.

(1) Independent service allows the elevator to be run from within the car without responding to hall calls. This service should be included on all cars.

(2) Attendant service is activated from a key switch in the car. It allows an attendant in the car to control the opening and closing of the doors, the direction of travel, and whether to stop or bypass hall calls. When there is more than one car in a group, a car on attendant service is usually called by a separate, inconspicuous corridor push-button riser. Attendant service operation is frequently used for combined passenger/service applications.

d. Machine Type. Machine types in use today are the hydraulic pump, geared traction and gearless traction.

(1) The hydraulic pump can generate speeds of 0.25 m/s (50 fpm) to 0.75 m/s (150 fpm). For high-capacity applications, more than one pump may be needed to generate the required lifting capacity and speed. Hydraulic machine rooms should be located adjacent to the elevator hoistway at the lowest landing.

(2) Geared traction machines are used on Corps projects for medium-speed applications up to 2.0 m/s (400 fpm). The machines are normally located overhead, directly over the hoistway, but can be mounted to the side and below; this is termed a "basement traction" application.

(3) Gearless traction machines are used for high-speed passenger elevator applications. The machines should be located over the hoistway in an overhead machine room.

e. Hoist Drive Systems. The motors in use today are either alternating current (ac) or direct current (dc).

(1) AC motors are used directly in hydraulic elevator applications. They have across-the-line starting unless they

are larger than 40 hp, in which case they should be provided with wye-delta starting.

(2) AC motors for virtually all geared traction and some gearless traction machines use variable-voltage, variable-frequency (VVVF) drive systems. This eliminates the need for ac-dc operation using either the Ward Leonard (motor-generator or MG) drive or silicon-controlled rectifiers (SCR).

(3) Gearless traction machines typically use dc motors driven by MG or SCR. MG are a better application when there is a possibility of fluctuating line voltage or the building contains very sensitive electronic equipment. SCR use less power and require less maintenance, however, they are currently more expensive than MG. By the turn of the century, virtually all new gearless traction machines are expected to use ac motors driven by the VVVF drive.

f. Roping Arrangements. Hoist ropes are used on geared and gearless hoisting machines. Generally, elevators are roped 1:1, meaning they are directly connected from a counterweight, over the hoisting machine and down to the car. In basement traction applications of geared hoisting machines, twice the usual length of cable is required; if the rise is high, an undesirable bouncing effect can be created.

(1) In some cases a 2:1 roping arrangement may be specified for mechanical advantage, to allow the use of a smaller and faster hoisting machine. As an example, a 2:1 hoisting machine used to provide a rated car speed of 2.5 m/s (500 fpm) actually spins at 5.0 m/s (1000 fpm).

(2) Roped, holeless hydraulic elevators are a very successful recent development. They are roped 1:2, so the elevator moves two meters for every meter of movement by the hydraulic pistons.

g. Door Arrangements. Common elevator door arrangements are as follows:

(1) Single-speed side-acting doors are least costly. They are typically used for smaller elevators where minimal construction cost is a strong consideration.

(2) Two-speed side-acting doors are equipped with two sliding sections, which make them more compact than single-speed doors. They are slightly more costly and used in the same applications as single-speed side-acting doors, to maximize the door opening width in a minimum hoistway width.

(3) Single-speed bi-parting doors are typically used in the larger capacity ranges and when dictated by the shaft and platform arrangement. Their operating speed is generally faster than side-acting doors.

(4) Two-speed bi-parting doors have the fastest action and are used where a wide opening is required; they are common on large passenger elevators and service elevators.

(5) Vertical bi-parting doors maximize the door opening width in a narrow hoistway. They are quite expensive and are usually used only for freight elevators.

h. Clear Opening. The clear opening (width and height) of an entrance depends on its application. For regular passenger operation and handicap access, a minimum opening width of 1070 mm (3'-6") using bi-parting doors is required. Combined passenger/ service elevators typically have doors at least 1220 to 1320 mm (4'-0" to 4'-4") wide and 2135 to 2440 mm (7'-0" to 8'-0") high.

i. Platform Dimensions. A platform may be almost any size in order to fit a hoistway. However, the National Elevator Industries, Inc. (NEII) has set the standards shown in Table 1-2 for passenger elevator platform width (w) and depth (d):

TABLE 1-2 PASSENGER ELEVATOR PLATFORM DIMENSIONS

Capacity	**Platform Dimensions**
1140 kg (2500 lbs)	2135 mm w x 1550 mm d (7'-0" w x 5'-1" d)
1360 kg (3000 lbs)	2135 mm w x 1675 mm d (7'-0" w x 5'-6" d)
1600 kg (3500 lbs)	2135 mm w x 1880 mm d (7'-0" w x 6'-2" d)
1800 kg (4000 lbs)	2440 mm w x 1880 mm d (8'-0" w x 6'-2" d)

Service elevators should be deeper than they are wide. The 1800 kg (4000 lb) standard car is 1830 mm w x 2540 mm d (6'-0" w x 8'-4" d).

4. CHAIR LIFTS AND WHEELCHAIR LIFTS.

a. Usage. The use of stairway chair lifts and inclined or vertical wheelchair lifts is limited to areas of existing buildings where elevators cannot be installed.

b. Vertical Travel. Chair lifts and wheelchair lifts should be limited to approximately 12 feet of vertical travel.

c. Chair Lifts. Chair lifts and devices that ride on tracks are typically incorporated into the handrail structure of a stairway. They are limited to one person, 113 kg (250 lbs) capacity or two persons, 181 kg (400 lbs) capacity.

(1) Chair lifts will include keyed operating stations at each end and a keyed operating station on the unit. The key will be readily accessible.

(2) The platform will be stored in the vertical position.

(3) Required means of egress will be maintained when the platform is in use. Means of egress requirements are per NFPA 101, Life Safety Code.

d. Wheelchair Lifts. Wheelchair lifts are platform devices that operate in their own runway. They are limited to a maximum platform size of 1.67 m^2 (18 ft^2). Platforms will be rated not less than 204 kg (450 lbs) nor more than 340 kg (750 lbs). Platforms over 1.39 m^2 (15 ft^2) in area will be rated at a minimum of 340 kg (750 lbs).

(1) Commercially available wheelchair lifts typically have a 915 mm x 1220 mm (3'-0" x 4'-0") platform size and are rated at 204 kg (450 lbs).

(2) Wheelchair lifts will be key controlled.

5. ARCHITECTURAL AND STRUCTURAL CONSIDERATIONS.

a. Hoistway. Construction of the hoistway enclosure will be noncombustible and in accordance with code requirements.

(1) Deviation from plumb for the hoistway enclosure will not exceed ±25 mm (1 inch) per 20 stories of height.

(2) Provide structural support for attachment of guide rail brackets to the building structure throughout the hoistway at spacing dictated by seismic conditions, design particulars and codes.

(3) Bevel the top surface of projections and setbacks in the hoistway enclosures in accordance with Rule 100.6 of ASME 17.1.

(4) Provide a vertical surface for attachment of sill angles to the floor slab on each landing where an entrance is required; or provide a notch in the top edge of each floor slab the entire width of the hoistway to accommodate landing sills.

(5) Where the hoistway enclosure is concrete construction, provide rough openings for hoistway entrances and grouting following installation. Where drywall hoistway construction is utilized, erect walls around previously installed hoistway entrances.

(6) Provide rough openings for control/signal fixture recessed mounting boxes and grouting thereof as required to maintain fire resistive characteristics of the hoistway enclosure.

b. Pit.

(1) Provide waterproof pit construction as required by site conditions and codes.

(2) Provide a concrete pit floor reinforced as necessary to withstand vertical forces applied thereto by car or counterweight buffer impact, application of car or counterweight safeties to guide rails, or operation of the hydraulic jack.

(3) Provide a sump in a front corner of the pit with a removable steel subway-type grating installed level with the pit floor. The sump will be constructed to minimum dimensions of 610 mm (2 ft) cubed. The sump should not have permanent means for drainage unless absolutely necessary; the structure should be waterproofed sufficiently to avoid the need for permanent drainage. Permanent drainage installations require consideration of environmental regulations governing the discharge.

(4) Where the difference in depth between adjacent pits is more than 610 mm (2 ft), provide a means of separation extending from the pit floor to a height of not less than 1830 mm (6 ft). Perforated materials used for the separation of pits will reject passage of a 50 mm (2.0 inch) diameter ball.

(5) Where pit access is greater than 915 mm (3 ft) in depth and is via the lowest hoistway entrance, provide a permanently installed pit access ladder, accessible from the hoistway entrance, extending from the pit floor to no less that 1065 mm (3'-6") above the bottom landing sill.

(6) Where conditions allow and pit depth is 2440 mm (8 ft) or greater, provide a walk-in access door with clear opening dimensions of not less than 760 mm (2'-6") wide by 1830 mm (6 ft) high. This door will be equipped with a self-latching lock mechanism (key-entry only), automatic closing device, and signage to prohibit unauthorized entry.

(7) Provide a buffer access ladder whenever the buffer oil level gauge is located more than 1525 mm (5 ft) above the pit floor; provide a buffer inspection platform and access ladder whenever that dimension is greater than 2135 mm (7 ft).

c. Machine Room. Elevator machine rooms will be dedicated for elevator equipment only. Machine rooms and secondary machinery spaces will be constructed in accordance with code requirements to provide required clearances around the equipment.

(1) Machine room and secondary machinery space floors will be reinforced concrete.

(2) Where machine room and/or secondary machinery space floor level is above or below the point of access, provide fixed, permanent, noncombustible stairs with a maximum angle of 60 ° from horizontal.

(3) Access doors to elevator machine rooms and secondary machinery spaces will be of the self-closing and self-locking type. They should be provided with spring-type locks arranged to permit the doors to be opened from the inside without a key.

(4) Provide support for machine beams and grouting thereof after installation. Whenever possible, place machine beams on top of building steel in such manner as to be flush with the machine room floor.

(5) Provide an overhead hoisting beam in the machine room, installed directly above the hoistway, sized in accordance with the requirements of the elevator manufacturer.

(6) Drains or sumps are not generally provided in elevator machine rooms. The room should be made reasonably watertight. Curbs may be provided at the doors to prevent the ingress of water. Overhead fluid piping will not be permitted in the machine room, except for sprinkler piping, if required.

6. ELECTRICAL REQUIREMENTS. Electrical circuits, equipment and fixtures other than those mounted on the elevator cars will be shown on the contract drawings.

a. Hoistway.

(1) Provide electrical conduit as required running from the hoistway to remote signal fixtures, control panels, and/or communication stations.

(2) When a replacement or upgraded elevator is installed in an existing hoistway, any utilities and services (conduit, control wiring, etc.) not associated with the elevator system will be removed from the hoistway, as required by code.

b. Pit.

(1) Provide each pit with a permanent, vapor-tight lighting fixture with guard, mounted at a centerline height of 2440 mm (8 ft) above the pit floor and capable of producing at least 54 lux (5 footcandles) of illumination at floor level, and a light switch inside the pit, accessible from the pit access door and adjacent to the pit access ladder, if used.

(2) Provide a 120 volt/20 amp minimum, ground fault circuit interrupter (GFI)-protected duplex receptacle mounted at a centerline height of 305 mm (1 ft) above the lowest landing sill.

c. Machine Room.

(1) Provide the machine room with at least one 120 volt/20 amp minimum, GFI-protected duplex receptacle and overhead lighting capable of producing 108 lux (10 footcandles) of illumination at floor level. Provide a light switch within

460 mm (18 inches) from the strike-jamb side of the machine room entrance door.

(2) Provide a separate 120 volt branch circuit for each elevator to operate car lights, fan and alarm bell. Provide a dedicated branch circuit for car heating or air conditioning, if used. Provide branch circuits for lights and receptacles in the machine room and pit(s). Provide circuit breakers or fused disconnects as necessary for lights and receptacles in secondary machinery spaces; and for the self-contained emergency communication systems and access card reader systems, if provided.

(3) Provide the main line power supply for each elevator with a fused disconnect switch or circuit breaker equipped with lock-out provisions, located inside the machine room adjacent to the entrance door. Fuse(s) will be typed and sized for selective coordination with upstream protective devices. Provide chokes or filters on SCR motor drive installations as required to limit harmonic distortion to 5%.

(4) As required, provide the main line side of the elevator disconnect switch with means to absorb power that may be regenerated by the hoist motor under overhauling load conditions. Typically, this applies to emergency power operation for installations where SCR motor drive elevator equipment comprises at least 80% of the emergency generator inductive load, or where MG drive elevator equipment comprises at least 20% of the emergency generator total load.

(5) For elevator machine rooms and hoistways equipped with automatic sprinkler protection, a shunt trip breaker will be provided in the main line power supply for each elevator. In the event that a heat detector or waterflow switch for the sprinklers in the hoistway or machine room activates, the elevator control system will cause automatic power shutdown of the elevators. See Paragraph 8b, Sprinkler Protection, for the description of sequence of operations for the power shutdown and additional requirements.

(6) Provide a dedicated telephone line inside the machine room terminating at the elevator controller cabinet for emergency communications.

(7) Provide emergency power for cab lighting and the intercom system as required by code. Emergency power for the elevator machines and machine room lighting is not generally required by code, but should be discussed with the using agencies. Limited emergency power (to move one car at a time, for example) may be needed in some cases. When emergency power is provided, the design must address the emergency power arrangement, sequence of operation, and the power and control interfaces between the emergency power system and the elevator system.

7. MECHANICAL REQUIREMENTS.

a. Hoistway Ventilation. Hoistway ventilation will be provided as required by the UBC or other applicable building code.

b. Replacements or Upgrades. When a replacement or upgraded elevator is installed in an existing hoistway, any utilities and services (e.g., piping) not associated with the elevator system will be removed from the hoistway as required by code.

c. Machine Room Temperature and Humidity Conditions.

(1) Provide heating, ventilation, and cooling as necessary to maintain ambient temperature in the machine room within a range not to exceed 10-32 °C (50-90 °F) and relative humidity sufficiently low to prevent condensation in sensitive equipment. The most cost-effective HVAC design that will accommodate these requirements should be selected.

Cooling is typically provided through the use of return air from adjacent air conditioned spaces as exhaust for the machine room, or via dedicated cooling units. Designs will provide an ambient environment which maintains the temperature and humidity within the tolerances of the elevator equipment specified.

(a) Where elevator control systems or equipment will remain energized during the building's unoccupied hours, means should be provided to maintain machine room temperature and humidity without depending on main HVAC systems that could otherwise be shut down or set back.

(b) If the elevator equipment has an emergency power supply, the machine room HVAC should have emergency power also.

(2) Where hydraulic elevators are installed in cold climates and subject to intermittent use, provide means to maintain the oil temperature within acceptable operating limits.

8. FIRE PROTECTION.

a. Smoke Detectors and Firefighters' Service. Firefighters' service will be provided in all elevators as prescribed by ASME A17.1. Phase I emergency recall to the designated landing will be automatically initiated by activation of smoke detectors located in the elevator machine room, in the hoistway, or in the elevator lobby on any landing other than the designated landing. Phase I emergency recall to the alternate landing will be activated by a smoke detectors located on the designated landing. ASME A17.1 requires smoke detectors in hoistways which are sprinklered. Detectors will be connected to building fire alarm system in accordance with NFPA 72. Only elevator smoke detectors will initiate automatic emergency recall.

b. Sprinkler Protection. In buildings required to be fully sprinklered, automatic sprinklers will be provided in elevator hoistways and machine rooms as required by NFPA 13. In accordance with NFPA 13, sprinklers are required in elevator hoistways for hydraulic elevators and in machine rooms of electric and hydraulic elevators, but are not required in electric elevator hoistways of noncombustible construction. When sprinklers are provided in machine rooms or hoistways the following are required:

(1) Waterflow Switches and Valves. A waterflow switch, outside stem and yoke (O.S.& Y.) control valve and check valve assembly will be provided for the elevator sprinklers. The control valves will be located outside of and adjacent to the protected elevator machine room or hoistway. A separate waterflow switch, O.S.& Y. valve and check valve assembly will be provided for each floor level where elevator machine room or hoistway sprinklers are located. Control valves will be readily accessible to qualified personnel, but should not be readily accessible to the general public. An inspector's test connection with outside discharge will be provided for each waterflow switch. Sprinkler heads will be standard heads with intermediate temperature classification.

(2) Heat Detectors. A fixed temperature heat detector, rated at 57-60 °C (135-140 °F), will be provided within 610 mm (2 ft) of each sprinkler head located in the elevator machine room and in the hoistway.

(3) Automatic Power Shutdown. The elevator control system will cause automatic power shutdown of the elevators in the event that a heat detector or sprinkler head located in the elevator machine room or hoistway actuates. The designer will indicate on the drawings the equipment required to achieve automatic shutdown, including wiring, detectors, switches, shunt-trip breakers, sprinkler heads, waterflow switches, valves, and inspector's test connections. Actuation of such heat detector or sprinkler head shall cause the following sequence of operation for the affected elevators:

(a) Elevators which are in motion will proceed to the nearest available landing away from the fire floors. Power-operated doors will open and remain open. A fire floor is considered to be a landing where a fused sprinkler head or activated heat detector is located.

(b) Elevators which are standing at a landing with open doors will remain open at that floor. If power-operated doors are closed, the system will cause the doors to open.

(c) Power to the affected elevators will be automatically shut down by operation of a shunt-trip breaker in the main line power supply. Shutdown will occur only after the elevators are stopped at a landing, and power-operated doors are opened.

(d) Automatic shutdown will override Phase I emergency recall operation, but will not override Phase II emergency in-car operation per ASME A17.1, if Phase II operation is in effect.

(e) Provide a zone arrangement for heat detectors and waterflow switches to direct the affected elevator car(s) to a safe landing prior to shunt-trip activation.

APPENDIX A
REFERENCES

GOVERNMENT PUBLICATIONS

Code of Federal Regulations

10 CFR 435	Energy Conservation Mandatory Performance Standards for New Federal Buildings
10 CFR 436	Federal Methodology for Life-Cycle Cost Analysis
36 CFR 1191	Americans with Disabilities Act Accessibility Guidelines

Federal Standard

795	Uniform Federal Accessibility Guidelines

NONGOVERNMENT PUBLICATIONS

American Society of Mechanical Engineers (ASME); P.O. Box 2300, Fairfield, NJ 07007

A17.1	Safety Code For Elevators and Escalators
A17.3	Safety Code For Existing Elevators and Escalators

International Conference of Building Officials; 5360 South Workman Mill Road, Whittier, CA 90601

Uniform Building Code (UBC)

National Fire Protection Association (NFPA); Batterymarch Park, Quincy MA 02269

NFPA 13	Standard For The Installation of Sprinkler Systems
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code

National Elevator Industries, Inc. 630 Third Avenue, New York, NY 10017

Vertical Transportation Standards