524 CMR 17.00: POWER PASSENGER AND FREIGHT ELEVATORS (FOR INSTALLATIONS MADE PRIOR TO JULY 1, 1989)

Section

17.01: Hoistway Enclosures: General

(1) The hoistways of all elevators shall be enclosed throughout their height and constructed in accordance with 780 CMR (Massachusetts State Building Code) in effect at the time of construction.

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(2) When the elevator hoistway penetrates any fully enclosed solid floor above the bottom landing, walls of hoistway shall be of two hour fire rated construction.

NOTE: Elevator hoistways exposed to wheeled traffic shall be so designed as to withstand the impact loads of such traffic.

(a) For elevator installations made prior to March 9, 1950, if the elevator hoistway penetrates any fully enclosed solid floor above the lowest landing in a building that is not two hour fire rated, the hoistway walls shall be a minimum of one hour fire rated construction.

(b) The hoistways of all elevators and the stairwells surrounding them shall be enclosed through out the complete height of the building and vented to the outer air. The hoistway shall be of two hour fire rated construction. For elevator installations made prior to March 9, 1950, a fire rated hoistway is not required, provided that the stairwell enclosure, including any openings therein, is of two hour construction and there is one other means of egress from the building from each floor, accessible without having to pass through said enclosure.

(3) All windows in exterior and interior walls of an elevator hoistway are prohibited except for elevator installations made prior to March 9, 1950 existing windows in the exterior wall of a hoistway may remain, provided that said windows were in compliance with the code at the time of installation. All windows in interior walls of a hoistway shall be removed and replaced with enclosing materials that have a minimum two hour fire rating, unless the building is not two hour fire rated, in which case the enclosing material shall be a minimum of one hour fire rated construction.

(4) Not more than four elevators shall be installed in the same hoistway.

(5) Dividing wall partitions which are located within an elevator hoistway shall be constructed with solid walls of not less than ¾ hour fire-resistive construction.

(6) Glass hoistways must conform to 524 CMR 17.14(1)(g).

(7) For elevator hoistways which are not fully enclosed, protection shall be provided adjacent to areas permitting the passage of people (passageways, stairways and elevator landings). This protection shall be fixed solid guards seven feet in height and sufficient distance from the moving portion of the elevator so that individuals cannot come in contact with the elevator.

17.02: Machine Rooms, Sheave Rooms and Secondary Levels

(1) All machine rooms shall be located above or below or contiguous to any side of the hoistway.

EXCEPTIONS: Machine rooms for oil hydraulic elevators in 524 CMR 17.23 shall be located not more than ten feet from any side of the hoistway.

(2) Machine rooms located above any hoistway shall be provided with a flooring which is either above or level with the top of the machine supporting beams.

(a) Machinery spaces located above any hoistway and containing hoisting or counterweight sheaves directly over the car shall be provided with flooring located either below the sheaves or level with the top of the sheave supporting beams. Machinery spaces located above any hoistway and containing secondary and deflecting sheaves shall be provided with flooring if the space also contains other elevator equipment in addition to the sheaves. Where no flooring is provided beneath secondary and deflecting sheaves requiring frequent replenishment of the sheave bearing lubricant means shall be provided for lubricating the sheave bearing from the machine room.

(b) Machine room floors shall be designed to support a uniformly distributed load of not less than 50 lbs. per square foot.

(c) Sheave room or secondary level floors shall be designed to support a uniformly distributed load of not less than 30 lbs. per square foot.

(d) Floors shall be either of concrete construction or of open metal construction which will reject a ¾" ball.

(e) Where holes in flooring for sheaves or groups of ropes are unprotected, they shall be provided with curbing guards not less than four inches high.

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(f) Machine room, sheave room and secondary level flooring shall fill the entire top of the hoistway where the cross-sectional area is 150 square feet or less. Where the cross-sectional area is greater than 150 square feet, the flooring shall either fill the entire top of the hoistway or shall extend not less than two feet beyond the general contour of the sheaves, machines, and controllers, and shall also extend to the entrance of the room. Where this flooring does not entirely cover the top of the hoistway, all open or exposed sides of the platform shall be provided with masonry or open metal construction which will reject a ¾ inch ball and not less than six feet high and so designed and supported that when subjected to a pressure of 75 lbs. applied horizontally at any point on the walls of the enclosure, the deflection will not exceed one inch.

(g) Where a section of bar type or other metal cover is part of a machine room floor, it shall conform to the following requirements:

1. The section shall be installed in a steel frame set flush with the top of the machine room floor.
2. The cover shall be hinged to the steel frame and shall be equipped with a lock and key which will lock the cover in the closed position. Such cover or grating shall not be removable.
3. EXCEPTION: Floors are not required above the hoistway of elevators where the machine is located below or at the side of the hoistway and the overhead sheaves are mounted in frames at the sides of the hoistway, provided that:
   a. There is no other equipment, such as selectors, signal machines, *etc*., exclusive of governors on the same level.
   b. The sheaves are equipped with ball or roller bearings packed in lubricant; or, if they have bearings requiring frequent lubrications, means are provided to lubricate the bearings from the top of the car or the machine room.

(3) Machine room, sheave room, and secondary level enclosures shall be constructed as follows:

(a) Where solid construction hoistways are required by 524 CMR 17.00, the walls shall be not less than two hour fire-resistive construction other than for doors, windows, louvers, or ventilators.

(b) Where open construction hoistways are permitted by 524 CMR 17.00, the walls shall be of non-combustible materials which shall be either solid construction walls, or open metal construction which will reject a two inch ball, and shall be not less than six feet high.

(c) Where the machine room is located within the building and where solid construction hoistways are required by 524 CMR 17.00, the ceiling of each machine room shall be of not less than two hour fire-resistive construction.

(d) Where an open construction hoistway is permitted, the machine room ceiling may be omitted.

(e) No machinery, equipment, water lines, drainage lines, or other equipment shall be located in an elevator machine room or hoistway, except that necessary to operate the elevator.

EXCEPTIONS:

1. Heating and cooling apparatus for the machine room.
2. Pumps for the removal of water from the pit.

NOTE: Elevator machinery spaces that require air conditioning to maintain their temperature shall not locate the units needed for that purpose within the walls of the machine room

(4) Machine room walls shall be not less than two feet from the front and not less than two feet from any side of the hoisting machine.

(5) In the space provided for elevator machinery, the head room above the floor or platform shall be not less than the following:

(a) For elevator hoisting machines -- seven feet.

(b) For secondary sheave spaces housing machinery in addition to the sheaves -- four feet six inches.

(c) For secondary sheave spaces housing no machinery in addition to the sheaves, or for spaces housing other sheaves vertically over the car -- three feet six inches.

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Machine and supporting beams may encroach on this headroom in the secondary sheave space provided there is a clearance of not less than two feet six inches between the underside of such beams and the top of the secondary sheave level slab or grating.

(d) Means of access for the inspection, as necessary, of speed governors shall be provided from outside the hoistway, the clear opening to be not less than 30" x 30"

(e) When the speed governor is not accessible from outside the hoistway, a flooring or grating shall be provided.

(f) The access opening shall be provided with a self-closing door equipped with a spring lock that can be opened by hand from the inside of the hoistway. Where solid construction is required doors shall have a fire-resistive construction of not less than 1½ hours. Where open construction is permitted doors shall be constructed of non-combustible material.

(g) No emergency entrance, or door, or opening for any purpose shall be installed in an elevator hoistway other than that required for the operation of the elevator as required by 524 CMR.

(h) An enclosed switch or circuit breaker shall be installed in all overhead machinery rooms, sheave rooms, *etc*. The switch or circuit breaker shall not be bypassed by any other means, shall be located at the entrance to such spaces, and shall comply with 527 CMR 12.00 (*Massachusetts Electrical Code* in effect at the time of installation) and 524 CMR 17.34(2).

(6) Exposed gears, sprockets, tape and rope sheaves, or ropes and tapes passing through the secondary levels shall be equipped with guards.

(7) Each machine room, sheave room or secondary level shall be electrically illuminated with lighting of not less than ten foot candle at the floor level, and each lighting circuit shall be provided with an enclosed type switch located within the room at the lock jamb of the entrance door.

(8) All machine rooms shall be provided with natural or mechanical ventilation to avoid overheating of the equipment and to insure safe and normal operation of the elevator.

(9) Machine rooms shall be provided with self-closing doors not less than 30" wide by six feet six inches high equipped with spring-locks that can be opened by hand from the inside of the machine room. Where solid construction is required, doors shall have a fire-resistive construction of not less than one and one half hours. Machine room doors shall be identified with a sign that will read “ELEVATOR MACHINE ROOM – NO STORAGE ALLOWED”. The letter size shall be a minimum of ¾ inch and shall be of a contrasting color with that of the background.

Location of controllers for floor mounting: Location of one or a bank of controllers shall have the minimum clearance to walls or permanent room partitions. (Such clearances are to "live" panel parts.)

One or a group of controllers:

(a) Front of panel to wall: 30".

(b) Back of frame to wall: 24".

(c) One side of frame to wall: 18".

(10) Where the entrance to machine rooms and overhead machinery spaces is more than five feet above the adjacent floor or roof surface, and where entrance to secondary sheave levels is through openings in machine room floors and the difference in floor levels is more than five feet, access shall be provided by means of a metal ladder or stairway having an angle not exceeding 60° from the horizontal.

(a) Where the difference in level is over one foot and not over five feet and when the entrance door opens inward, ladders may be vertical, provided the ladder has hand grips at the top to extend above the door opening and is located in the center of the machine room door opening. The rungs on the ladder shall be located not less than six inches from the wall.

Where the difference in level is one foot or less, no ladder or stairs are required.

(b) Inclined ladders or stairways shall be fitted with a metal handrail above all outside stringers. Vertical ladders shall be fitted with hand grips at the top.

(c) When the entrance door opens outward and is more than three feet above the adjoining roof, a metal or masonry platform shall be provided not more than eight inches below the door sill.

17.02: continued

(d) The platform shall be not less than two feet wide and shall project not less than two feet beyond the lock jamb of the door.
(e) A guard rail shall be provided at the edges of this platform. This guard rail shall be not less than 42" high.

(11) Elevator machine rooms shall not be used as public thoroughfares and are restricted to licensed elevator mechanics, authorized personnel accompanied by a licensed mechanic, or other authorized personnel after the equipment has been made safe.

(12) All overhead machinery and sheaves shall be supported on steel beams. Controllers, motor generator sets and other auxiliary equipment may be mounted on the machine room or secondary level floor provided the floor is designed to support the imposed static load. Governors may be mounted on machine room or secondary level floors if the floor is designed to withstand the impact load resulting from the application of the car safety device. Supports for machinery and sheave beams shall be of sufficient strength to support the imposed loads and may be building walls or frames.

(13) Supporting beams if used shall be so supported and fastened in place as to effectively prevent same from becoming loose or displaced under the conditions imposed in service.

(14) Loads on overhead beams and their supports shall be computed as follows:
(a) The total load on overhead beams shall be assumed as equal to the weight of all apparatus resting on the beams plus twice the maximum load suspended from the beams
(b) The load resting on the beams shall include the complete weights of machine, sheaves, controllers, *etc.* The load suspended from the beams shall include the sum of the tensions of all ropes suspended from the beams.

(15) No elevator machinery, other than the deflector or secondary sheaves or signal devices, shall be fastened to the overhead supporting beams by means of a tension connection.

(16) Where winding drum machines are used, a permanent beam or bar shall be provided at the top of the counterweight guides and beneath the counterweight rope sheaves to prevent the counterweights from being drawn into the sheaves. It shall be of such strength that the ropes will be pulled out of the sockets before there is failure of the beam. The bar or beam shall be located in line with the center of mass of the counterweight, or if more than one stop is used, they shall be located symmetrically with respect to the counterweight.

(17) The required factor of safety for all steel overhead beams and their supports, based upon both the average ultimate strength of the material and the loads, shall be not less than five.

(18) The allowable deflections of overhead beams and their supports shall be in accordance with the following:
(a) For overhead machine beams of all A.C. installations, and for D.C. installations where the car speed is over 150 f.p.m., the deflection under static load shall not exceed 1/2000 of the span.
(b) For overhead machine beams of D.C. installation, where the car speed is 150 f.p.m. or less, the deflection under static load shall not exceed 1/1666 of the span.
(c) For all overhead sheave beams the deflection under static load shall not exceed 1/1333 of the span.
(d) For overhead beams supporting the machine beams, the deflection under static load shall not exceed 1/1666 of the span.

(19) Heating of Machinery Spaces and Hoistways.
(a) Any source of heat may be used which does not contaminate the air in the above-mentioned spaces, and which does not conflict with any existing health, fire or building ordinance.
(b) Temperature. Any system of heating shall have a capacity to insure a continuous uniform temperature in machinery spaces and hoistways of not less than 50°F and higher as required by the elevator manufacturer's specifications.

17.02: continued

(c) Machine rooms shall be provided with natural or other means of ventilation to avoid overheating of the electrical equipment and to insure safe operation of the elevator, with the temperature not to exceed 90°F.

(20) The following applies to all existing elevator machine rooms:

(a) All materials not directly related to the elevator equipment shall be prohibited from storage in any elevator machine room or machinery space.

(b) Elevator related material stored in machine rooms shall be stored in non-combustible containers.

(c) All flammable/combustible liquids shall be kept in approved containers and secured in approved flammable liquids locker.

(d) All machine rooms shall contain a fire extinguisher approved by 527 CMR: *The Massachusetts Fire Prevention Regulations*.

(e) The machine room door fire rating, penetrations in the fire rated assembly of the machine room and other building conditions that would prevent the spread of fire and/or smoke from the machine room shall conform to the requirements of 780 CMR: *The Massachusetts State Building Code*.

(f) If an existing electric, drum or hydraulic elevator machine room hoistway or pit contains sprinklers, they shall be removed as follows:

1. Water supply piping for all the sprinklers shall be cut off at the wall outside the machine room or hoistway and the piping shall be capped. All sprinkler piping within the hoistway or machine room shall be removed.
2. Automatic main line power disconnecting devices shall be disabled or removed.
3. The removal of sprinkler piping and disabling or removal of automatic main line power disconnecting devices shall require a permit to be filed with the Commonwealth of Massachusetts, Department of Public Safety, Elevator Division.

Note: The above shall be in compliance with the M.G.L. c. 148, § 27A.

17.03: Venting of Hoistways

(1) Required Venting. Hoistways of all elevators regardless of height shall be provided with means for venting smoke and hot gases to the outer air in case of fire.

(2) Location of Vents. Vents shall be located:

(a) In the side of the hoistway enclosure not more than two feet directly below the top of the hoistway, opening either directly to the outer air or through non combustible ducts of two-hour fire-rated construction to the outer air; or,

(b) In the wall or roof of the penthouse or overhead machinery space above the roof, provided that openings of at least equivalent area are provided in the floor or floors at the top of the hoistway.

(c) When elevator hoistways are vented to the atmosphere below the machine room floor, the machine room must also be vented to the atmosphere. That ventilation shall be a minimum 1% of the area of the machine room. but not less than one square foot.

(d) Where the roof of a building has a fire-resistive rating in whole or in part of less than two hours, the hoistway may be covered at or below the roof line with a two-hour fire-rated cap, provided a two-hour vent extends directly vertically upward from hoistway through roof and at least three feet beyond the roof surface. In all cases, bottom of vent opening shall be at least three feet above the roof. In sloping roof, the three-foot distance above the roof line shall be measured from the highest point where the vent emerges through the roof.

(e) Where the entire roof of a building has a fire-resistive rating of two hours or more, the hoistway may be capped with two-hour fire-rated construction. Hoistway ventilation shall be brought directly through the roof to a height of three feet above the roof, that portion below the roof must be of two-hour fire-rated construction.

(f) A horizontal or inclined duct of two hour fire rated material may be used when powered by a fan connected to the emergency generator and activated by smoke detectors.

(3) Area of Vents. The area of the vents shall be not less than 3½% of the area of the hoistway or less than three square feet for each elevator car, whichever is greater. Of the required vent area, not less than ⅓ shall be of the permanently open type.

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EXCEPTIONS: Where mechanical ventilation, moving the same volume or more of air as the required vent, is provided in the overhead elevator machine room (*see* 524 CMR 17.02(8)), the required vent area may be reduced subject to the following:

(a) The building is not a hotel, apartment house, hospital, or similar building with overnight sleeping quarters;

(b) The machine room is so located that it has no outside exposure;

(c) The hoistway does not extend to the top story of the building;

(d) The machine room exhaust fan is automatically reactivated by thermostatic means.

(e) Normally power closed dampers may be installed and actuated to the open position by a thermostat, fire alarm initiating device, or a power failure.

(4) Closed Vents. Closed portions of the required vent area shall consist of windows, skylights, or duct openings glazed with plain glass not more than ⅛" thick. Power closed ventilation may be used in the hoistway or machine room provided that it is opened under each one of the following circumstances:

(a) by an approved automatic thermostat designed to open at a temperature of not more than 90°F.

(b) by a building fire alarm system.

(c) in the event of a power failure.

(5) Skylight Guards. A guard, securely anchored to the supporting structure, consisting of a wire-mesh screen of at least #13 steel wire gauge with openings which will reject a ball one inch in diameter, or an expanded metal screen of equivalent strength and open area, shall be installed above every elevator skylight. A similar screen of at least #18 steel wire gauge, or of expanded metal of equivalent strength and open area, shall be installed below every elevator skylight.

17.04: Clearance and Pits

(1) Horizontal.

(a) The clearance between a hoistway enclosure and a loading side of the car platform opposite a car opening shall not be more than the following:

1. Seven inches where pass type vertical biparting counterbalanced doors are installed wholly within the hoistway.
2. Five inches for all others.

(b) The clearance between the sill of the car and the threshold of the landing shall be not less than ¾ inch nor more than 1½ inches.

(c) There shall be a clearance of not less than ¾ inch between cars and the hoistway enclosures and a clearance of not less than one inch between cars and their counterweights.

(d) There shall be a clearance between elevator counterweights and the hoistways of not less than ¾ inch.

(e) If two or more cars are operated in adjacent hoistways, the clearance between cars shall be not less than two inches.

(f) All recesses or offsets in hoistways which are opposite a car opening shall be protected by substantial curtain walls, grating or vertical bars of the fixed type. They shall be firmly secured set on a flush line with the general surface of the hoistway. The distance between the vertical members shall not exceed four inches.

(g) Sides not used for loading and unloading recesses other than for windows or recesses necessary for elevator equipment shall not be permitted. Beams, floor slabs or building equipment construction shall not project more than two inches inside the general line of the hoistway unless the top surface of the projection is beveled at an angle of not less than 75° with the horizontal. Where setbacks occur in the enclosure wall, the top of the setback shall be beveled at an angle of not less than 75° from the horizontal. The maximum clearance between the car and the hoistway shall not exceed four inches other than space necessary for elevator equipment. Separator beams between elevators are not required to have bevels

EXCEPTION: The provisions of 524 CMR 17.04(1) shall not apply to existing hoistway projections in elevator installations made prior to March 9, 1950.

17.04: continued

(2) Vertical Bottom Clearances.

(a) A pit shall be provided at the bottom of every power elevator hoistway. The pit shall be not more than the sufficient depth necessary to contain the buffers, unless the elevator does not serve the lowest floor. The pit shall be of sufficient depth to contain the buffers, compensating ropes sheaves (if any) and any other equipment necessary for the safe and satisfactory operation of the elevator and to provide the following minimum vertical clearance between the car the counterweight and their buffers when the car is at the bottom and top landing respectively:

Not less than six inches where oil buffers are used or where spring buffers are used with "generator field control".

Not less than 12 inches where spring buffers are used with "Rheostatic control" for contract speeds of 100 f.p.m. or less.

Not less than 18 inches where spring buffers are used with "Rheostatic control" for car speeds of from 101 to 200 f.p.m.

(b) The floor of the pit shall be of concrete and approximately level. Where structural conditions make it essential, trenches or depressions may be provided for the installation of buffers and compensation sheaves located in the pit.

(c) The clear vertical distance between the underside of the car platform or between the underside of any equipment attached thereto, exclusive of the car frame channels, car safety blocks, guide shoes and any aprons or guard attached to the car sill, and the pit floor when the car rests on the fully compressed buffer shall be not less than two feet. In measuring this clearance the depth of any trenches or depressions in the pit floor shall not be included.

(3) Vertical -- Top Clearances. The top clearances for power passenger and freight elevators shall be:

(a) Car Clearance. When the car is at its top landing, the clear distance between the top of the crosshead of the car and the corresponding point of any obstruction or equipment in the hoistway vertically above it shall be not less than the sum of the following four items:

1. The clearance between the counterweight buffer and its striker block.
2. The stroke of the counterweight buffer used.
3. Two feet.
4. ½ the distance required to stop the car from 115% of contract speed with a retardation of 32.2 feet per second. This item may be omitted if provision is made to eliminate the jump of the car at counterweight buffer engagement

When any equipment on the car projects more than two feet above the car crosshead, the minimum overhead car clearances required shall be increased by the amount by which this projection exceeds two feet.

(b) Counterweight Clearance. When the car floor is level with the bottom landing, the clear distance between the top of the counterweight assembly and the corresponding point of any obstruction or equipment in the hoistway vertically above it shall be not less than the sum of the following items:

1. The clearance between the top of the car buffer, and its striker block.
2. The stroke of the car buffer used
3. Six inches where oil buffers are used, and 12 inches where spring buffers are used.
4. ½ the distance required to stop the car from 115% of contract speed with a retardation of 32.2 feet per second. This item may be omitted if provision is made to eliminate the jump of the counterweight at car-buffer engagements.
5. Where the car precompresses the buffer, the total stroke of the buffer minus the precompression shall be added in lieu of 524 CMR 17.04(3)(b)1. and 2.

(4) Access to Pits. Safe and convenient access shall be provided to all pits, and shall conform to the following:

(a) Access may be by means of the lowest hoistway door or by means of a separate pit access door.

(b) Access to pits extending more than four feet below the sill of the pit access door shall be provided by means of fixed vertical ladders of non combustible material, located within reach of the access door. The ladder shall extend not less than 30 inches above the sill of the access door, or hand grips shall be provided to the same height.

17.04: continued

(c) Pits shall be accessible only to authorized persons.

Where a separate pit access door is provided, it shall be self-closing and provided with a spring type lock arranged to permit the door to be opened from inside the pit without a key. Such doors shall be kept locked and electrically contacted when a hazard from moving equipment exists immediately upon entering the pit. The pit entrance door of a walk-in pit shall be identified with a sign which will read "DANGER ELEVATOR PIT". The letter size shall be a minimum of ¾" and shall contrast with the background.

(5) Illumination of Pits. A permanent lighting fixture shall be provided in all pits, which shall provide an illumination of not less than five foot candles at the pit floor. A light switch shall be provided and shall be so located as to be accessible from the pit access door or adjacent to the pit access ladder and the bulb shall be guarded.

17.05: Hoistway Guards

(1) Counterweight Runways. Counterweight runways of power elevators located in the elevator hoistway shall be enclosed from a point 12" above the floor of the pit to a point at least seven feet above the floor of its own pit and any other pit adjacent to such counterweight runway, other than where compensating chains or ropes which practically compensate for the weight of the hoisting ropes are attached to the counterweight. In this case, counterweight enclosures shall not be required on the side facing the elevator.

(2) Adjoining Hoistways. Where two or more elevators are located in the same hoistway and where the pit floors of adjacent elevators are located at different levels exceeding two feet, a hoistway guard extending from the floor of each higher pit to a height of not less than seven feet above the floor of such higher pit shall be provided to separate all hoistways adjoining each other. Where the difference in level is two feet or less, a metal railing 36" high may be installed in lieu of the guard.

(3) Landing Sill Guards.

(a) All elevator landing sills shall be guarded on the underside with smooth metal guard plates of not less than No. 14 U. S. Gauge (0.078125 in.) extending the full width of the car entrance, securely fastened in place as follows:

(b) Where a car leveling or inching device is provided and the hoistway edge of the sill is either flush with or projects into the hoistway, the guard shall have a straight vertical face extending below the sill not less than the depth of the leveling or inching zone plus three inches, provided that where the sill projects inward from the general line of the hoistway the bottom of the guard shall also be beveled at an angle of not less than 75° with the horizontal or the guard shall be extended from the hoistway edge of the landing sill to the soffit of the hoistway landing door next below.

(c) Where no car leveling or inching device is provided and the sill projects inward from the general line of the hoistway, the guard shall either be beveled at an angle of not less than 75° with the horizontal or it may have a straight vertical face extending from the hoistway edge of the landing sill to the soffit of the hoistway landing door next below.

(d) Where vertical biparting-parting counterbalanced landing doors are provided, the landing sill guards may be omitted provided that, where the trucking sills of such doors project inward from the hoistway face of the door, the lower edge of the trucking sill is equipped with a guard having an angle of not less than 60° with the horizontal.

(4) Soffits of Other Projections. The soffits of all other projections other than door interlocks or contacts, door operating devices, and indicator and signal devices which extend into the hoistway and which are opposite a car entrance, shall be guarded on the underside with smooth metal guard plates of not less than No. 14 U. S. Gauge (0.078125 in.) having an angle of not less than 75° with the horizontal.

(5) Hoistway Guard. Hoistway guards shall be building walls, solid or latticed partitions, grille work, metal gratings or expanded metal with smooth edges, as follows:

(a) Where wire grille work is used, the wire shall be not less than No. 13 Steel Wire Gauge (0.0915 in. diameter) and the mesh shall be not more than two inches.

17.05: continued

(b) Where expanded metal is used, its thickness shall be not less than No.13 U. S. Gauge (0.094 in.).
(c) The spacing between bars shall be not more than two inches, other than where used as "furring" material, in which case the spacing between bars or slats shall be not more than four inches.
(d) Where sheet metal is used it shall be not less than No. 14 U. S. Gauge.
(e) Where building walls are used, they shall be of not less than two hour fire-resistive construction

(6) Rope Enclosures. Where ropes pass through floors on the outside of the hoistway, they shall be enclosed completely from floor to ceiling at all floors with solid enclosure to not less than two hour fire resistive construction.

(7) Hoistway not to Lowest Floor. If a hoistway does not extend to the lowest floor of a building, and the space under the bottom of the hoistway is used for any purpose, the following conditions shall exist:
(a) Buffers shall be provided.
(b) The cars and counterweights shall be provided with safety devices.
(c) There shall be a structure under the hoistway sufficiently strong to withstand the impact of the car with contract load or the impact to the counterweight when either is descending at contract speed or at governor-tripping speed where a governor-operated safety is used.

17.06: Pipes and Wiring

(1) No pipes, ducts, vessels, electrical conduits or cables shall be located within an elevator hoistway or its pit other than those used to furnish or control power, light, heat, communications or signals for the elevator or hoistway, or for low voltage fire detection systems for the hoistway. EXCEPTION: Existing non-elevator related pipes and wiring installed prior to March 9, 1950 which are still in use and which are located within elevator machine rooms or hoistways, may remain. Sprinklers shall not be installed in elevator machine rooms, hoistways, or pits per 780 CMR: *the Massachusetts State Building Code*.

(2) The fixed electrical conductors installed in elevator or counterweight hoistway, machine room and pit shall be encased in rigid metal conduits or electrical metallic tubing. Flexible conduits or armored cables may be used between fixed conductors and limit switches, interlocks, push buttons and similar devices.

(3) The traveling electrical conductors connecting the car to the fixed wiring in the hoistway shall have a flame retardant and moisture resistant outer cover.

(4) Pipes, conduits and armored cables shall be securely fastened to the hoistway construction.

(5) Pressure in steam pipes used to heat the elevator machine rooms or hoistway shall not exceed 15 lbs. above atmospheric pressure.

(6) No pipes, ducts or vessels conveying gases or liquids shall be discharged or vented into the hoistway.

(7) No part of any electric circuit having a rated system or circuit voltage in excess of 300 volts shall be used either for any operating circuit or for any control circuit or any equipment which is located in the hoistway, on the car, on the landing doors, or at the landing openings. Circuits of rated system in excess of 300 volts may be used in machine rooms for the operation of motors and for generators, provided that wiring subject to such higher voltage is thoroughly insulated from all other wiring.

(8) All live parts of electrical apparatus in elevator hoistways shall be suitably enclosed to protect against accidental contact. Metal coverings shall be permanently grounded. All wiring for electricity shall be done in accordance with the best practice.

In case any question arises as to what is the best practice, work done according to the requirements of 527 CMR 12.00 (*Massachusetts Electrical Code*) shall be considered as so done.

17.07: Hoistway Doors: General

(1) All landing openings in power-elevator fire-resistive hoistways shall be provided with doors, panels and frames of not less than 1½ hour fire-resistive construction.

(2) All landing opening doors shall provide a clear passage of not less than 6½ feet in height.

(3) (a) All hoistway doors shall be provided with interlocks.

(b) When landing doors at terminal floors or any other floors are locked preventing access to an exit stairway the elevator shall be equipped with a telephone to the connected to an outside location that is answered on a 24-hour basis.

(4) No hardware, other than as required for interlocking, indicators, door operators and signal devices, shall extend into the hoistway beyond the line of any landing threshold.

(5) There shall be installed an emergency release system which permits the operation of the car by the operating devices when the hoistway doors are open. It shall be located only at the top and lowest landing if the latter is the normal point of access to the pit. A continuous-pressure key-operated switch, made operable only by the control switch described in 524 CMR 17.35(11)(b) shall be located within easy reach of the landing door. This key shall cut out all corridor operating devices and shall permit operation of the car only when all landing doors except the top and lowest landing doors are closed and locked, and shall permit operation of the car only in a zone extending below the top landing for a distance not exceeding the height of the car cab enclosure. This key shall not be master-keyed and shall not be operable by any key which will operate locks or devices used for other purposes in the building. The key shall be removable only when the switch is in the "Off" position and shall be available only to licensed elevator mechanics and elevator inspectors.

(a) Operation Requirements of Hoistway Access Switches. The operation of the switch at either access landing shall permit, and may initiate and maintain movement of the car with the hoistway door at this landing unlocked or not in the closed position, and with the car door or gate not in the closed position, subject to the following:

NON-TEXT PAGE

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1. The operation of the switch shall not render ineffective the door interlock or electric contact at any other landing.
2. The car cannot be operated at a speed greater than 150 feet per minute.
3. For automatic and continuous pressure operation elevators, provided:
   a. Landing operating devices of continuous-pressure operation elevators, and car and landing operating devices of automatic operation elevators shall be first made inoperative by means other than the access switch.
   b. Power operation of the hoistway door and/or car door or gate is inoperative.
4. Automatic operation by a car-leveling device is inoperative.

(b) The top-of-car operating device (see 524 CMR 17.35(10)) is inoperative.

Where electrically operated switches, relays or contacts are used to render inoperative the hoistway door interlock or electric contact or the car door or gate contact, the control circuits shall be arranged to conform to the requirements of 524 CMR 17.10 and 17.14(8), and in addition to render the normal car and hall operation ineffective if any such switch, relay or contact fails to function in the intended manner.

EXCEPTION: Emergency release systems as described in 524 CMR 17.07 shall not be required on elevators installed prior to March 9, 1950. For elevators installed after March 9, 1950 but prior to December 10, 1971, a continuous pressure key-operated hoistway access switch shall be required at the top landing only.

(6) (a) No keys or devices shall be permitted which will unlock any landing door when the car is not within the landing zone.

EXCEPTION: If all the door panels and interlocks are replaced on an existing elevator, hoistway door unlocking devices for use only by Massachusetts licensed elevator mechanics and trained firefighters are required.

(b) On completion of the installation and safety testing of an elevator, the elevator contractor shall notify the local fire department to have an authorized representative available to witness a demonstration from the elevator manufacturer, or agent thereof, relative to the purpose, operation and use of the hoistway door unlocking device. The unlocking device for that manufacturers' door shall be secured at a location in the building that is readily accessible to the fire department.

(c) The opening and closing of car doors and landing doors shall be the sole responsibility of the local fire department during firefighting or extrication operations.

(7) Hoistway doors for passenger elevators shall be so arranged that it is not necessary to reach back of any panel, jamb, or sash to operate them.

(8) Hangers for power-operated hoistway doors shall be designed to withstand a downward thrust of five times the weight of the door and an upward thrust of four times the weight of the door.

(9) Means shall be provided to prevent hangers for all sliding hoistway doors from jumping the tracks. Stops shall be either provided to prevent the hanger carriage from leaving the ends of the track or suitable stops shall be provided on the door.

(10) Manually operated or self-closing hoistway doors of the sliding type for elevators with automatic or continuous-pressure operation shall be provided with either one or more vision panels, or a hall position indicator or a hall lantern. All swing-type hoistway doors shall be provided with vision panels. Vision panels may be provided for any type of hoistway door irrespective of the type of operation of the elevator. Where required or used, vision panels shall conform to the following requirements:

(a) The area of any single panel shall not be less than 25 square inches, and the total area of one or more panels in any hoistway door shall be not more than 80 square inches.

(b) Each clear panel opening shall reject a ball six inches in diameter.

(c) Panels shall be of clear wired glass.

17.07: continued

(d) The center of the vision panel for horizontal, slide and swing type doors shall be not less than 54" nor more than 66" above the elevator landing. For vertical biparting-parting counterbalanced doors, it shall be located to comply with the dimensions specified insofar as the conditions will permit.

(e) If used for power-operated hoistway doors, the wired-glass panel shall be substantially flush with the surface of the landing side of the door.

(11) Door counterweights shall run in metal guides in such a manner that they cannot become dislodged or shall be boxed in. The bottoms of the guides or boxes shall be constructed so as to retain the counterweight if the counterweight rope breaks.

(12) Power opened hoistway doors shall be equipped with interlocks, operating mechanisms and control systems which are arranged to prevent the opening of all doors in the hoistway other than the door or doors which are located as follows:

(a) At that landing where the car is at rest.

(b) At that landing when the car is coasting through the landing zone with its operating device in the stop position.

(c) At that landing where the car is being moved by the car leveling devices within the landing zone.

(13) Hoistway doors shall be arranged so that they may be opened by hand from the hoistway side unless locked "out of service". Neither the door at the main floor landing or at the top or bottom terminal landing shall be locked "out of service" when the elevator is in service.

(14) Where an elevator is installed in a single blind hoistway, there shall be installed in the blind portion of the hoistway an emergency door at every third floor, which fully protects the opening, but not more than 42 feet apart, conforming to the following:

(a) The clear opening shall be at least two feet four inches wide and six feet six inches high

(b) It shall be easily accessible and free from fixed obstructions.

(c) It shall be either of the horizontally sliding type or swinging single section type, irrespective of the type of door installed at other landings.

(d) It shall be self-closing and self-locking with the firefighter's key lock (524 CMR 17.39(2)), and shall be marked in letters not less than two inches high "DANGER - ELEVATOR HOISTWAY."

(e) It shall be provided with an electric contact conforming to 524 CMR.

(f) It shall be unlocked from the landing side only through the use of the firefighter's key (524 CMR 17.39).

(g) The key lock shall be so designed that the key shall be removable only in the locked position.

(15) All landing door frames must be thoroughly grouted to obtain the proper fire rating.

(16) The hoistway side of each landing entrance shall have a minimum four inch high numeral identifying the floor level. Said numeral shall be a decal or adhesive backed material.

17.08: Landing Doors for Power Passenger Elevators

(1) Automatic Fire Door. No automatic fire door shall lock any landing opening in the hoistway enclosure of any passenger elevator or lock any exit leading from any hoistway landing door to the outside of the building.

(2) Landing Openings. Landing openings in passenger elevator hoistway enclosures shall be protected by horizontal sliding doors, combination sliding and swinging doors, or by swinging doors.

(3) Certain Measurements. The distance between the hoistway side of the landing door opposite the car opening and the hoistway edge of the landing threshold on elevators which can be operated only from the car shall be not more than four inches. For automatic-operation elevators, the distance between the hoistway side of the hoistway door opposite the car opening and the hoistway edge of the landing threshold, shall be not more than the following:

17.08: continued

(a) For swinging doors, ¾ inch.
(b) For sliding doors, 2¼ inches.

In no case shall the hoistway face of the hoistway door project into the hoistway beyond the edge of the landing sill. When the hoistway door consists of two or more sections, the distance specified in 524 CMR 17.08(3)(b) shall be measured from the section of the door nearest to the edge of the hoistway landing sill. Where distances are greater that specified above, space guards or baffles may be installed in accordance with 524 CMR 17.14(8).

(4) Confined Space Egress. No elevator landing shall comprise of, or lead to, a confined locked space of over four inches without either:

(a) the installation in the space of a means to recall the elevator; or
(b) provision of a means to keep the elevator at the landing with the car and landing doors in the open position until egress from the confined locked space is achieved.

17.09: Landing Doors for Power Freight Elevators

(1) Landing Opening. Each landing opening in a freight elevator hoistway shall be equipped with a door set within four inches of the face of the landing threshold.

Bi-parting counterbalanced doors shall have the lower edge of the upper door section provided with a fire-resistive, non-shearing, non-crushing member to provide a spacing of not less than ¾" between the rigid members of the door sections when closed.

Any rigid astragal, locking or latching device overlapping the meeting edge is prohibited.

(2) Types of Landing Doors. Landing doors may be horizontally or vertically sliding, counterbalanced vertically sliding, combination sliding and swinging or swinging type.

(3) Power-operated Vertical Bi-parting Counterbalanced Doors. If vertical bi-parting counterbalanced doors are power operated, the landing door shall not start to close until after the car gate is within 12" of full closure, and, on opening, the car gate shall not start to open until the landing door is within 12" of its full open position.

(4) Pull Straps on Manually-operated Vertically-sliding Bi-parting Counterbalanced Hoistway Doors. Manually-operated vertically sliding bi-parting counter-balanced hoistway doors of elevators which can be operated from the landings shall be provided with pull straps on the inside and the outside of the door and shall be located at the lower edge of the upper door section. The length of the straps shall conform to the following:

(a) The bottom of the straps shall be not more than six feet above the floor when the door is in the fully-opened position.
(b) The length of the straps shall not be extended by means of ropes or other materials.

Pull straps where provided on manually operated vertically sliding bi-parting doors of elevators which can be operated from the car shall only be mounted on the inside of the door and shall also conform to the requirements of 524 CMR 17.09(4)(a) and (b).

(5) Counterbalanced Doors. Single or multisection vertically-sliding doors and vertically-sliding bi-parting counterbalanced doors shall be so counterbalanced that they will not open by gravity. Fastenings shall be provided to prevent the detachment or dislodgment of the counterbalancing weights of doors. Suspension means and their connections for vertically-sliding counter weighted doors shall have a safety factor of not less than five.

17.10: Hoistway Door Interlocks

(1) Interlocks shall be arranged to prevent the operation of the elevator machine by the operating devices in a direction to move the car away from the landing unless all hoistway doors are both closed and locked in the closed position; and the interlock shall not be required to prevent the movement of the car by inching or leveling devices with the hoistway door open.

(2) The interlock shall prevent the opening of the hoistway door from the landing side unless the car either is at rest within the landing zone or coasting through the landing zone with its operating devices in the stop position.

17.10: continued

(3) For automatic operation or continuous-pressure operation, the hoistway door shall not be considered in the closed position until the door is within ⅜ inch of the nearest face of the door jamb; or, in the case of horizontally sliding bi-parting doors, ⅜ inch of contact with each other.

(4) For power elevators where the hoistway door is not equipped with a door closer, the door shall be considered in the closed position only when the door is within ⅜ inch of the nearest face of the door jamb; or, in the case of bi-parting doors, either ⅜ inch of contact with each other when horizontal sliding doors are used; or two inches of contact with each other when vertical sliding doors are used, and the upper sections of the vertical sliding bi-parting doors are equipped with astragals which close the opening between the door section when the interlock circuit is closed.

(5) Where the hoistway door of an elevator requiring the presence of an operator in the car is equipped with a door closer, the door shall be considered to be in the closed position and the car may be started when the door is within four inches of the nearest face of the jamb; or, in the case of a bi-parting door, when the sections are within four inches of contact of each other, if at this position and any other up to the closed position, the door cannot be opened from the landing side more than four inches from the jamb, or the sections more than four inches from each other in the case of a bi-parting door.

(6) All interlocks for all hoistway doors shall be so designed that the door is locked in the closed position (as defined in 524 CMR 17.10(3), (4) and (5) immediately preceding) before the car can be operated by the operating devices. Devices employing locks and contacts of a type in which the interlocking contact is made when the door is closed and the locking of the door takes place subsequently, are not interlocks and are not permitted where interlocks are required under 524 CMR 17.00.

(7) Interlock contacts shall open the operating circuit and shall be positively opened by the locking member. They shall be maintained in the open position by the action of gravity or a restrained compression spring or both, or by means of a positive linkage. The interlock shall hold the door in the locked position by means of gravity or a restrained spring or by both.

(8) Each type and make of door interlock shall be tested and approved on the basis of test conforming to the best engineering practice made by or under the supervision of a competent designated laboratory. Minor changes in design may be made without re-testing, subject to the approval of either the enforcing authority or the testing laboratory. In case any question arises as to what is the best engineering practice, test conforming to the American National Standard Safety Requirements for Elevators, Dumbwaiters, Escalators, and Moving Walks, ASME A17.1 shall be considered as conforming thereto.

(9) Approved interlocks shall be suitably and plainly marked for identification, the marking to be permanent and so placed as to be readily visible when the interlock is mounted in position. Only one identification marking is required, which shall include the following.

(a) Manufacturer's name or trademark;
(b) Type of style letter or number;
(c) Rated voltage.

(10) The car cam used to actuate any particular interlock shall exert a force at least double the average force, and shall have a movement at least ½" in excess of the average movement, as given in the test certificate for that interlock.

(11) On all vertical BIPARTING-parting doors, means shall be provided to prevent the closing of the interlock circuit by hand when the doors are in the open position.

(12) No electrically released, gravity or spring applied rope gripper or rope-lock shall be used as a component device in any interlock system.

(13) Where required, interlocks, or combination mechanical locks and electric contacts, or electric contacts, and the wiring, shall be so located that they are not accessible from the landing side when the hoistway doors are closed.

17.11: Landings for Power Passenger and Freight Elevators

(1) The landing threshold shall be constructed and maintained so that persons will not readily slip thereon.

(2) If there is a railroad track upon any elevator landing, the tops of the rails shall be flush with the floor for a distance of six feet from the threshold.

17.12: Power Operation, Power Opening and Power Closing of Hoistway Doors and Car Doors

(1) Types of Doors and Gates Permitted. Where both a hoistway door and a car door or gate are opened and/or closed by power, the hoistway door and the car door or gate shall either:

(a) Both be of the horizontal sliding type, or

(b) Both be of the vertically sliding type.

(2) Power Opening of Car Doors or Gates. Power opening of a car door or gate shall be subject to the following:

(a) Power opening shall occur only when the car is stopping, or is leveling, or is at rest.

(b) Collapsible type car gates shall not be power opened to a distance exceeding _ the clear gate opening and in no case more than ten inches.

(3) Power Opening of Hoistway Doors. Power opening of a hoistway door shall conform to the following:

(a) Power opening shall occur only at that landing where the car is stopping, or is leveling, or is at rest, and shall start only when the car is within the landing zone or is within the leveling zone where an automatic car leveling device is provided.

(b) Power opening may be initiated automatically through control circuits provided that the car is being automatically stopped or leveled and provided that, when stopping under normal operating conditions, the car shall be at rest or substantially level with the landings before the hoistway door is in the fully open position.

(c) Sequence opening of a vertically sliding hoistway door and adjacent car door or gate shall be provided.

(4) Power Closing or Automatic Self-Closing of Car Doors or Gates Where Used with Manually Operated or Self-Closing Hoistway Doors. Where a car gate of an automatic or continuous pressure operation passenger elevator is closed by power, or is of the automatically released self-closing type, and faces a manually operated or self-closing hoistway door, the closing of the car door or gate shall not be initiated unless the hoistway door is in the closed position; and the closing mechanism shall be so designed that the force necessary to prevent closing of a horizontally sliding car door or gate from rest shall not be more than 30 lbs.
EXCEPTION: Where a car door or gate is closed by power through continuous pressure of a door-closing switch, or the car operating device, and where the release of the closing switch or operating device will cause the car door or gate to stop or to stop and reopen.

(5) Power Closing of Hoistway Doors and Car Doors or Gates by Continuous Pressure Means. Horizontally or vertically sliding hoistway doors with manually closed or power operated or power closed car doors or gates may be closed by continuous pressure means, subject to the following:

(a) The release of the closing means shall cause the hoistway door and a power-operated or power-closed car door or gate to stop or to stop and reopen.

(b) The operation of the closing means at any landing shall not close the hoistway door at any other landing nor the car door or gate when the elevator car is at any other landing.

(c) For elevators having more than one hoistway opening at any landing level, a separate closing means shall be provided in the car for each car door or gate and its adjacent hoistway door. Any closing means at a landing shall close only that hoistway door and the car door or gate at the side where such means is located.

EXCEPTION: A separate closing means need not be furnished for a horizontally sliding hoistway door and adjacent car door or gate which conform to the requirements of 524 CMR 17.12(8).

(d) Sequence closing of a vertically sliding hoistway door and adjacent car door or gate shall be provided where required by 524 CMR 17.12(10).

17.12: continued

(6) Power Closing of Horizontally Sliding Hoistway Doors and Horizontally Sliding Car Gates by Momentary Pressure or by Automatic Means. Power closing by momentary pressure or by automatic means shall be permitted only for automatic or continuous pressure elevators. The closing of the doors shall be subject to the following:

(a) It shall conform to the requirements of 524 CMR 17.12(8).

(b) A momentary pressure switch shall be provided in the car, the operation of which shall cause the doors to stop or to stop and reopen.

(7) Power Closing of Vertically Sliding Hoistway Doors and Vertically- Sliding Car Doors or Gates by Momentary Pressure or by Automatic Means. Power closing by momentary pressure or by automatic means shall be permitted only for automatic or continuous pressure elevators. Vertically sliding hoistway doors used with vertically power-operated car doors or gates may be closed by momentary pressure or automatic means, subject to the following:

(a) A warning bell or other audible signal shall be provided on the car which shall start to sound at least five seconds prior to the time the car door or gate starts to close and shall continue to sound until the hoistway door is substantially closed.

EXCEPTION: The five-second time interval may be omitted when the doors are closed by a closing switch in the car.

(b) Sequence closing of the hoistway door and adjacent car door or gate shall be provided and shall conform to the requirements of 524 CMR 17.12(10).

(c) The car door or gate shall be equipped with a reopening device conforming with the requirements of 524 CMR 17.12(9).

(d) A momentary-pressure type switch shall be provided in the car and at each landing, which when operated shall cause the car door or gate and the hoistway door at the landing to stop or to stop and reopen.

(e) The average closing speed shall not exceed one foot per second for a vertically sliding counter weighted hoistway door or for each panel or section of a bi-parting counterbalanced hoistway door or car gate, and shall not exceed two feet per second for a vertically sliding counter weighted car door or gate.

(8) Kinetic Energy and Force Limitations for Power Door Operators Used with Horizontally Sliding Hoistway Doors and Horizontally Sliding Car Doors or Gates. Where a power operated horizontally sliding hoistway door is closed by momentary pressure or by automatic means (see 524 CMR 17.12(6)) or is closed simultaneously with another door from one continuous pressure means (see 524 CMR 17.12(5)(c)), the closing mechanism shall be designed and installed to conform to the following requirements:

(a) The kinetic energy of the hoistway door and all parts rigidly connected thereto, computed for the average closing speed, shall not exceed seven foot pounds where a reopening device for the power-operated car door or gate conforming to the requirements of 524 CMR 17.12(9) is used, and shall not exceed two and one half foot pounds where such door reopening device is not used. Where the hoistway door and the car door or gate are closed in such a manner that stopping either one manually will stop both, the sum of the hoistway and the car door weights as well as all parts connected rigidly thereto shall be used to compute the kinetic energy. The average closing speed shall be determined by timing the closing door as follows:

1. With single-slide and two-speed doors, determine the time required for the door to travel from a leading edge of the point two inches away from the open jamb to a point six inches away from the opposite jamb.

2. With center-opening or two-speed center-opening doors, determine the time required for the leading edge of the door to travel from a point one inch away from the open jamb to a point one inch from the center meeting point of the doors.

(b) The force necessary to prevent closing of the hoistway door (or the car door or gate if power operated) from rest shall be not more than 30 lbs.

(9) Reopening Device for Power Operated Car Doors or Gates. Where required by 524 CMR 17.12(7)(c) or 17.12(8), a power operated car door or gate shall be provided with a reopening device which will function to stop and reopen a car door or gate and the adjacent hoistway door in the event that the car door or gate is obstructed while closing. For center opening doors the reopening device shall be so designed and installed that the obstruction of either door panel when closing will cause the reopening device to function.

17.12: continued

(10) Sequence Operation of Power Operated Hoistway Doors with Car Doors or Gates.

(a) Where Required. Sequence operation shall be provided under the following conditions: Sequence opening and closing shall be provided for power operated vertically sliding bi-parting counterbalanced or power operated vertically sliding hoistway doors which slide down to open where used on passenger elevators or on freight elevators permitted to carry employees. (*See* 524 CMR 17.15(4) in conjunction with power operated vertically sliding car door or gate).

EXCEPTION: Doors at openings used exclusively for freight.

(b) Operating Requirements. The sequence operation of a hoistway door and adjacent power operated vertically sliding car door or gate shall conform to the following:

1. In opening, the hoistway door shall be opened at least ⅔ its travel before the car door or gate can start to open.
2. In closing the car door or gate shall be at least ⅔ its travel before the hoistway door can start to close.

17.13: Car Construction

(1) Car suspension frames and platform frames of passenger and freight elevators, and platform stringers of freight elevators shall be constructed of steel meeting not less than the requirements of specification A7 of the ASTM.

(2) The stresses of rolled steel sections or annealed cast steel used in the construction of car frames and platforms based on the static load imposed on them, including the weight of the unloaded car and the maximum rated carrying capacity, shall not exceed the values given in 524 CMR 17.13: *Table 1* for passenger cars and in 524 CMR 17.13: *Table 2* for freight cars.

The stresses tabulated below are based on steels having an ultimate strength from 55,000 to 65,000 lbs. per sq. inch for rolled sections or cast steel and 46,000 to 56,000 lbs. per sq. inch for rivets. For steels of greater ultimate strength, the allowable stresses may be increased proportionately.

TABLE 1.
ALLOWABLE STRESSES FOR PASSENGER CAR-FRAME AND PLATFORM MEMBERS

Loading	Maximum Allowable Stress (lb.per.sq.in.)		Basis
Tension	10,000		Net area
Bending	10,000		Gross section
Shear on shop rivets	8,000		Net area
Bearing on shop rivets	16,000		Net area
Shear on bolts in clearance holes	7,000		Gross section
Bearing on bolts in clearance holes	14,000		Gross section
Bolts or threaded portions of rods in tension	6,000		Net area
Compression	11,700	59 L/R	Gross area

L = effective free length of member in inches R = least radius of gyration in inches

17.13: continued

TABLE 2.
ALLOWABLE STRESSES FOR FREIGHT CAR-FRAME AND PLATFORM MEMBERS

Loading	Maximum Allowable Stress (lb.per.sq.in.)		Basis
Tension	12,000		Net area
Bending of car frame member and platform framing at entrance	12,000		Gross section
Bending on platform stringers	15,000		Gross section
Shear on shop rivets	9,500		Net area
Bearing on shop rivets	19,000		Net area
Shear on bolts in clearance holes	8,000		Gross section
Bearing on bolts in clearance holes	16,000		Gross section
Bolts or threaded portions of rods in tension	8,000		Net area
Compression	14,000	59L/R	Gross section

L = effective free length of member in inches R = least radius of gyration in inches

(3) No cast iron shall be used in the construction of any member of the car frame or platform subject to tension or bending. Cast iron may be used for compensating cable anchorage's, releasing carriers and guideshoe stands.

(4) The deflection of crosshead and safety plank shall not exceed ⅛ inch in each ten feet of span under static conditions with contract load substantially uniformly distributed over the car platform.

(5) The slenderness ratio L/R for members not normally subject to compression shall not exceed 250; for members normally subject to compression this ratio shall not exceed 120. Loading resulting from buffer and safety operation shall not be considered normal loading.

(6) No glass shall be used in freight elevators except to cover certificates, lighting fixtures, vision panels and appliances necessary for the operation of the car.

(7) There shall be no obstructions or projections in the car floor.

(8) Where platform floors are constructed of wood or other combustible materials they shall be covered on the underside with sheet metal of not less than No. 27 U. S. Gauge thickness.

(9) Elevators provided with car leveling or inching devices shall have their platforms provided with a metal guard not less than No. 16 U. S. Gauge in thickness. This guard shall extend horizontally the full width of the car entrance and vertically below the car floor for not less than the depth of the leveling or inching zone plus three inches. The lower edge of the guard shall be beveled at an angle of not less than 70° with the horizontal.

(10) The requirements for loading classifications will be found in 524 CMR 33.00. Satisfaction as to compliance will be evidenced by the manufacturer's certificate.

(11) Welding of parts upon which safe operation of all equipment contained in 524 CMR depends shall be done by qualified welders; and all work upon completion shall be approved by the state elevator inspector before the elevator, escalator, dumbwaiter, *etc*., is placed in service. EXCEPTION: Tack welds not later incorporated into finished welds carrying calculated loads.

17.14: Car Enclosures

(1) General.

(a) Each power passenger or freight elevator car shall be fully enclosed on top and at all sides other than above the top of a power freight elevator car gate.

17.14: continued

(b) The car enclosure shall be secured to the car platform and sling in such a manner that it cannot work loose or become displaced in ordinary service.
(c) No part of a car enclosure shall deflect either so as to reduce the minimum clearances specified in 524 CMR 17.04 or more than one inch when subjected to any single horizontally applied force of 75 lbs.
(d) Means for ventilating shall be provided for all cars with solid enclosures and solid doors.
(e) No elevator shall have more than two entrances.
(f) No elevator shall have more than one compartment.
(g) Glass exceeding one square foot in area may be used in passenger elevator cars. Such glass shall:
1. Be laminated type glass and properly secured;
2. Meet all requirements, except as to transparency, as provided in Reference Codes ANSI Z97.1.
3. Be so mounted in the structure that the structure, including the glass in place, shall withstand without damage all required elevator tests.
4. The Z97.1 marking must be visible on each piece of glass after installation.

(2) Passenger or freight elevators may have two compartments, one of which is located immediately above the other provided the compartments elevator conforms to the following requirements:
(a) The elevator shall be used exclusively for passengers or exclusively for freight at any one time.
(b) Each compartment shall conform to the requirements of 524 CMR 17.00 except that a trap door in the floor of the upper compartment shall provide access to the top emergency exit for the lower compartment.
(c) Where either or both compartments are intended for passenger service, the minimum rated load for each compartment shall conform to the requirements of 524 CMR 17.15.

Where one compartment is intended for freight use, its minimum rated load shall conform to the requirements of 524 CMR 17.15 or shall be based on the freight loads to be handled, if greater than the minimum rated load requirement.

Where both compartments are used exclusively for freight, the minimum rated load of each compartment shall conform to the requirements of 524 CMR 17.15(3).

The rated load of the elevator shall be the sum of the rated loads of the individual compartments.
(d) An emergency stop switch conforming to the requirements of 524 CMR 17.35(6) and 17.35(7) shall be provided in each compartment, and these emergency stop switches shall be so connected that the car cannot run.
(e) All hoistway doors shall be closed and locked and the car doors for each compartment closed before the car can be operated.

(3) Power Passenger Elevator Car Enclosures, Sides and Top.
(a) Power passenger elevator car enclosures shall be either of metal, fire-retardant wood or equally fire-retardant materials provided that untreated wood or materials of equivalent combustible characteristics may be used if covered with sheet metal not less than No. 27 U. S. Gauge (0.0172 inch) or equivalent approved non-combustible material applied directly to all exterior surfaces of the enclosure. Finishes or linings of materials shall be permitted on the interior of the car provided that the requirements of ANSI/ASTM E84 and E648 are met.
(b) Openings in an enclosure, other than as required for entrance, vision panels, emergency exit, and ventilation, are prohibited.
(c) Ventilating openings less than seven feet above the car platform shall reject a ball two inches in diameter.
(d) No cast iron shall be used for car tops.
(e) Each passenger elevator car shall be of solid construction and designed and installed to be capable of sustaining a load of 300 lbs. on any square area two feet on a side and 100 lbs. applied at any point. Simultaneous application of these loads is not required.
(f) Smoking or carrying a lighted pipe, cigar, cigarette or other ignited smoke or flame carrying device in a passenger elevator shall be prohibited.

17.14: continued

(4) Power Passenger Elevator Car Emergency Exits.

(a) Each power passenger elevator car shall be provided with an emergency exit in the top of the car.

(b) In addition to the top emergency exit, whenever there is an adjacent elevator which is not more than two feet six inches away and without intervening hoistway partitions, counterweights, or similar obstruction, a side emergency exit may be provided in each car to permit emergency passage to each adjacent car.

(c) Top emergency exit panels shall:

1. Be not less than 400 sq. inches in area;
2. Measure not less than 16" on any one side.

The exit panel shall open outward and shall be so hinged or otherwise attached to the car top that the panel can be opened from the top of the car only. At no time shall the panel project beyond the line of the car top and shall be arranged so that no equipment mounted in or on the car top obstructs a clear passageway.

NOTE: The exit cover shall be kept in the closed position when not in use by a manually operated self-locking latch or bolt without the use of keys or tools. A handle shall be attached to the top of the exit frame for convenience in opening.

(d) Side emergency exit panels if installed shall:

1. Be of the hinged type, open only into the car;
2. Be not less than 16" in width;
3. Be extended from the floor or base molding up to the soffit molding and in no case less than five feet in height;
4. Be located where passage of persons is not obstructed by car frame members or by fixed hoistway equipment;
5. Be provided with a lock arranged so that the door may be opened from inside the car by means of a removable key and from the outside of the car by means of a non-removable handle.
6. Be provided with an electric contact which shall prevent the operation of the car by the operating devices when the panel is open on all automatic operation or continuous pressure operation elevators which may be operated from both the car and the landings.

(5) Power Passenger Elevator Car Doors.

(a) Cars of passenger elevators which can be operated from the car only and cars of automatic operation passenger elevators shall be provided with a horizontal door or horizontal gate at each entrance as follows:

1. Elevators shall be provided with horizontal car doors.
2. Elevators installed in hoistways where space conditions do not permit the installation of car doors may be provided with horizontal gates.

(b) The car door or gate when closed shall guard the full opening, and each door or gate shall be provided with a car door or gate electric contact. Car gates where permitted shall be of a design which will reject a ball three inches in diameter and shall be so guided top and bottom and of such strength as not to deflect past the line of the car sill when subjected to a force of 100 lbs. applied horizontally at any point. Collapsible type power gates shall not be power opened for a space in excess of nine inches from full closure.

(c) Car doors for passenger elevators, employing a type of operation which does not require the presence of an operator in the car and which are closed by power other than by hand, shall be driven by a mechanism so designed and set that the force necessary to prevent the closing of the door shall not exceed 30 lbs. The kinetic energy of the door plus all parts connected rigidly thereto, computed for the average closing speed, shall not exceed five foot-pounds. Where the same mechanism also closes the hoistway door, the total kinetic energy shall not exceed seven foot-pounds.

(d) All power operated car doors and gates shall be provided with a reopening device which will function to stop and reopen the car door or gate and the adjacent hoistway door, in the event that the car door or gate is obstructed while closing.

For center opening doors the reopening shall be so designed and installed that the obstruction of either door panel when closing will cause the reopening device to function.

(e) For automatic-operation passenger elevators having power closed or automatically released, self-closing car doors and manually closed or self-closing hoistway doors, the closing of the car door shall be delayed until the hoistway door is in the closed position.

17.14: continued

(f) Each car door for power passenger elevators may be provided with wired glass panels not to exceed a width of six inches and a height of 24".
(g) Sliding car doors shall operate in guides.
(h) Hangers for power-operated car doors shall be designed to withstand a downward thrust of five times, and an upward thrust of four times, the weight of the door.
(i) Each car door or gate shall be provided with a car door or gate electric contact.

(6) Power Freight Elevator Car Enclosure Sides and Top.
(a) Freight elevator car sides shall be of solid metal construction to a height of not less than six feet above the car platform. Above six feet, car sides other than that section opposite a counterweight shall be extended to the car top or crosshead and shall be of solid metal construction or of perforated metal or of wire mesh not less than No. 13 Steel Wire Gauge construction which will reject a ball 1½ inches in diameter. The section of the car enclosure opposite a counterweight shall be extended to the car top or crosshead and shall be of solid metal construction.
(b) Each freight elevator car top shall be of solid construction or open metal construction which will reject a ball 1½ inches in diameter, capable of sustaining a load of 300 lbs. on any square area of two feet on each side or 150 lbs. applied on any spot.
(c) Where sheet metal is used, it shall be equal in strength and stiffness to not less than No. 14 U. S. gauge sheet metal (0.078 inch).
(d) The front section of each freight elevator car top shall be hinged along a line not less than 18 inches from the front of the car or an emergency top exit shall be provided.

(7) Power Freight Elevator Car Doors or Gates.
(a) A car door or gate shall be provided at each entrance to power elevator freight cars.
(b) Each door or gate shall be provided with a car-door or gate electric contact, or with an interlock.
(c) Car gates for freight elevators when closed shall guard the full width of the opening, and they shall be not less than six feet high.
(d) If vertical bi-parting counterbalanced doors are power operated, the landing door shall not start to close until after the car gate is within twelve inches of full closure and, on opening, the car gate shall not start to open until the landing door is within twelve inches of its full open position.
(e) Collapsible gates when fully expanded shall reject a ball four and one half inches in diameter. Vertical lifting type car gates shall be of a design to reject a ball two inches in diameter.

A gate made in two or more parts which slide or telescope by each other in the same direction may be used if the gate is solid or if the openings are ⅜ inch square or smaller, and if the edges of adjacent parts of the gate always lap so that the danger of injury due to shear is eliminated.
(f) A weight used to close automatically or counterbalance a car door or gate shall run in metal guides from which it cannot become dislodged, or it shall be boxed in. The bottoms of the guides and boxes shall be so constructed as to retain the weight if the suspension member breaks.
(g) Sliding car doors for power freight elevators may be solid, may be provided with open grille or bars which shall reject a ball two inches in diameter, and may be provided with glass vision panels. Grilles or bars may extend the full height of the door panel.
(h) Sliding car doors or gates shall operate in guides.
(i) Hangers for power operated car doors shall be designed to withstand a downward thrust of five times, and an upward thrust of four times, the weight of the door.

(8) Location of Power Passenger and Power Freight Car Doors and Gates. Doors or gates for automatic or continuous-pressure operation elevators shall be so located that the distance from the face of the car door or gate to the face of the hoistway door shall be not more than the following:
(a) Where a swing-type hoistway door and a car gate are used -- four inches.
(b) Where a swinging-type hoistway door and a car door are used -- 5½ inches.

17.14: continued

(c) Where a sliding-type hoistway door and a car gate or door are used -- 5½ inches. The distance specified shall be measured as follows:

1. Where multi-section car and hoistway sliding doors are used, or where one of these doors is multi-section and the other is single-section, between the section of the two doors nearest to each other.

2. Where a multi-section car door and a swinging-type hoistway door are used, between the hoistway door and the section of the car door farthest from it.

3. Where a car gate is used, between the car gate and that section of the hoistway door nearest to the car gate.

Where existing distances are greater than specified by 524 CMR 17.14(8)(a), (b), or (c), a space guard or baffle of sheet metal shall be provided, attached to the hoistway door and/or car door. The guard is to be mounted by a tamper-proof means. The bottom of the guard shall be not less than one eighth inch, nor more than one half inch from the edge of the sill. The face of the guard shall run vertically not less than forty inches nor more than the height of the vision panel. The guard shall extend the full width of the door. The top of the guard shall be inclined toward the face of the door at an angle of not less than 60°. nor more than 75° from the horizontal. Exposed edges shall be beveled or rolled to eliminate sharp edges. The guard shall be sufficiently rigid or reinforced to prevent collapsing or denting. Mounting of the guard shall have proper clearances at the bottom and sides to permit easy closing of the door and shall not interfere with self-closing. On multi-section horizontally sliding doors only the leading or fast panel shall be fitted with the space guard. For swinging doors, the sides of the guard shall be closed.

(9) Power Elevator Car Door or Gate Electric Contact.

(a) The electric contact of the car door or gate, other than when the car is being operated by inching or leveling devices, shall prevent the operation of the car by the operating devices unless the door or gate is in the closed position.

(b) Horizontal sliding type doors or gates shall be considered in the closed position when the clear open space between the edge of a door or gate and the nearest face of the jamb does not exceed two inches. Where the car gate is the vertical slide type, the gate shall be considered in the closed position when the lower horizontal member of the gate is not more than three inches above the car sill. Where the car door or gate of an elevator that can be operated from the car only is provided with a door closer, the electric contact on the car door or gate may permit the starting of the car when the clear open space does not exceed four inches.

(c) The car door or gate contact shall be located so that it is not normally accessible to a person standing on the car platform.

(d) Car door or gate contacts shall open the operating circuit and shall be positively opened by a lever or other device attached to and operated by the door or gate. Contacts shall be maintained in the open position by gravity or a restrained spring or both, or by means of a positive linkage.

(e) Each type and make of contact shall be tested and approved on the basis of tests conforming to the best engineering practice made by or under the supervision of a competent designated laboratory. Minor changes in design may be made without retesting, subject to the approval of either the state elevator inspector or the testing laboratory. In case any question arises as to what is the best engineering practice, tests conforming to the American National Standard Safety Code for Elevators and Escalators (ASME A17.1) shall be considered as conforming thereto. Such contacts shall be suitably marked for identification.

(10) Platform Guards (Aprons). The entrance side of the platform of passenger and freight elevators equipped with leveling devices or truck-zoning devices shall be provided with smooth metal guard plates of not less than No. 16 US gauge steel, or material of equivalent strength and stiffness, adequately reinforced and braced to the car platform and conforming to the following:

(a) It shall extend not less than the full width of the widest hoistway door opening.

(b) It shall have a straight vertical face, extending below the floor surface of the platform, of not less than the depth of the leveling or truck zone, plus three inches.

(c) The lower portion of the guard (three inches) shall be bent back at an angle of not less than 60° nor more than 75° from the horizontal.

17.14: continued

(d) The guard plate shall be securely braced and fastened in place to withstand a constant force of not less than 150 lbs. applied at right angles to and at any position on its face without deflecting more than one quarter inch and without permanent deformation.

Where the car entrance on the truck loading side is provided with a collapsible type gate and the height of the hoistway door opening is greater than the distance from the car floor to the car top, a head guard extending the full width of the door opening shall be provided on the car to close the space between the car top and the soffit of the hoistway door opening when the car platform is level with the floor at the truck loading landing entrance.

17.15: Capacity and Loading

(1) Contract Load of Passenger Elevators

(a) For passenger elevators having platform areas not exceeding 50 square feet the contract load shall be not less than determined by the following formula:

$L = .667A^2 + 66.7A$

(b) For platform areas exceeding 50 square feet, the contract load shall be not less than: $L = .0467A^2 + 125A$ -- 1367 where L = contract load in pounds and A = net inside area of car in square feet.

(c) Table below shows the maximum net inside car areas for various contract loads:

TABLE 1.

Duty Load	Net Car Area	Duty Load	Net Car Area
500	7.0	4500	46.2
600	8.3	5000	50 .0
700	9.6	6000	57.7
1000	13.25	7000	65.3
1200	15.6	8000	72.9
1500	18.9	9000	80.5
1800	22.1	10000	88.0
2000	24.2	12000	103.0
2500	29.1	15000	125.1
3000	33.7	18000	146.9
3500	38.0	20000	161.2
4000	42.2	25000	196.5

(2) Capacity Plate and Signs for Passenger and Freight Elevators.

(a) In each passenger elevator car, a metal plate shall be provided which shall be fastened in a conspicuous place and shall bear the following information in not less than one-quarter inch letters or figures stamped in, etched, or raised on the surface of the plate:

CAPACITY (X) POUNDS

The contract load of the elevator in pounds shall be inserted in space (X) above.

(b) In each freight elevator car, the capacity shall be indicated in a conspicuous place in letters and figures not less than one inch high, by the word "CAPACITY", followed by figures giving the contract load in pounds.

(c) Upon the crosshead of each power elevator car, a metal plate shall be placed, bearing the following information:

The weight of the complete car, including the safeties;

The contract car speed in feet per minute at which the elevator is designed to travel;

The number, diameter in inches, and the rated ultimate strength in pounds of wire ropes.

(d) In every freight elevator a sign shall be posted with one of the following markings:

1. THIS ELEVATOR DESIGNED FOR GENERAL FREIGHT LOADING.
2. THIS ELEVATOR DESIGNED FOR MOTOR VEHICLE LOADING.
3. THIS ELEVATOR DESIGNED FOR INDUSTRIAL TRUCK LOADING.

Sign plates shall be of metal and letters shall be not less than ½" and stamped in, etched, or raised on the surface of the plate.

17.15: continued

(3) Minimum Load for Freight Elevators.

(a) Minimum Load Permitted.

The minimum load for freight elevators in pounds shall be based on the weight and class of the load to be handled, but shall in no case be less than the minimum specified in 524 CMR 17.15(3)(b) for each class of loading based on the inside net platform area.

(b) Classes of Loading.

Freight elevators shall be designed for one of the following classes of loading:

1. Class A -- General Freight Loading.

Where the load is distributed, the weight of any single piece of freight or of any single hand truck and its load is not more than ¼ the rated load of the elevator, and the load is handled on and off the car platform manually or by means of hand trucks.

For this class of loading, the rated load shall be based on not less than 50 lbs. per square foot of inside net platform area.

2. Class B -- Motor Vehicle Loading.

Where the elevator is used solely to carry automobile trucks or passenger automobiles up to the rated capacity of the elevator.

For this class of loading, the rated load shall be based on not less than 30 lbs. per square foot of inside net platform area.

3. Class C. -- Where an elevator carries or is loaded or unloaded by an industrial power truck other than a hand truck with a total weight of more than ¼ of the rated load of the elevator one of the three following types of Class loading shall apply.

Class C1 -- Industrial Truck Loading where truck is carried by the elevator.

Class C2 -- Industrial Truck Loading where truck is not carried by the elevator but used only for loading and unloading.

Class C3 -- Other loading with Heavy Concentrations where industrial truck is not used.

These loadings apply where the weight of the concentrated load including an industrial power or hand truck, if used, is more than ¼ the rated load and where the load to be carried does not exceed the rated load.

The following requirements shall apply to Class C1, Class C2 and Class C3 loadings:

The rated load of the elevator shall not be less than the load (including any truck) to be carried, and shall in no case be less than load based on 50 lbs. per square foot of inside net platform area.

The elevator shall be provided with a two-way automatic leveling device (see definition).

For Class C1 and Class C2 loadings, the following additional requirements shall apply:

For elevators with rated loads of 20,000 lbs. or less, the car platform shall be designed for a loaded truck of weight equal to the rated load or for the actual weight of the loaded truck to be used, whichever is greater. For elevators with rated loads exceeding 20,000 lbs., the car platform shall be designed for a loaded truck weighing 20,000 lbs., or for the actual weight of the loaded truck to be used, whichever is greater.

For Class C2 loading, the maximum load on the car platform during loading or unloading shall not exceed 150% of the rated load.

For any load in excess of rated load on elevators with a rated load of 20,000 lbs. or less, the driving machine motor, brake and traction relation shall be adequate to sustain and level the full 150% of rated load.

For any load in excess of the rated load on elevators with a rated load exceeding 20,000 lbs., the driving machine motor, brake and traction relation shall be adequate to sustain and level the rated load plus either 10,000 lbs. or the weight of the unloaded truck to be used, whichever is greater.

(4) Employees and Emergency Loading of Freight Elevators.

(a) Freight elevators may be used only by those persons required for handling freight.

(b) It shall be allowable at stated hours to carry employees, but not the general public, on a freight elevator, provided that the freight elevator conforms to the load-carrying requirements for passenger elevators (524 CMR 17.15(1)) and a special permit is granted by the enforcing authority subject to the following:

Car-switch operated elevators and continuous-pressure operated elevators shall be in charge of a licensed operator when used to carry employees at stated hours.

Stated hours shall be determined by the enforcing authority.

17.15: continued

(c) It shall be allowable to carry passengers on a freight elevator under emergency conditions, equal in number to the contract load divided by 150.

(5) Safe Lift Devices.

(a) When power freight elevators are used for carrying safes or other one-piece loads greater than the contract load of the elevator, and when power passenger elevators are used for carrying concentrated loads greater than 75% of the contract load of the elevator, the requirements of 524 CMR 17.15(5)(b) through 17.15(5)(i) shall be complied with as follows:

(b) A locking device shall be provided which will hold the car at any landing independently of the hoisting ropes while the safe or other object is being loaded or unloaded.

(c) The locking device shall be so designed that it cannot be unlocked unless the entire weight of the car and load is suspended on the ropes.

(d) The wrench or other device for operating the locking device shall be removable.

(e) The locking device shall be designed to withdraw the bars should it come in contact with the landing locks if the car is operated on the up motion.

(f) A metal plate shall be provided in the elevator car which shall bear the words "Capacity Lifting Safes" in letters followed by figures giving the capacity in pounds for lifting safes for which the machine is designated, the letters and figures to be no less than one-quarter inch high, stamped, etched, or raised on the surface of the plate

(g) The car platform, car frame, sheaves, shafts, ropes and locking devices shall be designed for the specified "Capacity Lifting Safes" with a factor or safety of not less than five.

(h) The car safeties shall be designed to stop and hold the specified "Capacity Lifting Safes" with the ropes intact.

(i) Where there is a passageway under the hoistway, the machine shall be designed to operate with the "Capacity Lifting Safes" at slow speed and the car safety shall be designed to stop and hold the car and "Capacity Lifting Safes" independently of the ropes.

(6) Operating Switch Location. All elevator machines equipped for carrying safes or other one-piece loads greater than the contract load of the elevator shall be provided with a special car switch near the machine for operating under such conditions.

17.16: Car and Counterweight Safeties and Speed Governors

(1) Power elevators suspended by ropes shall be provided with car safeties installed in or on a safety plank located beneath the car platform. Where multiple-type safeties are installed, one such safety shall be located in or on the safety plank located beneath the car platform. The safety or safeties shall be capable of stopping and sustaining the car with contract load.

(a) The application of the safety shall not cause the car platform to become out of level in excess of ½" per foot, measured in any direction.

(b) When the car safety is applied, no decrease in the tension of the governor rope or motion of the car in the descending direction shall release the car safety.

(c) It is permissible to release the safety by reversing the direction of the motion of the machine.

(d) Car safeties shall be operated by speed governors.

(e) Jaws and other parts of safeties of the sliding type, if made of forged steel of an ultimate strength of not less than 55,000 lbs. per sq. in. and cast steel of an ultimate strength of not less than 65,000 lbs. per sq. in., may, in action, be stressed to 17,000 lbs. per sq. in. For steels of greater strength the allowable stresses may be increased proportionately based on ultimate strength.

Cast iron shall not be used in any part of a car safety, the breakage or failure of which would result in failure of the safety device to function, to stop the car and sustain the load.

(f) Bearings for safety drums and screw-shafts shall be of non-ferrous material.

(g) Where two (duplex) safeties are provided, the lower safety device shall be capable of developing not less than ½ of the force required to stop the entire car with rated load. Duplexed safety devices shall be arranged so as to function approximately simultaneously.

Types A or Type C safety devices (see 524 CMR 17.16(19)) shall not be used in multiple.

(h) Type B safeties shall stop the car with its rated load from governor tripping speed within the range of the stopping distances shown in 524 CMR 17.16: *Table 2*.

17.16: continued

TABLE 1.
MAXIMUM AND MINIMUM STOPPING DISTANCES
TYPE B CAR SAFETIES WITH RATED LOAD, AND OF TYPE B
COUNTERWEIGHT SAFETIES

Rated Speed in Feet Per Minute	Maximum Governor Trip Speed in Feet Per Minute	Stopping Distances in Feet-Inches Minimum	Maximum
0 to 125	175	0-6	1-3
150	210	0-6	1-4
175	250	0-8	1-7
200	280	0-9	1-10
225	308	0-10	2-0
250	337	0-11	2-3
300	395	1-1	2-9
350	452	1-3	3-4
400	510	1-6	4-0
450	568	1-9	4-10
500	625	2-1	5-8
600	740	2-9	7-7
700	855	3-7	9-10
800	970	4-6	12-6
900	1085	5-5	15-3
1000	1200	6-8	18-6
1100	1320	7-11	22-4
1200	1440	9-4	26-4
1300	1560	10-11	30-11
1400	1680	12-7	35-7
1500	1800	14-5	40-10

(i) Counterweight safeties where furnished shall conform to the requirements for car safeties except where otherwise specified.

EXCEPTIONS:

1. Where otherwise specified in 524 CMR 17.16(3).
2. For rated speeds of not over 125 feet per minute counterweight safeties may be operated as the result of breaking or slackening of the hoisting ropes and may be of the inertia or other approved type without governors. (See 524 CMR 17.16(3)).

(j) Safeties shall be so designed that on their application the forces which provide the stopping action shall be compressive forces on each side of the guide-rail section.

(2) Speed governors for car safeties shall be set to trip at over speeds as follows:

(a) At not less than 115% of rated speed.

(b) At not more than the tripping speed listed opposite the applicable rated speed in 524 CMR 17.16: *Table 2*.

17.16: continued

TABLE 2.
MAXIMUM SPEEDS AT WHICH SPEED GOVERNOR TRIPS
AND GOVERNOR OVERSPEED SWITCH OPERATES

Rated Speed in Feet Per Minute	Maximum Governor Trip Speed in Feet Per Minute	Maximum Speed at Which Governor Overspeed Switch Operates, Down Feet Per Min.
0 to 125	175*	
150	210*	
175	250	225
200	280	252
225	308	277
250	337	303
300	395	355
350	452	407
400	510	459
450	568	512
500	625	563
600	740	703
700	855	812
800	970	921
900	1085	1031
1000	1200	1140
1100	1320	1254
1200	1440	1368
1300	1560	1482
1400	1680	1596
1500	1800	1710

* Governor Overspeed Switch Not Required

(3) The counterweight safety, where required, shall be operated by a separate speed governor. Provision shall be made to cause the application of the counterweight safety at a speed greater than that at which the car safety is applied, but not more than 10% above that speed. Broken rope safeties of the instantaneous type may be used on counterweights within the limits of the following:

TABLE 3.

Contract Speed	Total Weight of Counterweight
250 fpm	2000 lbs
200 fpm	3000 lbs
160 fpm	4000 lbs
125 fpm	5000 lbs

EXCEPTION: Speed governors are not required for the operation of counterweight safeties having a rated speed of not more than 125 feet per minute.

Every car safety shall be provided with a switch operated by the car safety mechanism. This switch shall conform to the requirements of 524 CMR 17.16(10).

(4) Car safeties shall be either of the instantaneous type or shall be of the sliding type which will bring the car to a stop or within the limits of the retardation hereinafter specified. Instantaneous type car safeties shall not be used for contract speeds exceeding 125 F.P.M.

17.16: continued

(5) The distance between the safety jaws shall not be less than the thickness of the guide rail plus 3/32" and the jaws shall not drag against the rail. Where roller or other types of guide shoes are used arranged with springs or other means which provide for a definite and limited movement of the car or counterweight with respect to the guide rails, minimum clearance specified shall be increased by an amount sufficient to prevent the safety jaws from coming in contact with the guide rails should the maximum car movement permitted by the guide shoes occur.

(6) Safeties shall be marked by the manufacturer with the range of weight and speed for which they are designed; said weight to include the complete car structure, the safety, the contract load in the car, and all moving equipment the weight of which is borne by the safety.

(7) Overspeed instantaneous safeties shall be applied by the governor. On the parting of the hoisting ropes governor applied instantaneous safeties shall apply instantly and independently of the speed action of the governor.

(8) No safety shall be permitted for stopping an ascending car or counterweights.

(9) The governor shall be located where it cannot be struck by the car in case of overtravel and where there is sufficient space (that is, not less than eight inches) for full movement of governor parts.

(10) A switch shall be provided on the speed governor and operated by the overspeed action of the governor when used with Type B and C car safeties of elevators having a rated speed exceeding 125 feet per minute, and when used with counterweight safeties.

Every car safety shall be provided with a switch operated by the car safety mechanism when the safety is applied.

These switches shall, when operated, remove power from the driving-machine motor and brake before or at the time of application of the safety.

(a) The setting of the car speed-governor overspeed switch shall conform to the following:

1. For rated speeds more than 125 feet per minute, up to and including 500 feet per minute, the car speed-governor overspeed switch shall open in the down direction of the elevator at not more than 90% of the speed at which the governor is set to trip in the down direction.

2. For rated speeds more than 500 feet per minute, the car speed-governor overspeed switch shall open in the down direction of the elevator at not more than 95% of the speed at which the governor is set to trip in the down direction.

3. The switch, when set as specified in either 524 CMR 17.16(10)(a)1. or 17.16(10)(a)2., shall open in the up direction at not more than 100% of the speed at which the governor is set to trip in the down direction.

EXCEPTION: The speed-governor overspeed switch may be set to open in the down direction of the elevator at not more than 100% of the speed at which the governor is set to trip in the down direction, subject to the following requirements:

A speed-reducing switch of the manually reset type is provided on the governor which will reduce the speed of the elevator in case of overspeed, and which shall be set to open as specified in 524 CMR 17.16(10)(a)1. and 17.16(10)(a)2.

Subsequent to the first stop of the car following the opening of the speed-reducing switch, the car shall remain inoperative until the switch is manually reset.

(b) Switches used to perform the functions specified shall be positively opened. Overspeed and speed-reducing switches, permitted by the exception to 524 CMR 17.16(10)(a), operated by the speed governor shall remain in the open position until manually reset. Switches operated by the car safety mechanism shall be of a type which will not reset unless the car safety mechanism has been returned to the off position.

(11) The size, material, and construction of the governor rope, together with the rated tripping speed of the governor, shall be stamped on the governor stand or given on a brass plate attached to it in letters not less than ¼ inch in height.

17.16: continued

(12) The arc of contact between the governor rope and the driving sheave shall, in conjunction with a tension device, provide sufficient traction to cause proper operation of the governor.

(a) The minimum length of governor jaws shall be such that no serious cutting, tearing, or deformation of the rope shall result from the operation of the safety.

(b) Governor jaws for sliding type safeties shall be so designed that the rope will pull through these jaws on the application of a stress exceeding that required to operate so as to stop the car.

(13) Elevators having winding-drum machines shall be provided with a slack-rope device which will cut off the power and stop the elevator machine if the car is obstructed in its descent. Slack-rope switches shall be constructed so that they will not automatically reset when the slack in the rope is removed.

(14) No car safety which depends on the completion or maintenance of an electric circuit for the application of the safety shall be used. Car safeties shall be applied mechanically.

(15) The gripping surfaces of the car or counterweight safeties shall not be used to guide the car or counterweights.

(16) A pawl or ratchet or chisel point safety shall not be used.

(17) Speed governors shall have their means of speed adjustment sealed after test. If speed governors are painted after sealing, all bearing and rubbing surfaces shall be kept free or freed of paint and a hand test made to determine that all parts operate freely as intended. Seals shall be of a type which will prevent readjustment of the governor tripping speed without breaking the seal.

(18) Each governor shall be sealed directly after testing by the authorized inspector conducting the test. No person other than an authorized inspector shall tamper with, break, or remove the seal.

(19) The governor-rope releasing carrier on the car (or on the counterweight) shall be set to require a tension in the governor rope, to pull the rope from the carrier, of not more than 60% of the pull-through tension developed by the governor; and the carrier shall be designed so that the pull-out tension cannot be adjusted in a normal manner to exceed the amount specified.

(20) Car safety devices (safeties) are identified and classified on the basis of performance characteristics after the safety begins to apply pressure on the guide rails. On this basis, there are three types of safeties:

(a) Type A Safeties. Safeties which develop a rapidly increasing pressure on the guide rails during the stopping interval, the stopping distance being very short due to the inherent design of the safety. The operating force is derived entirely from the mass and the motion of the car or the counterweight being stopped. These safeties apply pressure on the guide rails through eccentrics, rollers or similar devices, without any flexible medium purposely introduced to limit the retarding force and increase the stopping distance.

(b) Type B Safeties. Safeties which apply limited pressure on the guide rails during the stopping interval, and which provide stopping distances that are related to the mass being stopped and the speed at which application of the safety is initiated. Retarding forces are reasonably uniform after the safety is fully applied. Continuous tension in the governor rope may or may not be required to operate the safety during the entire stopping interval. Minimum and maximum distances are specified on the basis of governor tripping speed (see 524 CMR 17.16(1)(h)).

(c) Type C Safeties. (Type A with Oil Buffers). Safeties which develop retarding forces during the compression stroke of one or more oil buffers interposed between the lower members of the car frame and a governor-operated type A auxiliary safety plank applied on the guide rails. The stopping distance is equal to the effective stroke of the buffers.

17.16: continued

(21) Type C safeties may be used subject to the following requirements:

(a) The rated speed shall be not more than 500 feet per minute.

(b) The oil buffers shall conform to all requirements specified in 524 CMR 17.31 for oil buffers, except that the stroke shall be based on governor tripping speed and on an average retardation not exceeding 32.2 feet per second.

(c) After the buffer stroke, as defined in 524 CMR 17.16(21)(b) has been completed, provision shall be made for an additional travel of the plunger or piston of not less than 10% of the buffer stroke to prevent excessive impact on the buffer parts and the auxiliary safety plank.

(d) Where the distance between guide rails exceeds eight feet, the safety shall be provided with two oil buffers of substantially identical calibration; and the buffers shall be so located as to develop minimum stresses in the auxiliary safety plank during safety operation. Buffers shall be located in line with and symmetrically between the guide rails.

(e) The auxiliary safety plank shall be so supported and guided below the car frame that the clearances specified in 524 CMR 17.16(5) for the safety parts are maintained during normal operation. The auxiliary safety plank shall be so designed that the maximum stresses in the plank shall not exceed those specified for similar car-frame members in 524 CMR 17.13.

(f) The rail-gripping device of the auxiliary safety plank shall be so arranged and connected as to prevent the plank from being out of level more than ½" in the length of the plank when the safety is operated to stop the car.

(g) An electric switch shall be provided and so arranged and connected that the elevator cannot be operated by means of the normal operating device if any buffer is compressed more than 10% of its stroke.

(h) Means shall be provided to prevent operation of the elevator by means of the normal operating device if the oil level in any buffer is below the minimum allowable level.

(22) For all type B safeties the movement of the governor rope, relative to the car or the counterweight respectively, required to operate the safety mechanism from its fully retracted position to a position where the safety jaws begin to exert pressure against the guide rails, shall not exceed the following values based on rated speed:

(a) For Car Safeties:

200 feet per minute or less -- 42 inches
201 to 375 feet per minute -- 36 inches
Over 375 feet per minute -- 30 inches

(b) For Counterweight Safeties: All speeds -- 42 inches.

Drum-operated car and counterweight safeties, requiring continual unwinding of the safety drum rope to fully apply the safety, shall be so designated that not less than three turns of the safety rope will remain on the drum after the overspeed test of the safety has been made with rated load in the car.

(23) Speed Governor Data Plate. A metal plate shall be securely fastened to all speed governors and shall include the following information in legible, permanent figures and letters ¼ inch in height:

(a) The speed in feet per minute at which the governor is set and sealed to trip the governor rope grip jaws.

(b) The size, material, and construction of the governor rope on which the governor jaws were designed to operate.

(24) Hydraulic cylinders buried in the ground, installed without a safety bulkhead shall have governor-operated safeties or a plunger gripper installed by January 1, 2004.

17.17: Car Speeds

Depending upon the type of control, the maximum contract speeds of elevators shall be as follows:

(1) Variable voltage or unit multi-voltage shall not exceed 1500 feet per minute.

(2) Direct current Rheostatic shall not exceed 600 feet per minute.

(3) Hydraulic shall not exceed 500 feet per minute.

17.17: continued

(4) Alternating current 200 feet per minute.

(5) Continuous pressure 150 feet per minute.

(6) Electro-hydraulic 200 feet per minute.

17.18: Illumination of Cars and Lighting Fixtures

(1) Lights and Illumination Required. Cars shall be provided with an electric light or lights; not less than two lamps shall be provided. The minimum illumination at the landing edge of the car platform when the car and landing doors are open shall be not less than the following:

(a) For passenger elevators, five foot candles.
(b) For freight elevators, 2½ foot candles.
(c) Adequate car top lighting will be installed with a guarded bulb.

(2) Light Control Switches. Light control switches are not required, but if provided they shall:

(a) be located in or adjacent to the operating device in the car.
(b) in elevators having automatic operation, be of the key operated type or located in a fixture with a locked cover.

(3) Passenger Car Lighting Devices. Suspended glass used for lighting fixtures shall be supported by a metal frame secured at not less than three points. Fastening devices shall not be removable from the fixture. Glass shall not be drilled for attachment. Light troughs supporting wire raceways and other auxiliary lighting equipment where used shall be of metal, except where lined with non-combustible materials.

NOTE: Lighting arrangements using slow-burning combustible materials for diffusing and illumination purposes shall be permitted provided such combustible materials do not come in contact with lighting equipment.

(4) Guarding of Light Bulbs or Tubes in Passenger Cars. Light bulbs or tubes in passenger cars shall be so guarded as to prevent injury to passengers from breakage of the bulbs or tubes.

(5) Lamp Guards for Freight Cars. Lamps shall be equipped with substantial guards to prevent breakage.

(6) Glass in Car Lighting Fixtures. Glass used in connection with car lighting fixtures shall conform with 524 CMR 17.13(6). Glass exceeding one square foot in area shall be laminated type. The total area of glass in enclosure and doors shall not exceed four square feet.

(7) Emergency Lighting. All elevators, except freight elevators installed prior to June 7, 1991, and passenger elevators installed prior to November 30, 1971, shall be provided with battery operated emergency lighting conforming to the following:

(a) The emergency system shall provide some general illumination for the car. The intensity of illumination four feet above the car floor and approximately one foot in front of a car station shall be not less than 2/10 of a foot candle. Lights shall be automatically turned on in all elevators in service not more than ten seconds after normal lighting power fails. The power system shall be capable of maintaining the above light intensity for a period of four hours.
(b) Not less than two lamps approximately of equal wattage shall be used.
(c) The emergency lighting system shall be kept in workable condition with a built in charger so that it will perform the functions for which it is intended.

NOTE: If an emergency generator provides emergency car lighting within ten seconds after power failure, a battery operated lighting unit is not required.

17.18: continued

(8) Emergency Signal System All elevators, except freight elevators installed prior to June 7, 1991, and passenger elevators installed prior to November 30, 1971, which are located in buildings other than private residences and which are operated at any time without a designated operator in the car shall be provided with an emergency signal system. If the bell and/or the means of two-way conversation is normally connected to the building power supply, it shall automatically transfer to a source of emergency power within ten seconds after the normal supply fails. The power source shall be able to provide for the operation of the bell for one hour and the means of two-way conversation for four hours.

17.19: Contract-Load Test

(1) A contract load test under the supervision of the authorized inspector shall be made of elevators as required by 524 CMR 8.01 This test shall be made with contact load in the car. The brakes, limit switches, buffers, car safety, and speed governor shall be caused to function in each test, and approval of any elevator shall be granted only upon satisfactory completion of such test.

(2) Car and counterweight safeties and governors shall be tested as follows:

(a) Governor operated instantaneous type safeties or sliding type safeties of alternating current elevators shall be tested at rated speed by tripping the governor by hand. In such cases, the governor shall be separately tested for tripping speed.

(b) Sliding type safeties of elevators other than alternating current type shall be tested at governor tripping speed with the wire ropes attached and all electrical apparatus operative except for the overspeed control switch on the governor, if any.

(c) On overspeed tests, the stopping distance of sliding type safeties shall be determined by measuring the marks made on the guide rails by the safety jaws and with rated load in the car shall in accordance with ASME A17.2.1 (Inspectors Manual for Electric Elevators)

17.20: Equipment Prohibited Inside Car

Apparatus or equipment other than that used in connection with the operation of the elevator shall not be installed inside any elevator car.

EXCEPTIONS:

(a) Railroad and conveyor tracks in freight elevators.

(b) Light, heating, ventilation and air conditioning equipment.

17.22: Machines and Machinery

(1) Drums and leading sheaves shall be of cast iron or steel, and shall have finished grooves. U-grooves shall be not more than one-sixteenth inch larger than the ropes. The pitch diameter of sheaves or drums for hoisting or counterweight ropes shall be not less than 40 times the nominal diameter of the rope. Opening in drums shall be drilled at an angle of not over 45° with the run of the rope and shall be provided with a rounded corner with a radius at least equal to that of the rope.

(2) The factor of safety based on the static load to be used in the design of elevator hoisting machines shall be not less than ten for cast iron, cast steel, or materials other than wrought iron or wrought steel. For wrought iron or wrought steel, the factor of safety shall be eight.

(3) No set-screw fastenings shall be used in lieu of keys or pins if the connection is subject to torque or tension. Shafts which support drums, gears, couplings and other members and which transmit torque shall be provided with tight fitting keys. A fillet shall be provided at any point of change in the diameter of driving-machine sheave shafts, or drums to prevent excessive stress concentrations in the shafts.

(4) No friction gearing or clutch mechanism shall be used for connecting the drums or sheaves to the main driving gear of power elevators.

(5) No belt or chain-driven machine shall be used to drive any power elevator.

(6) No worm gearing having cast iron teeth shall be used for any power elevator machine.

17.22: continued

(7) Electric elevator machines shall be equipped with electrically released brakes which are applied by compression springs. No brakes shall be released until power has been applied to the motor.

(8) No single-ground, short-circuit, or counter-voltage shall prevent the action of the brake magnet from allowing the brake to set in the intended manner during normal operation. No motor field discharge, counter-voltage, single ground, or accidental short-circuit shall retard the action of the brake magnet in allowing the brake to set during emergency stops.

(9) Welding. Welding of parts on which safe operation depends shall be done in accordance with the appropriate standards established by the American Welding Society. All welding of such parts shall be done by welders qualified in accordance with the requirements of the American Welding Society. At the option of the manufacturer, the welders may be qualified by one of the following:

(a) By the manufacturer.
(b) By a professional engineer.
(c) By a recognized testing laboratory.

(10) Numbering of Elevators. When machinery of more than one elevator is in a machine room, each elevator machine shall be assigned a different elevator number which shall be painted on or securely attached to the driving machine and visible from the disconnect switch. The corresponding disconnect switch shall carry the same elevator number

17.23: Hydraulic Elevator Machines, Tanks, Pumps, Valves, and Gauges

(1) Types of Driving Machines. Types of driving machines shall be of the direct plunger type or roped hydraulic type.

(2) Machine and sheave beam supports and their foundations, and overhead beams and overhead sheaves and their supports for counterweights where provided shall conform to 524 CMR 17.02(12) through (17).

(3) Vertical Bottom Clearance. Vertical bottom clearance shall comply to 524 CMR 17.04(2).

(4) Gas Releases. Cylinders of hydraulic-elevator machines shall be provided with means for releasing air or other gas.

(5) Tanks, Pipes and Fittings.

(a) The outlet of pressure tanks shall be so located near the bottom to prevent the entrance of air or other gas into the elevator piping and cylinder under any condition of service. Hydraulic cylinders buried in the ground installed without a safety bulkhead shall have installed governor operated safeties or a plunger gripper by January 1, 2004.
(b) Pressure tanks that may be subjected to vacuum shall be provided with one or more vacuum relief valves to prevent the collapse of the tanks.
(c) Pressure tanks shall be so located and supported that inspection may be made of the entire exterior.
(d) Discharge tanks shall be covered to prevent the entrance of foreign material and provided with a suitable vent to the atmosphere.
(e) Pressure tanks, pipes and fittings shall be made and tested in accordance with the best practice. In case any question arises as to what is the best practice, work done according to the requirements of the ASME Unfired Pressure Vessels Code shall be considered as conforming to the best practice. Welding of all parts on which safe operation depends shall conform to the requirements of 524 CMR 17.22(9). Any person adding hydraulic oil to a unit shall notify the building owner that the cylinder must be replaced or the elevator removed from service.
(f) All piping shall be so supported as to eliminate undue stresses at joints and fittings, particularly at any section of the line subject to vibration.
(g) Flexible connections shall not be installed between the check valve, or control valve, and the cylinder.

17.23: continued

(h) Flexible connections may be installed other than between the check valve, or the control valve, and the cylinder provided the failure of the sealing element shall not permit separation of the joints connected.

(i) Flexible hose shall have a bursting strength of not less than ten times the working pressure. The replacement date of all hose shall not exceed six years and shall be permanently marked with the SAE hose type identification and the required replacement date.

(j) Atmospheric storage and discharge tanks shall conform with the following:

1. They shall be so designed and constructed that when completely filled, the factor of safety shall be not less than four, based on the ultimate strength of the material.

2. They shall be provided with a means of checking the liquid level. Such means shall be accessible without removal of any cover or other part.

(6) Relief Valve. Each pump or group of pumps shall be equipped with a relief valve conforming to the following requirements:

(a) Type and Location. The relief valve shall be located between the pump and the check valve and shall be of such a type and so installed in a by-pass connection that the valve cannot be shut off from the hydraulic system.

(b) Setting. The relief valve shall be pre-set to open at a pressure not greater than 125% of the working pressure at the pump.

(c) Size. The size of the relief valve and by-pass shall be sufficient to pass the maximum rated capacity of the pump without raising the pressure more than 20% above that at which the valve opens. Two or more relief valves may be used to obtain the required capacity.

(d) Sealing. Relief valves having exposed pressure adjustments, if used, shall have their means of adjustment sealed after being set to the correct pressure.

EXCEPTIONS: No relief valve is required for centrifugal pumps driven by induction motors, provided the shut-off, or maximum pressure which the pump can develop, is not greater than 135% of the working pressure at pump.

(e) Manual lowering valves shall be painted a distinctive color, preferably red, and shall have a permanently marked metal plate attached to the hand wheel or other opening or closing device with letters not less than ⅜" in height reading, "Relief Valve".

(f) All work including installation, adjustment, and sealing of valves after being set to correct position, and including the lowering of the car by manual operation of the valves, shall be performed only by a licensed elevator mechanic.

(7) Gauges.

(a) Each pressure tank shall be provided with a gauge glass, having fittings and valves of material that will not be corroded by the fluid, and equipped to automatically shut off the fluid in case of failure of the gauge glass. The gauge glass shall be attached directly to the tank and so located as to indicate the level of the fluid within the working limits.

(b) Each pressure tank shall have a pressure gauge which correctly indicates pressure to at least 1½ times the normal working pressure allowed in the tank. This gauge shall be connected to the tank by a pipe of such material that it will not be corroded by the fluid and in such a manner that the gauge cannot be shut off from the tank except by a cock with a "T" or lever handle. The cock shall be located near the gauge.

(c) Pressure tanks shall be provided with a ¼ inch pipe-size valve connection for attaching an inspector's test gauge while the tank is in service.

(d) Tanks shall be provided with means to render the elevator inoperative in the up direction, if for any reason the liquid level in the tank falls below the permissible minimum.

(8) Plungers and Cylinders of Hydraulic Elevators.

(a) The plunger shall be of uniform diameter and as nearly as possible of uniform thickness and finished on the outside. The pressure end of the plunger shall be provided with a plunger bottom either of greater diameter than the plunger or other means shall be provided to prevent the plunger from traveling beyond the limits of the cylinder without loss of fluid and to prevent the car striking the limits of the hoistway.

(b) Plungers of hydraulic elevators shall be of ample strength and rigidity as a column to support the loads and to withstand the compressive forces impressed upon them with a factor of safety not less than three for any position of the car in the hoistway. Walls of plungers of hydraulic elevators, subject to external pressure, shall be of sufficient thickness to insure stability of the cross-section with a factor of safety not less than three.

17.23: continued

(c) Cylinders of hydraulic elevators shall be designed with a factor of safety of at least five against bursting.
(d) Where plungers are composed of more than one section, the strength at the joints shall be equal to or greater than the strength of the plunger.
(e) Plungers of plunger elevators shall be securely fastened to the car frame or car platform.
(f) Where plunger elevators are provided with a counterbalance and the length and weight of the plunger is such that the weight of the counterweight and counterweight ropes exceeds the weight of the elevator car, the fastening between the plunger and the car frame or platform shall be of sufficient strength to support the entire weight of the plunger. In addition, a rod or loop of galvanized wire rope shall be provided inside the plunger, attached to the bottom of the plunger and the car frame, of sufficient strength to support the weight of the plunger in case the fastening between the top of the plunger and the car should fail.
(g) Sufficient clearance shall be provided at the bottom of the cylinder of hydraulic elevators so that the bottom end of the plunger will not strike the bottom head of the cylinder when the car is resting on the fully compressed buffers or stops.
(h) A permanent type data tag shall be affixed to the tank reservoir unit in the machine room in clear sight, and shall contain the following information:

1. Date of installation
2. Name of installing company
3. Name of manufacturer
4. Piston diameter
5. Manufacturer's designed head pressure.

(i) Hydraulic cylinders buried in the ground without safety bulkheads shall either be replaced or shall have a governor-operated safety or a plunger gripper installed.
(j) All cylinders replaced below ground shall be provided with schedule 40 or greater PVC liner surrounding it for corrosion protection. The PVC liner shall be sealed at the top. If a hydraulic elevator is not equipped with an overspeed (rupture) valve, one shall be added the same time as the cylinder replacement.

(9) General Requirements for Plunger Elevators.
(a) Cars of plunger elevators are not required to be equipped with car safeties, provided the ram or plunger is directly connected to the structural member comprised of the steel bolster, or steel crosshead channels, where steel stile channels are an integral part of the assembly.
(b) Top clearances of plunger elevator cars and counterweights shall comply with the following for contract speeds not in excess of 100 feet per minute:

There shall be a clear distance of not less than two feet (2’-0”) between the top of the crosshead of the car and the corresponding point of any obstruction or equipment in the hoistway vertically above it when the plunger is in its fully extended position.

When any equipment on the car projects more than two feet above the car crosshead, the minimum overhead car clearances required shall be increased by the amount which this projection exceeds two feet.

There shall be a clear distance of not less than six inches above the top of the counterweight where provided and the corresponding point of any obstruction in the hoistway vertically above it when the plunger is in its lowest position.

(c) Plunger elevators shall have car guide rails of metal of such dimensions and strength as to withstand the thrusts to which they are subjected.
(d) In all other respects, plunger elevators shall be subject to the requirements for freight and passenger elevators.
(e) When liquid in excess of two gallons per month is added to the tank of a hydraulic elevator or dumbwaiter, where the driving machine is of the direct plunger type, the following rules shall be fully complied with:

1. A log shall be posted in the pump room on the liquid tank in full view of a person instructed to add liquid.
2. The log shall read as follows:
   Amount of liquid added in gallons.
   Date when liquid was added.
   Full name of person adding liquid to the hydraulic tank.
   A letter shall be mailed immediately to the authorized inspector having jurisdiction and a copy of the letter mailed to the Department of Public Safety, Elevator Division, One Ashburton Place, Boston, when the given amount of liquid is added.

17.23: continued

(10) Automatic Leveling for Hydraulic Elevators. All hydraulic elevators shall be provided with two-way automatic leveling.
EXCEPTION: 524 CMR 17.23(10) shall not apply to hydraulic elevators installed prior to March 9, 1978.

(11) Anti-creep Leveling Devices. Every hydraulic elevator shall be provided with an anti-creep leveling device conforming to the requirements of the following:

(a) It shall maintain the car within three inches of the landing from any point within the interlock zone irrespective of the position of the hoistway door.

(b) For the electro-hydraulic elevators, it shall be required to operate the car only in the up direction.

(c) For maintained pressure hydraulic elevators, it shall be required to operate the car in both directions.

(d) Its operation may depend on the availability of the electric power supply provided that:

1. The disconnect switch required by 524 CMR 17.34 is in the closed position at all times except during maintenance, repairs and inspections, and

2. The electrical protective devices required by 524 CMR 17.23(11) shall not cause the power to be removed from the device.

EXCEPTION: Stop switches in pits, stop switches on top of cars, and car side emergency exit door contact switches may be connected to cause the power to be removed from the anti-creep leveling device.

(12) Power Disconnecting Switch. The power disconnecting switch conforming to requirements of 524 CMR 17.34 shall be provided except that it shall be connected into the power supply line to control valve operating magnets, and to the pump motor in the case of electro-hydraulic elevators. Where the hydraulic pressure is supplied by a pressure tank and an electric pump, a separate disconnecting switch shall be provided to disconnect the power from the pump driving motor. The disconnect switch shall be kept in the closed position at all times except during maintenance, repair or inspection.

17.24: Venting of Hydraulic Machinery Spaces

(1) Machinery spaces of hydraulic elevators shall be provided with means for venting smoke and hot gases to the outer air in case of fire.
EXCEPTION: Machinery spaces located not more than ten feet from the hoistway may be vented to the hoistway through continuous fire rated ducts with a fire rating equal to that of the hoistway securely fastened to and penetrating the hoistway structure.

(2) Area of Vents. The area of the vents shall be not less than one per cent of the area of the machinery space with a minimum of one square foot and shall conform to the following:

(a) Vent openings in machinery spaces shall be located directly under the roof in the machinery enclosure.

(b) The openings for all ducts shall be covered with a wire enclosure which shall have not greater than three eighths inch mesh.

(c) If a duct is used to vent the machine room it shall be fire rated and shall be inclined or if horizontal the flow of air shall be power driven by fan that is connected to the normal and the emergency power source and capable of moving the equivalent amount of air that is moved by gravity through a vertical vent.

17.25: Venting of Hydraulic Elevator Hoistways

Hydraulic elevator hoistways shall be vented in accordance with the requirements of 524 CMR 17.03

17.26: Hoisting Ropes

(1) Power elevators shall be provided with iron or steel wire hoist and counterweight ropes. The rope hitch shall be babbitted or wedge sockets.

17.26: continued

(2) No covering shall be permitted on ropes other than where liability to excessive corrosion or other hazard exists, in which case marline covering may be used.

(3) The factor of safety based on static loads for car and counterweight ropes for power passenger and freight elevators shall be not less than the values given in 524 CMR 17.26, Figures 1 and 2, corresponding to the contract speed of the car.

NON-TEXT PAGE

17.26: continued

(4) Hoisting ropes shall be not less than ½ inch in diameter.
EXCEPTION: The provisions of 524 CMR 17.26 shall not apply to elevators installations made prior to March 9, 1950.

(5) The minimum number of hoisting ropes shall be determined by using the factor of safety found in 524 CMR 17.26, Figures 1 and 2, together with the rated ultimate strength of the wire rope. The computed load on the car hoisting ropes shall be of the weight of the elevator car plus the contract load, plus the weight of the car-hoisting rope and the compensation minus the weight of the independent car counterweight, if any.

(6) The minimum number of hoisting ropes used with traction elevators shall be three. If any wire hoist rope of a set is worn or damaged and requires replacement, the entire set of ropes shall be replaced.

(7) The minimum number of ropes used with winding-drum elevators shall be two car-hoisting ropes and two ropes for each counterweight used.

(8) Where winding-drum machines are used, the required crosshead capacity plate shall bear the following information:

FIGURE 1.

Factors of Safety for Hoisting and Counterweight Ropes for Power Passenger Elevators

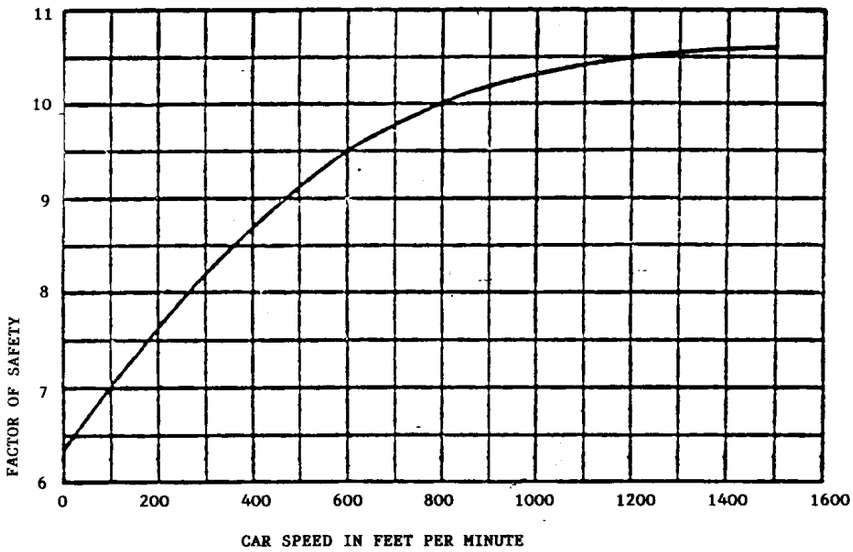
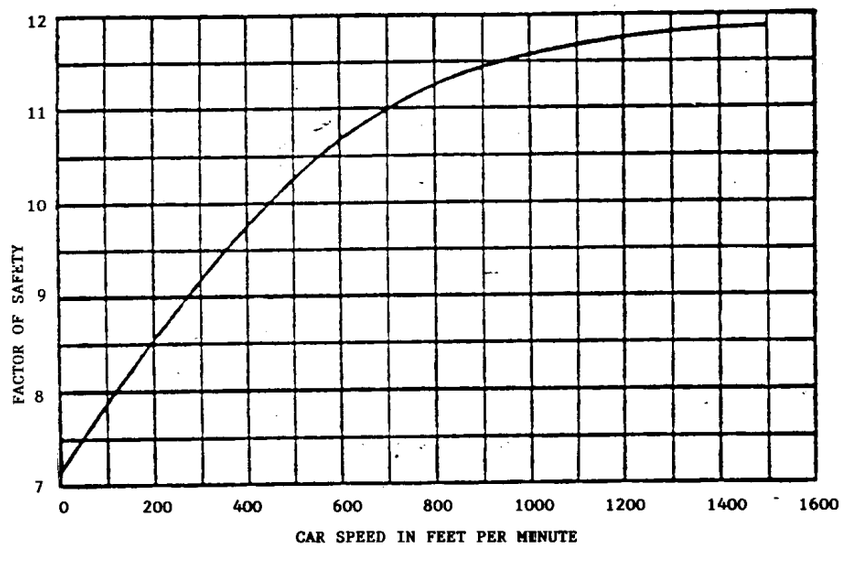


FIGURE 2.

Factors of Safety for Hoisting and Counterweight Ropes for Power Freight Elevators



17.26: continued

FIGURE 3.
WIRE ROPE SPECIFICATIONS

Rope	Number	Diameter in Inches	Rated Ultimate Strength in lbs.
Hoisting	_____	_____	_____
Car Counterweight	_____	_____	_____
Machine Counterweight	_____	_____	_____

(a) Where traction machines are used, the crosshead capacity plate shall bear the following information:

FIGURE 4.
WIRE ROPE SPECIFICATIONS

Rope	Number	Diameter in Inches	Rated Ultimate Strength in lbs.
Hoisting Ropes	_____	_____	_____

(b) Where hydraulic machines are used, the crosshead capacity plate shall bear the following information:

FIGURE 5.
WIRE ROPE SPECIFICATIONS

Rope	Number	Diameter in Inches	Rated Ultimate Strength in lbs.
Hoisting	_____	_____	_____
Car Counterweight	_____	_____	_____

(9) A metal tag shall be attached to the rope fastenings. On this tag shall be stated the following:

(a) Diameter.
(b) Rated ultimate strength.
(c) Material of the ropes.
(d) Date of the rope installation.
(e) Name of company or person installing ropes.
(f) Name of manufacturer.
(g) Whether non-preformed or preformed.

A tag shall be reinstalled at each rope renewal.

(10) Where wire rope equalizers are used, the equalizers and their fastenings in their several parts and assembly shall have a strength of not less than 10% in excess of the required strength of the rope. Rope equalizers, when used, other than those of the single swing tree type used with drum type machines and those of the individual compression spring type capable of being fully compressed without failure, shall be approved on the basis of tests, made by a competent designated laboratory, showing the ultimate strength of the equalizer and its fastenings in its several parts and assembly.

(11) All wire ropes anchored to a winding drum shall have not less than one turn of rope on the winding drum when the car or counterweight has reached the extreme limit of its over-travel.

(12) No car or counterweight rope shall be lengthened or repaired by splicing.

17.26: continued

(13) The winding-drum ends of car or counterweight ropes shall be secured by clamps on the inside of the drums or by individual tapered babbitted sockets.

(14) The car and counterweight rope ends shall be fastened by individual babbitted sockets or wedge type socket. Individual babbitted sockets are not required for elevators installed prior to March 9, 1950, however when hoist and counterweight ropes are replaced, adjustable babbitted sockets shall replace non-adjustable sockets where practical.

(15) Where socketed rope fastenings are used, adjustable shackle rods shall be provided to attach wire ropes to cars and counterweights in such a manner that all portions of the rope other than the portion within the socket shall be readily visible.

(16) Method of Socketing Wire Ropes.

(a) Where a babbitted socket is used, the length of the socket shall be not less than 4.75 times the nominal diameter of the rope.

(b) The hole at the small end shall be as given in the following table:

524 CMR 17.26(18) TABLE 1.
RELATION OF WIRE ROPE TO SMALL DIAMETER OF WIRE ROPE SOCKET

Nominal Diameter of Rope in inches.	Inside Diameter of Small End of Rope Socket
¼ to 7/16 inclusive	shall not be more than 1/16 in. larger than the actual rope diameter
½ to ¾ inclusive	shall not be more than 3/32 in. larger than actual rope diameter
⅞ to 1⅛ inclusive	shall not be more than ⅛ in. larger than actual rope diameter
1¼ to 1½ inclusive	shall not be more than 3/16 in. Larger than actual rope diameter

(c) The hole opening at the small end of the socket shall be rounded and free from cutting edges.

(d) The hole opening at the large end of the socket shall be not less than 2.25 times the nominal diameter of the rope.

(e) The socket shall be drop-forged steel, or steel casting.

(f) The socket shall be of such strength that the rope will break before the socket is perceptibly deformed.

(g) Rope ends to be socketed shall be served with three seizings at each side of any point at which the rope is to be cut.

(h) Only annealed iron wire shall be used as a seizing wire. The wires shall be wound tight and even. The twisted ends of the seizing shall be so placed that they fall into the valleys between strands and away from the ends of the rope, as otherwise the seizing will not pass through the small hole end of the socket.

(i) For ⅝ inch or smaller wire rope, the first two seizings shall be not less than ½" long, and the third seizing not less than ¾" long. The first seizing shall be close to the cut, and the second seizing shall be spaced back from the first seizing the length of the end to be turned in. The third seizing shall be at a distance from the second seizing equal to the length of the socket. Larger rope requires longer seizing than specified above.

(j) Tape shall not be used for seizing.

17.26: continued

(k) The rope thus served shall be entered at the small hole and slipped through the socket a sufficient distance for manipulating, and after removing the first two seizings the strands shall be spread and the hemp center cut out as close as possible to the remaining seizing and removed. All grease shall be carefully removed by wiping off the extended strands and washing with a non-flammable solvent. The strand ends shall then be bent and turned in and bunched closely together. The portion turned in shall have a length not less than two and one half times the nominal diameter of the rope. Then, with the rope end pulled as far as possible into the socket, the turned ends or loops in the strand of all socketed ropes shall be turned towards the center of the socket and shall project above the babbitted end not more than ¼ inch and not less than ⅛ inch. The third seizing shall slightly project outside the hole at the small end of the socket. The socket, when ready for pouring, shall be held vertical and the rope held truly axial with the socket. Tape or waste may be wound around the rope at the small end of the socket to prevent the metal from seeping through but shall be removed after the metal has cooled.

(l) Only clean babbitt metal free from dross shall be used heated to a fluidity just sufficient to char a piece of soft wood without igniting it.

(m) Where the seizing and socketing has been done properly, the original and uniform relation of rope lay will not be disturbed. Any disturbance of rope lay is a clear indication of careless seizing and socketing and is not permitted.

(n) Whenever elevator ropes are replaced or shortened, the counterweight top clearances shall not be reduced below those required.

(o) Auxiliary rope-fastening devices, designed to support elevator cars or counterweights if any regular rope-fastening fails, may be provided subject to the following requirements:

1. They shall be approved by the enforcing authority on the basis of adequate tensile and fatigue tests made by a competent designated laboratory.
2. The device and its fastenings, in its several parts and assembly, shall have a strength at least equal to that of the manufacturer's breaking strength of the rope to which it is to be attached.
3. Steel parts used in the device shall be cast or forged with an elongation of not less than 20%, conforming to ASTM specifications A235-63T, Class C for forgings and A27-62, grade 60/30 for cast steel, and shall be stress relieved.
4. The device shall be so designed and installed that:
   It will not become operative unless there is a failure of the normal rope fastening.
   It will function in a rope movement of not over 1½".
   It will not interfere with the vertical or rotational movements of the rope during normal service.

(17) Periodic Resocketing of Babbitted Rope Sockets of Car Hoisting Ropes on Winding-Drum Driving Machines.

(a) Refastening Periods. The hoisting ropes of power elevators having winding-drum driving machines with 1:1 roping, if of the babbitted rope socket type, shall be resocketed at the car ends at time intervals no longer than:

1. 24 months
2. All drum to counterweight and drum to car ropes shall be resocketed every 24 months.

(b) Tags. A metal tag shall be securely attached to one of the wire rope fastenings after each resocketing and shall bear the following information:

1. The name of the person or firm who performed the resocketing.
2. The date on which the rope was resocketed.

17.27: Governor Ropes

(1) Governor ropes shall be of uncovered iron, steel, or Monel metal.

(2) Governor ropes shall not be of tiller rope construction.

(3) Governor ropes shall be not less than three eighths inch in diameter.

(4) Governor ropes shall run clear of governor jaws during the normal operation of the elevator.

17.27: continued

(5) Governor ropes shall run not more than one eighth inch either side of the common center line of the governor jaws.

(6) Governor rope ends shall be fastened by tapered babbitted sockets or a wedge type clamp.

(7) Where socketed rope fastenings are used, the length of the socket shall conform to the requirements for wire rope sockets for hoisting ropes and shall be not less than 4.75 times the nominal diameter of the rope and shall be installed in such manner that all portions of the rope other than the portion within the socket shall be readily visible.

17.28: Governor Tail-ropes

(1) Material Tail-ropes. Tail-ropes shall be of iron, steel, Monel-metal, phosphor bronze, or stainless steel, of regular-lay construction, and shall be not less than ⅜ inch in diameter.

(2) Tiller rope construction shall not be used.

(3) The factor of safety of governor ropes shall be not less than five.

(4) Tail-ropes shall be secured to car on counterweight safety operating drums by clamps or tapered babbitted sockets on the inside of the drum.

(5) Tail-ropes shall be connected to governor ropes by tapered babbitted sockets.

(6) Deflecting sheaves for tail-ropes shall be fastened by metal brackets to car frame safety planks.

17.29: Compensating Ropes or Chains

(1) Compensating chains shall be firmly secured to the car frame, the counterweight, or the hoistway.

(2) Compensating ropes shall be of uncovered iron or steel.

(3) Whenever compensating ropes are employed, a compensating rope tension sheave shall be installed in the elevator pit. This tension sheave shall be guided and equipped with a contact switch arranged to positively open the motor and brake operating circuits before the compensating sheave reaches its upper or lower limit of travel.

17.30: Guide Rails

(1) General. Guide rails for power elevator cars and counterweights shall be of steel, other than where the use of steel rails presents an accident hazard, as in chemical or explosive industries, wood guide rails may be used.
EXCEPTIONS: For passenger oil hydraulic elevators only, guide rails, guide rail brackets and their fastenings shall be of steel and may have other approved shapes subject to the following regulations:

(a) They shall have a section modulus and movement of inertia equal to or greater than that of a section shown in 524 CMR 17.30(1): *Figure 1*, for a given condition.

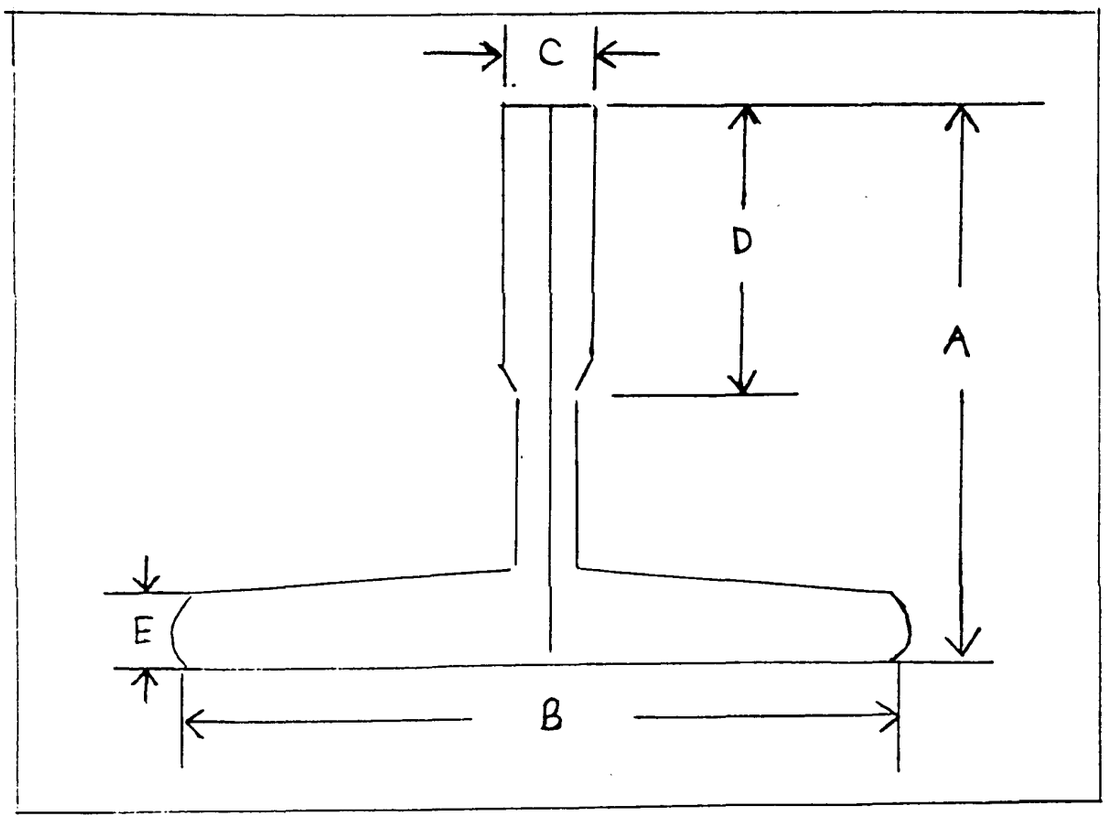
(b) Welding may be used to fasten rail supports provided the welding is done by certified welders. For elevators installed prior to March 9, 1950, wood counterweight rails may remain provided that the shaft is fire rated and that there is no other wood found in the hoistway.

17.30: continued

524 CMR 17.30(1) TABLE 1.
GUIDE RAIL DIMENSIONS

Nominal Weight Per Foot in Lbs.	Nominal Dimensions in Inches					
	A	B	D	E		
8	2-7/16	3½		⅝	1¼	5/16
11	2½	4½		⅝	1½	5/16
12	3½	5		⅝	1¾	5/16
15	3½	5		⅝	1-31/32	½
18½	4¼	5½		¾	1-31/32	½
22½	4	5½		1⅛	2	9/16
30	5	5½		1¼	2¼	11/16

FIGURE 1.
T-Section Rail



17.30: continued

(2) Length of Guide Rails.

(a) For hydraulic elevator where the car is secured directly to the top of a hydraulic plunger the guide rails shall be extended at the top and bottom to prevent the guide shoes from running off when the plunger is fully extended or fully compressed.

(b) For all other power elevators the guide rails shall be continuous from the bottom to the top of the hoistway.

(3) Weight of Guide Rails.

(a) The weight of steel guide rails shall not be less than given in the following table:

524 CMR 17.30(3) TABLE 2.

Total Weight of car and load Total Weight of Counter weight per pair of rails (pounds)		Minimum weight of each car guide rail (pounds per lineal foot) (pounds per linear foot)	Minimum weight of each counterweight guide rail			
			With guide rail safeties		Without guide rail safeties	
Above:	To and including		1 to 1 Roping		2 to 1 Roping	
		4,000**	7.5**	7.5*	7.5	7.5
	4,000	15,000	15.	15.	7.5	7.5
	15,000	27,500	22.5	22.5	15.	15.
	27,500	40,000	30.	30.	15.	15.

* If the rails are effectively bracketed or tied at intervals of six feet or less to prevent spreading, this load may be doubled. This applies only to 7½ pound rails and only when such rails are used for counterweights.
** If car guide rails weighing 7½ pounds were effectively bracketed or tied at ten foot intervals, the 4,000 lb. load may be increased to 4,500 lbs., and if bracketed or tied at 6½ foot intervals, this load may be increased to 5,000 lbs.

(b) Where cars equipped with duplex safety devices are employed, the Maximum Car and Load Weights given in 524 CMR 17.30: *Table 2* may be multiplied by the following factors based upon the vertical distance between centers of safeties:

524 CMR 17.30(3) TABLE 3.
CAR DUPLEX SAFETIES

Distance Between Safeties in Feet	Multiply Maximum Load Given in Table I by
18 (or over)	2.0
15	1.83
12	1.67
9	1.50
6	1.33

(c) Where counterweights equipped with duplex-safety devices are employed, the Maximum Counterweight with Safety Weights given in 524 CMR 17.30: *Table 2* may be multiplied by the following factors based upon the vertical distance between centers of Safeties:

524 CMR 17.30(3) TABLE 4.

Distance Between Counterweight Duplex-Safeties	Factor
15' (or over)	2.0
10' to 14.99 incl.	1.67
5' to 9.99 incl.	1.33

17.30: continued

(4) Joints of Steel Guide Rails. Joints of steel guide rails shall be:

(a) Accurately machined with tongue and groove through the webs at right angles to the base and through the flanges parallel to the base, and fitted with fishplates each secured with not less than four substantial bolts through each rail; or,

(b) Accurately machined with tongue and groove through the webs and with backs of the flanges where the fishplates bear accurately machined at right angles to the tongue and groove and fitted with finished fishplates each secured with not less than four substantial bolts through each rail.

(5) Guide Rail Bolts. Guide rail bolts for fishplates, ties, brackets, backing, clips through bolts, and supports shall be not less than the sizes given in the following table:

524 CMR 17.30(3) TABLE 5.
SIZE OF GUIDE RAIL BOLTS

Weight of Rails per Foot	Diameter of Bolt in Inches
7.5 lb. to 8.2 lb.	½
14.0 lb. to 16.0 lb.	⅝
22.5 lb. to 23.0 lb.	¾
30.0 lb. to 32.0 lb.	¾

(6) Guide Rail Brackets.

(a) Guide rails shall be securely fastened in position with brackets, through bolts, ties, clips, or backing of steel of such strength, design, and spacing that the guide rails and their fastenings shall not deflect between supports more than ¼ inch under normal operation. Welding may be used to fasten rail supports to building steel provided the welding is done by certified welders approved by the enforcing authority.

(b) Where the supports are more than 14' on centers, rail backing shall be used regardless of the deflection under normal operation.

(c) Where an elevator is intended to handle heavy loads the guide rails, fastenings, backing, brackets, and supports shall be designed to sustain the thrusts imposed upon them when a concentrated load is on the car sill in addition to when the concentrated load is in place on the car platform.

(d) Guide Rail Brackets and Building Supports. Design and strength of Brackets and Supports.

The building construction forming the supports for the guide rails, and the guide rail brackets, shall be of such design as to:

1. Safely withstand the application of the car or counterweight safety when stopping the car and its rated load or the counterweight.

2. Withstand the forces specified in 524 CMR 17.16 within the deflection limits specified.

Where necessary, the building construction shall be reinforced to provide adequate supports for the guide rails.

(7) Bolt Holes. Bolt holes in steel beams for bracket bolts shall not exceed the diameter of the bolt by more than 1/16 inch. Such bolt holes shall be drilled or punched. They shall not be cut with a torch.

(8) Wood Guide Rails. Where the use of steel guide rails creates an explosion hazard, the use of wood guide rails is permitted, provided:

(a) The contract speed is not in excess of 100 feet per minute, and,

(b) The guide rails are of straight grained maple without knots, and,

(c) The size of the rails is either not less than 2" x 2½" where the car and load is not in excess of 5,000 lb. or not less than 2⅝" x 3" where the car and load is not in excess of 8,000 lb.

17.30: continued

(9) Use of Car or Counterweight Safeties. Where car or counterweight safeties are used, the guide rails and their supports shall be capable of withstanding the application of the safety when stopping the car with contract load or the counterweight when descending at governor tripping speed.

17.31: Car and Counterweight Buffers

(1) Buffers of the spring, oil, or equivalent type shall be installed under cars and counterweights.

(2) Spring buffers may be used with elevators having a contract speed not in excess of 200 feet per minute. Oil buffers shall be used with elevators having a contract speed in excess of 200 feet per minute.

(3) The minimum stroke of spring buffers shall be as follows, based on contract speed:
100 feet per minute or less --1½ inch stroke
101 to 150 feet per minute -- 2½ inch stroke
151 to 200 feet per minute -- four inch stroke
NOTE: Stroke as applying to spring buffers is the difference between the free length of the spring and its length when compressed to a point where all coils are practically in contact.

(4) The static load required to compress spring buffers a distance equal to their stroke shall be within a minimum of twice and a maximum of three times the total weight of the car plus contract load or of the counterweight, respectively.

(5) Each spring buffer shall be provided with a metal plate marked in a legible and permanent manner to show the stroke or compression of the spring and the maximum and the minimum loads for which the spring may be used in conformity with 524 CMR 17.31. This plate shall not be wired or attached to the spring coils in such manner as to become unfastened when the spring is fully compressed.

(6) The minimum stroke of oil buffers shall be based on the following:
(a) The stroke shall be such that the car or the counterweight on striking the buffer at 115% of contract speed shall be brought to rest with an average retardation not exceeding 32.2' per second.
(b) Where a speed retarding device is installed that will limit the speed at which the car or the counterweight can strike their buffers, the buffer stroke shall be based on at least 115% of such reduced striking speed and an average retardation not exceeding 32.2' per second. In no case shall the stroke used under such conditions be less than 50% of the stroke required by 524 CMR 17.31(6)(a), or less than 17", whichever is greater.

(7) Car and counterweight oil buffers shall develop an average retardation not in excess of 32.2' per second and shall develop no peak retardation greater than 80.5' per second having a duration exceeding 1/25th of a second with any load in the car from contract load to a minimum load of 150 lbs. when the buffers are struck with an initial speed of not more than:
(a) 115% of contract speed where no speed retarding device is used, and
(b) 115% of the pre-determined reduced speed for buffers where a speed retarding device is used.

(8) Oil buffers shall be provided with means for determining that the oil level is within maximum allowable limits. Glass sight gauges shall not be used.

(9) Buffers shall be located symmetrically with reference to the vertical center line of the car frame or the counterweight frame within a tolerance of two inches.

(10) Counterweight buffers similar to those required for cars shall be installed symmetrically under the counterweights of power elevators.

17.31: continued

(11) Car and counterweight oil buffers shall be field tested by running on to them with the car and contract load and the counterweight, respectively, at contract speed with the normal terminal slow-down device inoperative and final limit switches operative. Where a speed retarding device is installed the buffers shall be field tested by running on to them at the reduced striking speed with the car and contract load and the counterweight, respectively, with the normal terminal slow-down device and the speed-retarding device inoperative, and final limit switches operative.

(12) Car and counterweight oil buffers when installed and filled with oil shall be fully compressed and, when released, the buffers shall return to the fully extended position within 90 seconds.

(13) Buffers of the spring return type shall be tested for plunger return with a 50 lb. test weight resting on the plunger during the test. The plunger shall be depressed two inches and, when released, the plunger while supporting the test weight, shall return to the fully extended position within 30 seconds.

(14) No field test of spring buffers is required.

(15) Car and counterweight oil buffers may be compressed not to exceed 25% of their stroke when the car is level with the terminal landings.

(16) Every oil buffer installed shall be provided with a metal plate marked by the manufacturer in a legible and permanent manner indicating:

(a) The maximum and the minimum loads and the maximum striking speed for which the buffer may be used.
(b) The permissible range in viscosity of the buffer oil to be used at 100°F.
(c) The viscosity index number of the oil to be used.
(d) The pour point in degrees F. of the oil to be used.

17.32: Counterweights

(1) Counterweights shall run on guide rails within the elevator hoistway.

(2) Where two counterweights run on the same guides, the car counterweight shall be above the machine counterweight and there shall be a clearance of not less than eight inches between the counterweights. The ropes of the machine counterweight shall be covered or protected by metal or fiber sleeves firmly attached to the rope. These sleeves shall be not less than six inches longer than the car counterweight. The ends of metal sleeves shall be carefully reamed before being placed on the ropes.

(3) Where an independent car counterweight is used, it shall be of a weight to prevent undue slackening in any of the ropes during acceleration or retardation of the car.

(4) All counterweight sections shall be secured by at least two tie rods passing through holes in all the sections. The tie rods shall have lock nuts at each end, secured by cotter pins.

(5) Counterweights shall be located only in the hoistway of the elevators to which they are connected.

(6) No elevator car shall counterbalance another car.

17.33: Control and Operating Devices and Systems: General

(1) The frame of the electric elevator machine, the frame of the controller, and frames of electric appliances in or on the elevator car shall be effectively grounded.

(2) No circuit-breaker operated automatically by a fire alarm system shall cut off the power of a power elevator.

17.33: continued

(3) Each electric power elevator driven by a polyphase alternating-current motor shall be provided with a device which will prevent starting the motor if:

(a) the phase rotation is in the wrong direction, or,

(b) there is a failure in any phase.

(4) Where an overload circuit-breaker is used for a direct current electric elevator, the wiring shall be arranged so that the circuit of the brake-magnet coil is opened at the same time that the line circuit is opened.

(5) Electric slack-rope switches shall be enclosed.

(6) The installation of condensers which may either by functioning or failure cause an unsafe operating condition is prohibited.

(7) No person shall at any time make any required safety device or electrical protective device inoperative, except where necessary during tests, inspections, and maintenance. Immediately upon completion of such tests, inspections, and maintenance, such devices shall be restored to their normal operating condition in conformity with applicable requirements of this code.

(8) Operation of an elevator in a leveling zone at any landing by a car-leveling zoning device when the landing doors and/or the car gates or doors are not in the closed position, is permissible subject to the following:

(a) Operating devices of the manually operated car-leveling devices shall be of the continuous pressure type located in the car.

(b) Car-platform guards conforming to 524 CMR 17.05(3) and 17.05(4) shall be provided; and where a car-leveling device is used, landing sill guards conforming to 524 CMR 17.13(9) shall also be provided.

(c) The landing zone at any landing shall not extend more than 30" above and 30" below any landing where an automatic leveling device is used, and not more than eight inches above and below where a manually operated leveling device is used.

17.34: Control Devices

(1) A fused disconnect switch or a circuit breaker shall be installed and connected into the power supply line to each elevator and dumbwaiter motor or to the motor of the motor generator set and controller. Disconnect switches or circuit breakers shall be of the manually closed multi-pole type, and their location shall conform to 524 CMR 17.34(2). Where circuit breakers are used as a disconnecting means, they shall not be of the instantaneous type and shall not be opened automatically by a fire alarm system. Where there is more than one driving machine in a machine room, disconnect switches or circuit breakers shall be numbered to correspond to the numbers of the driving machine which they control. (*See* 524 CMR 17.22(10).) All fused disconnect switches or circuit breakers shall be capable of being locked in the open position by January 1, 2006.

(2) The fused disconnect switch or circuit breaker shall be of the manually closed multi-pole type, and shall be located adjacent to and visible from the elevator machine or motor-generator set to which it is connected and shall be located in the machine room at the lock jamb side of the entrance door. The switch shall be located not more than 18” from the lock-jamb side of the entrance door and should not extend more than 5’-6” above the finished floor. In the case of multi-car machine rooms the switches or circuit breakers shall be grouped together as close as possible.

NOTE: For elevators installed prior to December 10, 1971, the switch must be adjacent and visible to the machine and located by the door only where practical.

(3) No provision shall be made to close the disconnecting switch from any other part of the building.

(4) No control system shall be used which depends on the completion or maintenance of an electric circuit for the interruption of the power and the application of electro-mechanical brakes at the terminals, for the application of safeties, or for the closing of contractor by an emergency button. 524 CMR 17.00 does not apply to dynamic braking or to speed control devices.

17.34: continued

(5) On electro-hydraulic elevators all stop valves shall be arranged so to be opened electrically and to be closed either by gravity or by springs in compression, or by hydrostatic pressure, or by any combination of the above.

17.35: Operating Devices

(1) No power elevator shall be operated by a direct hand-operated rope, cable, or rod, or by a wheel or lever mechanism which motivates an operating rope or cable.

(2) The maximum rated system or circuit voltage permitted in the operating devices of power elevators shall be 300 volts.

(3) The handle of car-switch operating devices shall be arranged to return to the "stop" position and lock there automatically when the hand of the operator is removed.

(4) Where more than one operating device of the car switch or continuous pressure type is used in a car, the operating devices shall be so interlocked that only one can be used at a time.

(5) Where a single operating device is used, it shall be so located as to be near the car opening serving the greatest number of landing openings.

(6) An emergency stop switch which will cut off the sources of power shall be provided in the car adjacent to the operating device for all elevators and shall be suitably identified and of a distinctive color.

(7) Emergency stop switches may be operated by buttons or levers but shall be of the manually opened and closed type so installed that when opened gravity will not tend to close the switch.

(8) An emergency stop switch shall be installed in the pit and on top of the car of every electric elevator, electric hydraulic elevator, and every hydraulic elevator equipped with an electrically operated valve. An emergency switch shall not be required on elevators equipped with hoistway covers or mechanical brakes. An emergency switch shall be installed in the pit of all elevators equipped with hoistway covers and an electric brake. The switch in the car top shall be located vertically near the center of the car crosshead facing the front of the car. The switch in the pit shall be located vertically not more than six inches below the top of the pit, and not to exceed two feet from the face of the landing opening in full view of the landing near the front of the car. When access to the pit is by means of an access door, this switch shall be so located as to be accessible from the pit access door. Where access to the pits of elevators in a multiple hoistway is by means of a single access door, the stop switch for each elevator shall be located adjacent to the nearest point of access to its pit from the access door. Every car top and pit emergency switch shall be provided with a red metal plate marked "EMERGENCY", permanently and securely fixed to the front of the switch. The height of the lettering shall be not less than ¼ inch.

(9) Contact of emergency stop switches or buttons shall be directly opened mechanically and shall not be solely dependent upon springs for the opening of the contacts.

(10) Temporary operating devices installed on the top of any elevator to operate the car by a licensed elevator mechanic for construction, inspection and testing purposes, may be used provided that such devices are operative only when the normal operating devices are inoperative and all hoistway doors are closed and locked is allowed. Access shall be as described in 524 CMR 17.07(5).

(11) For elevators installed after December 10, 1971, a rigidly mounted operating switch without extension cords shall be mounted on the top of the car for the purpose of operating the car for construction, inspection and testing purposes, subject to the following:

(a) The operating switch shall conform to the following requirements:

1. It shall be of the continuous-pressure button-operated type with the operating buttons located flush with the switch box cover plate and shall be permanently marked, "CAR TOP SWITCH" in letters not less than ¼ inch high.

17.35: continued

2. It shall be located on top of the car crosshead and on that side of the car which is nearest the car door facing the top access landing

3. It shall operate the car subject to the following:

At a speed not exceeding 150 feet per minute.

Only when the car door gate is closed and all hoistway doors are closed, and where required by the code, locked.

Only when all car and landing operating devices are inoperative and the movement of the car is solely under the control of this switch.

(b) The operating switch shall be made operative, subject to the limitations specified in 524 CMR 17.35(11)(a)3. only by the operation of a control switch conforming to the following requirements:

1. The control switch shall, except as provided in 524 CMR 17.35(11)(b)5., be located in the car operating panel or in a separate panel located adjacent to the operating panel.

2. The control switch shall be operated by a cylinder type lock having not less than a five pin or five disc combination which shall not be operable by any key which will operate any other lock or device used for any other purpose in the building, except the key operating the access switch permitted by 524 CMR 17.07(5).

3. The control switch key shall be removable in either the OFF or ON position.

4. The control switch key shall be available to and used only by licensed elevator mechanics or an authorized state inspector.

5. In lieu of locating the key control switch in or adjacent to the car operating panel it may be mounted on the elevator controller in the elevator machine room.

(c) Separate additional means of the continuous pressure type may be provided on the car top to make power door operating devices and automatic car leveling devices operative for testing purposes.

(12) One lead to the emergency stop switch shall be run to the car through a separate and independent traveling cable where elevators have winding-drum machines.

(13) Where springs are used to break the circuit to stop an automatic-operation elevator at the terminal, they shall be of the compression type.

(14) The completion of another electric circuit shall not be depended upon to break the circuit to stop an automatic-operator elevator at the terminals. The interruption of the electric circuit shall prevent the movement of the car.

(15) Levers of operating devices for car switch operation elevators shall be so arranged that the movement of the lever toward the car gate which the operator usually faces will cause the car to descend and the movement of the lever away from the gate will cause the car to ascend. The direction of travel shall be indicated on the car switch.

(16) Automatic-operation elevators shall conform to the following requirements:

(a) When the car has started for a given landing, no impulse may be given from any landing to send the car in the reverse direction until the car has reached the destination corresponding to the first impulse. The car may stop at any intermediate landing to take on or discharge passengers going in the original direction.

(b) When the car has been stopped to take on or discharge passengers and is to continue in the direction determined by the first impulse, the car may be started by the closing of the car door or gate contact.

(c) The car cannot be started under normal operation by the operating devices unless every hoistway door is closed and locked in the closed position and every car door or gate is closed in the closed position.

(17) Continuous-pressure operation shall not be used for elevators unless they are provided with all of the safety devices required for automatic operation.

(18) Load-weighing devices which will prevent operation of the elevator shall not be installed in connection with passenger elevators.

17.35: continued

(19) Operation of an elevator in a leveling or truck zone at any landing by a car-leveling or truck-zoning device, when the landing doors and/or car doors or gates are not in the closed position, is permissible subject to the following:

(a) Operating devices of manually operated car-leveling devices or truck-zoning devices shall be of the continuous pressure type located in the car. See 524 CMR 17.05(3)(b).

(b) Car-platform guards conforming to 524 CMR 17.05(3) shall be provided; and where a car-leveling device is used, landing-sill guards conforming to 524 CMR 17.05(3) shall also be provided.

(c) The leveling zone at any landing shall not exceed more than 30" above or below any landing where an automatic leveling device is used, and not more than eight inches above or below where a manually operated leveling device is used.

(d) The truck zone at any landing shall not extend more than five feet six inches above the landing.

(e) Where a truck or leveling zone for one hoistway entrance extends into the door interlocking zone for a second entrance, the truck zoning or leveling operation shall be inoperative unless the hoistway door at the second entrance is in the closed position.

Where a truck or leveling zone for one hoistway entrance extends into the leveling zone for a second entrance, the leveling operation for the second entrance shall be inoperative while the hoistway at the first entrance is open.

EXCEPTION: The car may be operated by a car-leveling device at any landing having two hoistway entrances within two inches of the same level, with both car doors or gates and the corresponding hoistway doors open, provided landing-sill guards conforming to 524 CMR 17.05(4) are installed at both floors.

(20) A stop switch conforming to the requirements of 524 CMR 17.35(8) shall be provided for each elevator in the overhead machinery space in the hoistway, adjacent to the lock jamb side of the door.

17.36: Terminal Stopping

(1) Power elevators shall be provided with upper and lower normal terminal stopping devices arranged to stop the car automatically from any speed attained in normal operation within the top and bottom overtravel independently of the position of the operating devices and the final terminal stopping devices and before the buffer is fully compressed.

(2) Normal terminal stopping devices shall be installed in connection with power elevators as follows:

(a) Electric power elevators having winding-drum machines shall have stopping switches on the car or in the hoistway, operated by the movement of the car.

(b) Electric power elevators having traction machines shall have stopping switches on the car, or in the machine room or in the hoistway operated by the movement of the car. If located in the machine room, the stopping contacts shall be mounted on and operated by a stopping device mechanically connected to the car, and with no dependence on friction as a driving means. An automatic safety switch shall be provided which will stop the machine should the tape, chain, rope, or other similar device mechanically connecting the stopping device to the car, fail. In the case of electric power elevators using floor controllers or other similar devices for automatic stopping at the floor landings, only one set of floor-stop contacts is necessary for each terminal landing, provided these contacts and the means for operating them comply with the requirements for terminal stopping devices. These contacts then serve also as normal terminal stopping devices.

(3) Electric power elevators shall be provided with upper and lower final terminal stopping devices arranged to stop automatically the car and counterweight from contract speed within the top clearance and bottom overtravel independently of the operation of the normal terminal stopping devices and the operating device, but with buffers operative. Final-limit switches shall be set to operate with the car as close to the terminal landing as practical without interfering with the normal operation of the elevator. Where spring buffers are provided, the final-limit switches shall be set to open before the buffer is engaged. Where oil buffers are provided and also means to prevent jumping of the car or counterweight, the final-limit switch shall open before the buffer is fully compressed.

17.36: continued

(4) Final terminal stopping devices shall be installed in connection with electric power elevators as follows:

(a) Electric power elevators having winding-drum machines shall have stopping switches on the machines and also in the hoistway operated by the movement of the car.

(b) Electric power elevators having traction machines shall have stopping switches in the hoistway operated by the movement of the car.

(c) Final terminal stopping devices are not required on electro hydraulic elevators.

(5) The final terminal stopping device shall act to prevent movement of the car in both directions of travel. The normal and final terminal stopping devices shall not control the same switches on the controller unless two or more separate and independent switches are provided, two of which shall be closed to complete the motor and brake circuit in each direction of travel.

When two-phase or three-phase alternating current is used to operate the elevator, the above switches shall be of the multi-pole type. If the final terminal stopping device controls the same controller switch or switches as the operating device or the normal terminal stopping device, it shall be connected into the control circuit on the opposite side of the line.

(6) Chain, rope, or belt driven final machine terminal stopping devices shall not be used for power elevators having winding-drum machines.

(7) Electric power elevators having winding-drum machines driven by two-phase or three-phase alternating-current motors shall have the mainline circuit to the motor and brake directly opened either by contact in the machine stop-motion switch or by hoistway limit switches operated by a cam attached to the car. The opening of these contacts shall take place before or coincident with the opening of the final terminal stopping device and shall prevent movement of the machine in either direction.

Elevator machines with alternating current motors and direct current brakes and direct current mainline potential switches controlled by final terminal hoistway stopping switches do not require a mainline machine stop motion switch.

(8) Normal and final terminal stopping switches, whether on the car or in the hoistway, shall be of enclosed type. Normal and final terminal stopping devices, where on the car or in the hoistway, shall be securely mounted in such a manner that the movement of the switch lever or roller to open the contacts shall be in a direction as nearly at right angle as is possible to a line drawn between the face of the car guide rails. The cam or cams for operating the terminal stopping switches shall be of metal and shall be so located and of sufficient length to maintain the switch in the open position when the car is in contact with the overhead structure or resting on the fully compressed buffer with the overhead structure and the buffer in their normal position.

(9) The contacts of all terminal stopping devices shall be directly opened mechanically. Spring or gravity arrangements permitting the opening of the contact on withdrawal of the cam, lug, or similar device are prohibited.

17.37: Signals

(1) Landing Signals. Every power elevator, other than continuous pressure operation, automatic operation type elevators and elevators arranged to stop automatically at the floor landings, shall be equipped with a signal system indicating the landing at which the car is desired.

(2) Emergency Signals. Every elevator shall be provided with an emergency signal audible outside of the hoistway that is operative from within the car. It may also be provided with two-way communication connected to a location that can respond with aid on a 24 hour basis.

17.38: General

Connections. Connections between members of car frames and platforms shall be riveted, bolted, or welded, and shall conform to the following:

17.38: continued

(1) Bolts. Bolts, where used through sloping flanges of structural members, shall have bolt heads of the tipped-head type or shall be fitted with beveled washers.

(2) Nuts. Nuts, used on sloping flanges of structural members, shall seat on beveled washers.

(3) Welding. Welding of all parts of apparatus governed by 524 CMR 15.00 through 35.00 and upon which safe operation depends shall be done in accordance with the appropriate standards established by the American Welding Society.

17.39: Fire Emergency Service - Automatic Passenger Elevators

(1) All automatic passenger elevators described as follows must be provided with fire emergency service as described in American National Standard ASME A17.1-1991 with .MA Modifications 524 CMR 35.00:

(a) All automatic passenger elevators having a travel of 70 feet or more from the lowest accessible grade elevation surrounding the building must have fire emergency service.

(b) All automatic passenger elevators installed after July 24, 1987 having a travel of 25 feet or more must have fire emergency service.

NOTE: If any other automatic passenger elevator not included in 524 CMR 17.39 (1)(a) or (b) has fire emergency service of any kind, it shall also operate in accordance with ASME A17.1-1991 with Massachusetts Modifications 524 CMR 35.00.

(2) Switch Keys. Fire service shall only be activated with the use of the 3502 key and cylinder. The possession of the Massachusetts Firefighters key number 3502 shall be limited to fire department personnel, Massachusetts licensed elevator mechanics and Massachusetts elevator inspectors employed by the Department of Public Safety. This key shall not be a part of a building master key system.

(3) Fire Emergency Sign re. Use of Stairways. There shall be a sign securely fastened to the wall over every hall button station. Minimum size shall be 3¼" x 2¼". The lettering shall be impressed or engraved on a contrasting background, and shall read and be sized as follows

In Case of	⅛ inch equals 14 point lettering	Color: Black
Fire	⅜ inch equals 30 point lettering	Color: Red
In This Building	⅛ inch equals 14 point lettering	Color: Black
Use Exit Stairways	3/16 inch equals 16 point lettering	Color: Red
Do Not Use This Elevator	⅛ inch equals 14 point lettering	Color: Black

(4) Responsibility of the Fire Department.

(a) On completion of the elevator installation and safety test, the elevator contractor shall notify the local fire department to have an authorized representative available to receive instructions by the elevator manufacturer or his agent on the purpose, operation, and use of the firefighter's keyed switch. 524 CMR 17.39(4)(a) shall also apply to witness a demonstration from the elevator manufacturer, or agent thereof, relative to the purpose, operation and use of the hoistway door unlocking device. The unlocking device for that manufacturers' door shall be secured at a location in the building that is readily accessible to the fire department. If all the door panels and interlocks are replaced on a new or existing elevator, hoistway door unlocking devices for use only by Massachusetts licensed elevator mechanics and trained firefighters are required. 524 CMR 17.39(4)(a) shall apply to all new installations.

(b) All elevators operated by the use of the firefighter's keyed switch and the safety of all persons carried by or permitted to use such elevators during firefighting operations shall be the sole responsibility of the local fire department during firefighting operations.

(c) The opening of car doors and landing doors and the closing of same shall be the sole responsibility of the local fire department during firefighting operations.

(d) When elevators or elevator machine rooms have been involved in damage by a fire the local fire department shall notify the state or local elevator inspectors having jurisdiction. A thorough inspection shall be made by authorized elevator inspectors to determine that all systems continue to function as required by 524 CMR.

17.39: continued

(e) The fire department shall utilize a Lock-out Tag-out (LOTO) procedure on the electrical main line of the elevator equipment during fire department operations including extrications. A written procedure relative to removal of the lock shall be printed on the affixed LOTO tag to facilitate speedy removal for an incoming Massachusetts licensed elevator mechanic.

(5) Auxiliary Generators for Emergency Power. All automatic passenger elevators installed in new buildings after June 12, 1972 with a travel of 70 feet or more from the lowest grade elevation surrounding the building are required to have auxiliary generators for emergency power as follows:

NON-TEXT PAGE

17.39: continued

An auxiliary generator shall be provided of sufficient capacity and proper rating to supply elevator circuits in conjunction with the operation of fire emergency service. Said auxiliary generator shall be capable of handling the emergency load and shall start automatically within 25 seconds from the time the normal power has dropped to a pre-determined value as sensed by the automatic starting device for the auxiliary generator. The auxiliary generator shall have sufficient power to operate at least one elevator at a time on firefighter's keyed switch service with full load at a minimum of one third it rated speed with a maximum of 500' per minute. The system shall have the capability to transfer the emergency power to any elevator car on emergency firefighter's service through transfer switch arrangements or other suitable means. NOTE: Should any elevator regardless of travel or installation date have an auxiliary generator for emergency power, it shall operate as described above.

(6) Penalty. Any person violating or failing to comply with any provision of 524 CMR 17.39 or any regulation established hereunder shall be punished by a fine of not more than $500.00.

17.40: Medical Emergency

(1) Medical Emergency Elevators.

(a) All new buildings, or complete new additions to existing buildings in which an elevator is being installed, and for which building permits were issued on or after January 1, 2010 shall be provided with at least one passenger elevator designed to accommodate the loading and transportation of an ambulance gurney or stretcher (24" wide by 84" long with 5" radius corners) in its horizontal position. Any building or complete new addition to an existing building for which a building permit was issued between January 20, 1989 and December 31, 2009, in which an elevator was installed shall have been provided with at least one passenger elevator that is able to accommodate the loading and transportation of an ambulance gurney or stretcher sized 22 ½" wide by 75" long in its horizontal position. This elevator shall serve all landings of the building or if the building is divided into banks one car in each bank shall conform to 524 CMR 17.40. Complete new additions to existing buildings shall mean a hoistway constructed outside the confines or footprint of the existing building.

(b) Elevators installed after January 20, 1989 which have E.M.S. features, or equipment that is being installed, or was on order prior to the filing date of this change, shall conform to 524 CMR by June 1, 1993.

(c) The hoistway and car shall be provided with power operated passenger type horizontally sliding doors, minimum size to be 42" wide by 78" high. When center opening doors are used they shall be located on the narrow end of the car or car size and/or the door size will be altered to comply with 524 CMR 17.40(1)(d).

(d) Elevator capacity, platform size, and entrance configuration of medical emergency elevators installed pursuant to 524 CMR 17.40(1) shall be capable of accommodating the designated gurney or stretcher with equivalent ease

(2) Medical Emergency Key Switches and Markings.

(a) This elevator shall be controlled by a two position key switch at the main floor of a building and by a similar key switch in the car operating panel. The lock and key shall be that manufactured by Medeco Security Locks, Inc. and the key number shall be 65W-2650-T101-26-R7. The lock shall be arranged so that the switch shall be off when the key is in a vertical position and it shall be on when the key cut is facing approximately 90˚ to the right of the vertical. The key shall only be removable in the off position.

(b) Only elevator companies or manufacturers authorized by the Massachusetts Department of Public Safety, Elevator Section may order this lock.

(c) Only personnel authorized by the Massachusetts Department of Public Safety, Elevator Section may purchase this key.

(d) Both locks shall be identified with the words "MEDICAL EMERGENCY" engraved adjacent to the lock. The lettering shall be a minimum of 14 points with lettering or background color blue.

17.40: continued

(3) Medical Emergency Operation.

(a) When the main floor key is turned to the on position, it shall activate a continuous audible signal in the car which can be the same signal used for fireman's service. It shall also activate a visual signal in the car and at the main floor key call station that reads Medical Emergency. All car calls shall be canceled and be unable to be re-registered. The car shall not accept any hall calls after this service is activated.

(b) When the car is in motion, the in car stop switch shall be de-activated.

(c) When the car is moving toward the main floor it shall return non-stop and open its doors on arrival. It shall not comply with 524 CMR 17.40(3)(b), until the car begins to move.

(d) When the car is moving away from the main floor it shall reverse direction at the next available floor without opening its doors and return non-stop to the main floor.

(e) When the car is at a floor, other than the main floor with its doors open, they shall close without delay, and the car return to the main floor.

(f) The car shall return to the main floor after being called by the EMS main floor switch and open its doors even if the main floor EMS key switch has been returned to the off position during travel. On arrival at the main floor the audible signal in the car shall cease.

(g) Upon arrival at the main floor the doors shall open and if the main floor EMS key switch is "on" they shall remain open until that switch is turned "off". If the main floor EMS key switch is "off" the visual signals shall remain illuminated for a minimum of 60 seconds. During this delay the EMT must insert his key into the car control panel and turn it to the "on" position to retain control of the car. Upon expiration of the delay, without the key in the car being turned on the car shall return to normal service.

(h) If the elevator is an automatic car with attendant or independent service operation it shall activate its audible and visible signal and if on attendant service shall return to automatic operation after a minimum of 15 seconds and a maximum delay of 60 seconds and then proceed to the main floor.

(4) Car Operation.

(a) Upon entering the car it shall not accept a car call until the in car EMS key switch is turned to the on position. After turning that key on and registering a call, the car shall automatically close its doors and proceed to the call. All door zone detection devices shall be operative. If more than one call is registered, it shall stop at the first call and cancel all others at which time a second choice can be made.

(b) Upon arriving at the desired floor, the doors shall open automatically and the EMT shall remove his key when the switch is in the off position, the car shall then remain at that floor and will not accept a call or move away from that floor until the key is again turned on.

(c) The car must be returned to the main floor on EMS service and the key removed in its off position before returning the car to normal operation.

(d) If the car is on any form of special service such as inspection, firefighters, etc., when EMS service is initiated the audible and visible signals in the car shall be activated but the car shall not respond to the main floor EMS call.

(e) If the car has responded to a Medical Emergency call prior to a call for fireman's service, the EMT call for service shall not be overridden by firefighters service call until it returns to the main floor but the fireman's service audible and visible signals shall be activated.

(5) Designation. Medical Emergency Service shall be identified as follows:

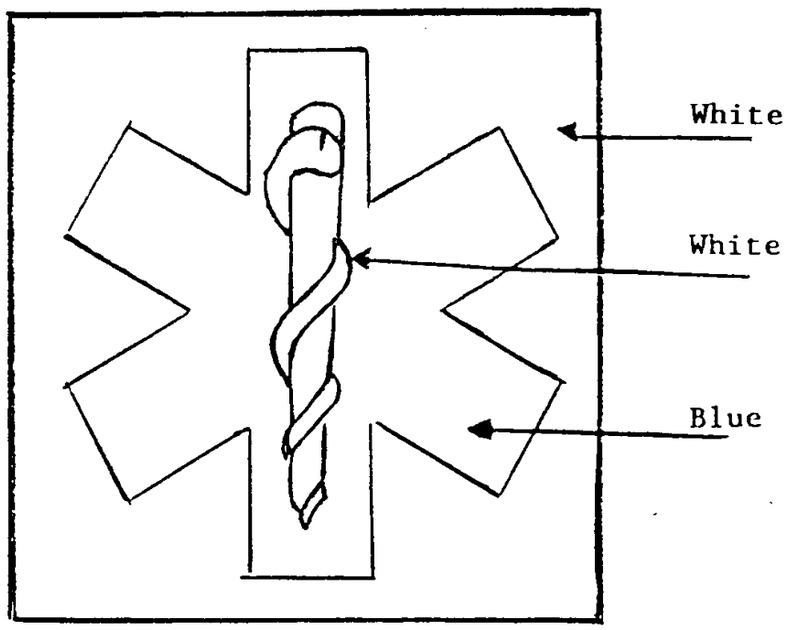
(a) At the main floor this elevator shall be identified by the national medical symbol (star of life), shown below.

(b) These symbols (two) shall be permanently attached to the hoistway door frame on each side of that frame at right angles to the sill at a height not less than 66" and not more than 78" above the floor level at the sill.

(c) The symbol shall be blue in color with contrasting background, the staff and serpent shall be white.

(d) The symbol itself shall be two to three inches in height.

17.40: continued



EXCEPTIONS: The following elevator installations need not comply with 524 CMR 17.40:

(a) Elevators in structures such as rock quarries, steel towers, dams, storage bins, smoke stacks, tanks (and other special industrial installations) where the elevators are used only by maintenance and operating personnel or in hospitals where the normal services of an EMT are available.

(b) Elevators in buildings or structures where each landing is at ground level or is accessible to ground by a ramp.

(c) Elevators in buildings or structures equipped with stairs that extend no more than one floor above or below the building entrance grade and with a configuration that shall accommodate the carrying of a gurney or stretcher on said stair and when said stair conforms to 780 CMR *et seq.* (the Massachusetts State Building Code) and is permitted by the authority having jurisdiction.

17.41: Registration of Freight Elevators Exempt under St. 1962, c. 288

(1) All freight elevators installed prior to July 1, 1989 are governed by 524 CMR 17.01 through 17.40 unless granted exempt status by the Board pursuant to St. 1962, c. 288. If granted exempt status, the freight elevator will be governed by 524 CMR 17.41 through 17.50. In order to be granted exempt status, a freight elevator owner must submit an application for exempt status to the Board, on a form provided by the Board. The Board may either act upon the application on its face, or convene a hearing.

(2) If granted exempt status, the Board shall issue a certificate of registration for the elevator to the owner or to the person in charge of the freight elevator. The owner or person in charge shall post the certificate in a conspicuous place in the elevator's machine room.

(3) An owner or the person in charge on an elevator denied exempt status by the Board, may appeal the decision to the Board of Elevator Appeals, pursuant to M.G.L. c. 143, § 70, within 30 days of receipt of the Board of Elevator Regulations' decision.

17.42: Hydraulic Cylinders for Freight Elevators Exempt under St. 1962, c. 288

All hydraulic cylinders buried in the ground that were installed without a safety bulkhead shall have a governor-operated safety or a plunger gripper installed by July 1, 2011.

17.43: Car Frames for Freight Elevators Exempt under St. 1962, c. 288

(1) Car suspension frames, platform frames, and platform stringers of freight elevators granted exempt status pursuant to Chapter 288 of the Acts of 1962 shall be constructed of steel meeting not less than the requirements of the American Society for Testing Materials (ASTM) specification A7.

(2) The stresses of rolled steel sections or annealed cast steel used in the construction of car frames and platforms based on the static load imposed on them, including the weight of the unloaded car and the maximum rated carrying capacity, shall not exceed the values given in 524 CMR 17.13: *Table 2* for freight cars.

The stresses tabulated in 524 CMR 17.13 are based on steels having an ultimate strength from 55,000 to 65,000 pounds per square inch for rolled sections or cast steel and 46,000 to 56,000 pounds per square inch for rivets. For steels of greater ultimate strength, the allowable stresses may be increased proportionately. However, any such deviating proportionality calculations must be performed and stamped by a registered Professional Engineer (P.E.) and submitted to the Board for approval.

(3) No cast iron shall be used in the construction of any member of the car frame or platform subject to tension or bending. Cast iron may be used for compensating cable anchorages, releasing carriers, and guideshoe stands.

(4) The deflection of crosshead and safety plank shall not exceed ⅛ inch in each ten feet of span under static conditions with contract load substantially uniformly distributed over the car platform.

(5) The slenderness ratio L/R for members not normally subject to compression shall not exceed 250; for members normally subject to compression this ratio shall not exceed 120. Loading resulting from buffer and safety operation shall not be considered normal loading.

(6) No glass shall be used in freight elevators except to cover certificates, lighting fixtures, vision panels and appliances necessary for the operation of the car.

(7) There shall be no obstructions or projections in the car floor.

(8) Where platform floors are constructed of wood or other combustible materials they shall be covered on the underside with sheet metal of not less than No. 27 U. S. Gauge thickness.

(9) Elevators provided with car leveling or inching devices shall have their platforms provided with a metal guard not less than No. 16 U. S. Gauge in thickness. This guard shall extend horizontally the full width of the car entrance and vertically below the car floor for not less than the depth of the leveling or inching zone plus three inches. The lower edge of the guard shall be beveled at an angle of not less than 70 degrees with the horizontal.

(10) The requirements for loading classifications can be found in 524 CMR 33.00. Satisfaction as to compliance will be evidenced by the manufacturer's certificate.

(11) Welding of parts upon which safe operation of all equipment contained in 524 CMR depends shall be done by American Welding Society (AWS) certified welders; and all work upon completion shall be approved by the state elevator inspector before the unit is placed in service.

EXCEPTION: Tack welds not later incorporated into finished welds carrying calculated loads.

(12) Full compliance with all provisions of 524 CMR 17.43 is required by July 1, 2011.

17.44: Machines and Machinery for Freight Elevators Exempt under St. 1962, c. 288

Beginning on July 1, 2011, freight elevators granted exempt status pursuant to St. 1962, c. 288 shall be direct drive as defined in 524 CMR 3.00 and shall meet the following requirements:

17.44: continued

(1) Drums and leading sheaves shall be of cast iron or steel, and shall have finished grooves. U-grooves shall be not more than 1/16 inch larger than the ropes. The pitch diameter of sheaves or drums for hoisting or counterweight ropes shall be not less than 40 times the nominal diameter of the rope. Opening in drums shall be drilled at an angle of not over 45 degrees with the run of the rope and shall be provided with a rounded corner with a radius at least equal to that of the rope.

(2) The factor of safety based on the static load to be used in the design of elevator hoisting machines shall be not less than ten for cast iron, cast steel, or materials other than wrought iron or wrought steel. For wrought iron or wrought steel, the factor of safety shall be eight.

(3) No set-screw fastenings shall be used in *lieu* of keys or pins if the connection is subject to torque or tension. Shafts which support drums, gears, couplings and other members and which transmit torque shall be provided with tight fitting keys. A fillet shall be provided at any point of change in the diameter of driving-machine sheave shafts, or drums to prevent excessive stress concentrations in the shafts.

(4) No friction gearing or clutch mechanism shall be used for connecting the drums or sheaves to the main driving gear of power elevators.

(5) No belt or chain-driven machine shall be used to drive any power elevator.

(6) No worm gearing having cast iron teeth shall be used for any power elevator machine.

(7) Electric elevator machines shall be equipped with electrically released brakes which are applied by compression springs. No brakes shall be released until power has been applied to the motor.

(8) No single-ground, short-circuit, or counter-voltage shall prevent the action of the brake magnet from allowing the brake to set in the intended manner during normal operation. No motor field discharge, counter-voltage, single ground, or accidental short-circuit shall retard the action of the brake magnet in allowing the brake to set during emergency stops.

(9) Welding of parts on which safe operation depends shall be done in accordance with the appropriate standards established by the American Welding Society. All welding of such parts shall be done by welders certified by the American Welding Society.

(10) When machinery of more than one elevator is in a machine room, each elevator machine shall be assigned a different elevator number which shall be painted on or securely attached to the driving machine and visible from the disconnect switch. The corresponding disconnect switch shall carry the same elevator number.

17.45: Guide Rails for Freight Elevators Exempt under St. 1962, c. 288

(1) Guide rails for cars and counterweights on freight elevators granted exempt status pursuant to St. 1962, c. 288 shall be made of steel. Where steel rails present an accident hazard, as in chemical or explosive industries, wood guide rails may be used. Guide rails for cars and counterweights on exempt freight elevators shall follow the guide rail dimensions provided in 524 CMR 17.30(1) TABLE 1. *Guide Rail Dimensions*. However, counterweight rails made of wood which were installed prior to March 9, 1950, may remain provided that no other wood is present in the hoistway.

(2) Length of Guide Rails.

(a) For hydraulic elevators where the car is secured directly to the top of a hydraulic plunger, the guide rails shall be extended at the top and bottom to prevent the guide shoes from running off when the plunger is fully extended or fully compressed.

(b) For all other power elevators, the guide rails shall be continuous from the bottom to the top of the hoistway.

17.45: continued

(3) Weight of Guide Rails. The weight of steel guide rails shall not be less than given in 524 CMR 17.30(3) TABLE 2.

(4) Joints of Steel Guide Rails. Joints of steel guide rails shall be:

(a) Accurately machined with tongue and groove through the webs at right angles to the base and through the flanges parallel to the base, and fitted with fishplates each secured with not less than four substantial bolts through each rail; or,

(b) Accurately machined with tongue and groove through the webs and with backs of the flanges where the fishplates bear accurately machined at right angles to the tongue and groove and fitted with finished fishplates each secured with not less than four substantial bolts through each rail.

(5) Guide Rail Bolts. Guide rail bolts for fishplates, ties, brackets, backing, clips through bolts, and supports shall be not less than the sizes given in 524 CMR 17.30(3) TABLE 5.

(6) Guide Rail Brackets.

(a) Guide rails shall be securely fastened in position with brackets, through bolts, ties, clips, or backing of steel of such strength, design, and spacing that the guide rails and their fastenings shall not deflect between supports more than ¼ inch under normal operation. Welding may be used to fasten rail supports to building steel provided the welding is done by an American Welding Society certified welder.

(b) Where the supports are more than 14 feet on centers, rail backing shall be used regardless of the deflection under normal operation.

(c) Where an elevator is intended to handle heavy loads, the guide rails, fastenings, backing, brackets, and supports shall be designed to sustain the thrusts imposed upon them when a concentrated load is on the car sill in addition to when the concentrated load is in place on the car platform.

(d) Guide Rail Brackets and Building Supports. Design and strength of Brackets and Supports. The building construction forming the supports for the guide rails, and the guide rail brackets, shall be of such design as to:

1. safely withstand the application of the car or counterweight safety when stopping the car and its rated load or the counterweight; and

2. withstand the forces specified in 524 CMR 17.16 within the deflection limits specified.

Where necessary, the building construction shall be reinforced to provide adequate supports for the guide rails. All calculations necessary to achieve compliance with 524 CMR 17.45(6)(d) must be performed and stamped by a registered Professional Engineer (P.E.).

(7) Bolt Holes. Bolt holes in steel beams for bracket bolts shall not exceed the diameter of the bolt by more than 1/16 inch. Such bolt holes shall be drilled or punched. They shall not be cut with a torch.

(8) Wood Guide Rails. Where the use of steel guide rails creates an explosion hazard, the use of wood guide rails is permitted, provided that:

(a) the contract speed is not in excess of 100 feet per minute; and,

(b) the guide rails are of straight grained maple without knots; and,

(c) the size of the rails is either not less than 2 inches x 2½ inches where the car and load is not in excess of 5,000 pounds or not less than 2⅝ inches x 3 inches where the car and load is not in excess of 8,000 pounds; and,

(d) all elevator related electrical equipment shall be National Electrical Manufacturers Association (NEMA) class 1, division 1 rated.

(9) Use of Car or Counterweight Safeties. Where car or counterweight safeties are used, the guide rails and their supports shall be capable of withstanding the application of the safety when stopping the car with contract load or the counterweight when descending at governor tripping speed.

(10) Full compliance with all provisions of 524 CMR 17.45 is required by July 1, 2011.

17.46: Car and Counterweight Safeties for Freight Elevators Exempt under Sr. 1962, c. 288

(1) Freight elevators granted exempt status pursuant to St. 1962, c. 288 which are suspended by ropes shall be equipped with car safeties installed in or on a safety plank located beneath the car platform. Where multiple-type safeties are installed, one such safety shall be located in or on the safety plank located beneath the car platform. The safety or safeties shall be capable of stopping and sustaining the car with contract load.

(a) The application of the safety shall not cause the car platform to become out of level in excess of ½ inch per foot, measured in any direction.

(b) When the car safety is applied, no decrease in the tension of the governor rope or motion of the car in the descending direction shall release the car safety.

(c) It is permissible to release the safety by reversing the direction of the motion of the machine.

(d) Car safeties shall be operated by speed governors.

(e) Jaws and other parts of safeties of the sliding type, if made of forged steel of an ultimate strength of not less than 55,000 pounds per square inch and cast steel of an ultimate strength of not less than 65,000 pounds per square inch, may, in action, be stressed to 17,000 pounds per square inch. For steels of greater strength the allowable stresses may be increased proportionately based on ultimate strength.

Cast iron shall not be used in any part of a car safety, the breakage or failure of which would result in failure of the safety device to function, to stop the car and sustain the load.

(f) Bearings for safety drums and screw-shafts shall be of non-ferrous material.

(g) Where two (duplex) safeties are provided, the lower safety device shall be capable of developing not less than one half of the force required to stop the entire car with rated load. Duplexed safety devices shall be arranged so as to function approximately simultaneously.

Types A or Type C safety devices (*see* 524 CMR 17.16(20)) shall not be used in multiple.

(h) Type B safeties shall stop the car with its rated load from governor tripping speed within the range of the stopping distances shown in 524 CMR 17.16: TABLE 2. *Maximum Speeds at Which Speed Governor Trips and Governor Overspeed Switch Operates*.

(2) Exempt freight elevators shall comply with the maximum and minimum stopping distances for Type B car safeties with rated load as provided in 524 CMR 17.16: TABLE 1. *Maximum and Minimum Stopping Distances Type B Car Safeties with Rated Load, and of Type B Counterweight Safeties*.

(3) Full compliance with all provisions of 524 CMR 17.46 is required by July 1, 2011.

17.47: Operating Devices for Freight Elevators Exempt under St. 1962, c. 288

Beginning on July 1, 2011, no power freight elevator granted exempt status pursuant to St. 1962, c. 288 shall be operated by a direct hand-operated rope, cable, or rod, or by a wheel or lever mechanism which motivates an operating rope or cable.

17.48: Variances

(1) Application. If the owner of a freight elevator granted exempt status pursuant to St. 1962, c. 288 believes that full compliance with 524 CMR 17.00 would be overly burdensome, the owner or owner's designee may apply to the Board for a variance from any provision of 524 CMR 17.00. The burden shall be on the applicant to demonstrate that compliance with a specific provision of 524 CMR 17.00 is overly burdensome and that the granting of the variance would not compromise public safety or otherwise undermine the purpose of 524 CMR 17.00. Application for a variance shall be made on a form provided by the Board for this purpose, shall be accompanied by any supporting documentation on which the applicant seeks to rely, and shall be signed by the applicant.

In determining whether to grant a variance, the Board's consideration may include, but will not be limited to, the following elements:

(a) the use of the elevator/whether it carries exclusively freight;

(b) the age of the elevator;

(c) the maintenance/safety history of the elevator;

(d) the distance the elevator is capable of traveling;

17.48: continued

(2) Board Action. Upon receipt of an application for a variance, the Board or its designee may:
(a) Grant the application with whatever conditions are deemed appropriate;
(b) Deny the application without a hearing;
(c) Schedule a hearing before the Board.

(3) Appeal. Any person aggrieved by the Board of Elevator Regulations' action on a variance request application may file a request for an adjudicatory hearing before the Board of Elevator Appeals within 30 days of receipt of the decision pursuant to M.G.L. c. 143, § 70. All adjudicatory hearings shall be held in accordance with the provisions of M.G.L. c. 30A and 801 CMR 1.02. Any person aggrieved by a decision of the Board of Elevator Appeals after a hearing may appeal to the Superior Court in accordance with M.G.L. c. 30A, § 14.

17.49: Training in the Use and Operation of Elevators Exempt under St. 1962, c. 288

In addition to 524 CMR 1.09, owners of elevators granted exempt status pursuant to St. 1962, c. 288 shall be responsible for training all individuals who use said elevators in their safe and proper use and operation. Owners must document the training and keep it on file. Documentation of the training must include the name of the individual trained, the date of the training, the content of the training, and a notation of any materials provided to the trainee. A copy of the training documentation shall be immediately provided to the Board upon request.

17.50: Non-compliance with 524 CMR 17.41 through 17.49 and Shut Down Orders

Non-compliance with any provision of 524 CMR 17.41 through 17.49 shall be grounds for immediate shut down of the affected elevator(s). An inspector of the Department of Public Safety may shut down any elevator granted exempt status pursuant to St. 1962, c. 288 for non-compliance with any provision of 524 CMR 17.41 through 17.49 or if a determination is made that the elevator is unsafe to operate. The elevator shall remain shut down until the issues leading to the shut down are remedied and the elevator is cleared to operate by an inspector. Shut down orders as given by the Board or an inspector may be appealed pursuant to M.G.L. c. 143, § 70.

REGULATORY AUTHORITY

524 CMR 17.00: St. 2006, c. 45; M.G.L. c. 143, §§ 68 and 69.