

Part IV

GENERAL REQUIREMENTS

SECTION I. SHAFTWAY CONSTRUCTION.

Order 410.—Passenger Elevator Shaftway Enclosures. New Installations.

(a) The shaftway of every new passenger elevator installation shall be completely enclosed on all sides with a fireproof enclosure made of wired glass in metal frame, or solid incombustible plaster not less than 2 inches thick on metal lath and metal frame, all metal well covered; or of brick, concrete, approved hollow building units (clay or concrete tile or blocks) of sufficient thickness to give rigidity. Every fireproof enclosure shall be extended to the roof, or shall be covered at the top with a fireproof floor.

(b) Every shaftway entrance and other shaftway opening shall be protected by an approved fire door, except that wired glass may be used in the upper section of any such door. Every window in such a shaftway enclosure, except in outside walls, shall consist of metal frame, metal sash and wired glass.

See also orders 421, 422, 423 and 435.

Note: Doors in outside walls of elevator shaftways need not be fireproof except in cases where fire doors are required by the State Building Code.

Order 411.—Freight Elevator Shaftway Enclosures. New Installations.

(a) The shaftway of every freight elevator and dumbwaiter hereafter installed in a building more than two stories in height (excluding basement), or in a building three stories or less in height where the travel exceeds 30 feet, shall be completely enclosed on all sides with a fireproof enclosure as specified in order 410; except that no fireproof enclosure is required in a three story building without basement where the travel of the car does not exceed 30 feet, and where the building complies with one of the following:—

- (1) used as a warehouse only;
- (2) of fireproof construction and with the contents practically incombustible;
- (3) equipped with a complete automatic sprinkler system.

Note: An open balcony or mezzanine is not considered a story.

(b) In any three story building of frame construction, with or without basement, the elevator shaftway enclosure above the basement may be semi-fireproof, instead of fireproof, but if the shaftway extends to the basement the enclosure in the basement shall be fireproof.

(c) The shaftway of every new elevator installation shall be completely inclosed in the basement with a fireproof enclosure as specified in order 410, except freight elevators in shaftways not over one story in height above the basement.

Note: Where an elevator is located under a roof and such sheltered space is not enclosed on two sides or more, the elevator will be considered as located outside of the building.

(d) Doors shall be approved fire doors or shutters and shall be self-closing or equipped to close automatically in case of fire or provided with shaftway landing door interlocks. All windows in inside enclosure walls shall be of approved fire resistive construction with wired glass. Where a hand cable is operated through the shaftway enclosure a slot not more than 5 inches wide by not more than 3 feet long with the bottom 30 inches from the floor, may be cut in the enclosure. This slot or opening shall be protected with an approved self-closing fire shutter, or an approved fire shutter which will close automatically in case of fire.

Exception: Doors in outside walls of elevator shaftways need not be fire-proof except in cases where fire doors are required by the State Building Code.

Note: Experience has demonstrated the value of the elevator as a life saving device in case of fire. A simple form of fire-resistive construction (plaster on metal lath) will usually resist a fire for a greater length of time than the elevator can be used as an exit from a burning building. Fire resisting shaftway enclosures are therefore recommended for all elevators.

Order 412.—Guarding Shaftways of Elevators. New and Existing Installations.

(a) The shaftway of every freight elevator, dumb-waiter and existing passenger elevator, where a fireproof enclosure is not required and is not provided, shall be enclosed with guards not less than 6 feet in height above each floor. If the guards are made of wood they shall be solid. If the guards are made of metal they shall be the equivalent in strength, rigidity and protection of wire

screen of not less than No. 10 U. S. Standard Gauge with mesh not greater than 1 inch measured along the wire from center to center of wires at points where they cross.

Note: On an existing elevator where the openings in the grill work are larger than specified in this order, a screen may be stretched around the outside of the car.

(b) On new freight elevator installations, existing passenger elevators, and all other existing elevators where the ceiling height is more than 12 feet, the space between the top of the entrance opening and ceiling shall be enclosed. This enclosure shall be in a plane not more than 6½ inches from the edge of the landing.

(c) Where material is stored near a shaftway enclosure the enclosure shall extend from floor to ceiling.

Note: In the case of a shaftway enclosure for a hand power elevator space for operating the hand rope should be allowed.

Order 413.—Combined Stairways and Elevator Shaftway Enclosures. New and Existing Installations.

An elevator shaftway which is placed in a fireproof stair enclosure need not have an additional fireproof enclosure, but the elevator shaftway shall be guarded to a height of not less than 6 feet above each floor and every stairway in the manner described in order 412—(a), except that incombustible material shall be used throughout.

Order 414.—Guards for Outside Windows in Shaftways. New and Existing Installations.

(a) Every outside window in an elevator shaftway, up to and including the fourth story, and in every case where the window sill is not more than 15 feet above an adjoining roof, shall be completely guarded on the outside with:—

(1) Metal bars not less than ½ inch in diameter or equivalent and spaced not more than 10 inches center to center, or

(2) Wire screen of wire not less than ¼ inch in diameter with mesh not greater than 3 inches, measured along the wire from center to center of wires at points where they cross. If any such screen is hinged the fastening shall be on the inside.

Note: Flat bars not less than ¼ inch thick, with the ends securely anchored, will be considered the equivalent of ½ inch diameter rods in building window guards.

(b) Where an open side of an elevator car passes a window in a wall of a shaftway and approved car gate protection is not provided for such open side a guard consisting of vertical metal bars $\frac{1}{2}$ inch in diameter or equivalent, spaced not more than 2 inches apart, or substantial grating, removable if desired, shall be provided over the inside of the window.

Order 415.—Guards for Projections in Shaftways.

1. Existing Installations.

(a) All projections and shearing edges in elevator shaftways, such as floors, beams, sills, pipes, bolts and other stationary parts within 4 inches of the edge of the car, unless guarded against by the permanent car enclosure, shall be provided with smooth beveled guards fitted directly under such projections so as to push any projecting object back into the car. The beveled surface of each guard shall make an angle of not less than 60 degrees with the horizontal.

Recommendation: Where conditions permit the angle of inclination should be made 70 degrees with the horizontal.

2. New Installations.

(b) On elevators hereafter installed beveled guards shall be made of smooth metal not less than $\frac{1}{8}$ inch in thickness (No. 11 U. S. Standard Gauge) unless a solid backing of wood, concrete or equivalent material is provided, in which case the metal may be not less than $\frac{1}{16}$ inch in thickness.

(c) On a car where a leveling device operates the car with the door open, the platform shall be equipped on the under side with a vertical toe guard at least two inches longer than the leveling zone. Dust caps over hanger tracks and door hanger sheaves shall be fastened in place to prevent displacement or movement toward the car.

(d) In new installations contact boxes, door closers and other equipment shall be placed so that the purpose of this order will not be defeated.

Note: The requirements of this order do not apply to interlocks or other floor lock devices where the guarding of such devices would interfere with their proper operation.

For additional toe guards on sidewalk elevators see order 480—(d).

Order 416.—Clearances on Car Fronts. New Installations.

The distance between the car sill and the landing threshold sill shall be not more than $1\frac{1}{2}$ inches nor less than $\frac{3}{4}$ inch on any elevator hereafter installed. All moving parts, including ropes, cables and sheaves, shall clear passing points at least $\frac{3}{4}$ inch. On every elevator hereafter installed, a clearance of $1\frac{1}{2}$ inches or more shall be maintained between any part of the door fronts or mechanism and the car sill, except on an elevator which is equipped with a car gate and provided with a device to prevent the operation of the car unless the car gate is closed.

Order 417.—Depth of Pits and Overhead Clearances. New Installations.

(a) The depth of the pit and the overhead clearance for any power elevator hereafter installed shall each be not less than the number of inches shown for a given speed and capacity in the following table; except that in no case shall the clearance between the bottom of the car and the bottom of the pit be less than 15 inches when the car is resting on the fully compressed buffers:

TABLE SHOWING REQUIRED MINIMUM DEPTH, IN INCHES, OF PITS AND OVERHEAD CLEARANCES

Elevator car speed in feet per min.	Capacity of Elevator in Pounds								
	0 to 2500	3000	4000	5000	6000	7000	8000	9000	10000 or more
0 to 50.....	30	31	34	36	38	41	43	46	48
100.....	34	35	37	40	42	45	47	49	52
200.....	41	43	45	47	50	52	54	57	59
300.....	49	50	53	55	57	60	62	64	67
400.....	57	58	60	63	65	67	70	72	75
500.....	64	65	67	70	73	75	77	80	82
600 or more.....	72	73	76	78	80	83	85	88	90

Note: The required depth of pit and overhead clearance for intermediate car speeds and elevator capacities can be obtained by interpolation.

Recommendation: It is recommended that every pit be deeper than the minimum depth given in this table and that no power elevator pit be less than 36 inches deep.

(b) Every hand power elevator hereafter installed shall have a pit at the bottom of the shaftway equal to not less than the thickness of the elevator platform plus the required clearance for any attachment that may be placed on the bottom of the platform.

(c) All parts of a new elevator installation shall be designed and adjusted to permit safe movement to the limits of travel at the top and bottom of the shaftway, including the depth of the pit and the overtravel at the top of the shaftway.

Note: Where oil buffers are installed (see order 419) the elevator manufacturer will need to be consulted to determine the necessary increase in the pit depth.

Order 418.—Construction of Pits.

1. New Installations.

(a) The pit for every elevator hereafter installed shall be equal in area to the shaftway. The walls and floor of the pit shall be substantially constructed of incombustible material forming a tight enclosure.

2. New and Existing installations.

(b) Where water cannot be kept out of a pit with ordinary construction, a proper automatic drain shall be installed to keep the pit dry, or a pit tank shall be constructed of boiler plate not less than $\frac{1}{4}$ inch thick, properly braced.

(c) The floor of every pit shall be level, except that sufficient slope shall be allowed for drainage.

(d) The foundation of every guide rail shall be constructed so as to withstand the impact of the fully loaded car when the car safety device is applied to the guides in a free fall of 10 feet.

Order 419.—Buffers. New Installations.

(a) Every passenger elevator, every power freight elevator and every set of counterweights hereafter installed, shall be provided with buffers which shall rest on a solid foundation in the pit. The function of the buffers shall be to absorb the energy of the fully loaded car and the counterweights descending at full rated speed. For car speeds up to and including 400 feet per minute, oil or spring buffers may be used. For car speeds exceeding 400 feet per minute oil buffers shall be used.

(b) Car buffers of the spring type, or their equivalent, shall be installed in the pits of hand power invalid elevators and hand power hospital elevators.

Order 420.—Shaftways and Pits Unobstructed. New and Existing Installations.

(a) No elevator machine or other machinery shall be located in the pit, except that this requirement need not apply to machinery used in connection with sidewalk elevators. Every elevator shaftway and pit shall be kept free of any rope, wire or pipe, except such as is needed for the operation of the elevator and for the heating and lighting of the car or the shaftway, and except branch pipes with sprinkler heads.

Exception: In existing installations, pipes in a shaftway may remain unless carrying steam with pressure exceeding 15 pounds, and wires may remain if placed in conduit.

(b) No elevator shaftway or pit shall be designed or used as a passageway, or for the storage of material.

Order 421.—Penthouses—Where Required. New Installations.

Above every elevator hereafter installed there shall be a penthouse or working space with at least six feet average headroom above the screen or floor required by orders 423-424, except that such headroom may be decreased if approved in writing by the Industrial Commission. Where a new elevator is installed in an existing building, or in a new building where the elevator terminates below an occupied floor, or below a roof, provided the overhead machinery consists only of sheaves and governor and where the penthouse cannot readily be provided, the headroom may be decreased to a height which will permit access to the sheaves for oiling and inspection.

Exception: This requirement does not apply to sidewalk type elevators, without counterweights, which are located within buildings.

Order 422.—Construction of Penthouses.

(a) In new installations in fireproof buildings every penthouse shall be made of incombustible material throughout. Every penthouse in a non-fireproof building shall be made of incombustible material, or may be of frame con-

struction if covered on the outside with incombustible material.

(b) Properly weatherproofed windows shall be provided for the lighting and ventilation of penthouses.

(c) In every new installation access to the penthouse shall be made safe and easy from outside the shaftway by means of a stairway (with handrail) inclined not less than 75 degrees with the horizontal. One such stairway or ladder may serve a number of penthouses, on the same roof.

(d) In every new installation where a scuttle opening is provided in the floor over the shaftway the opening shall be equipped with a substantial cover so arranged that the opening cannot be conveniently used as an entrance to the penthouse.

Recommendation: Access to each penthouse should be under the same penthouse roof. The penthouse ceiling and wall in every installation should be so constructed or insulated as to minimize moisture from condensation which may damage the elevator equipment.

Order 423.—Overhead Floors and Machinery Supports. New and Existing Installations.

(a) There shall be a floor immediately under the machinery and sheaves at the top of the shaftway of every elevator. If the elevator machine is placed at the top of the shaftway, the floor shall cover the entire shaftway, shall be of fireproof or mill construction (see orders 5100 and 5101 of the Building Code issued by the Industrial Commission), and shall be built and supported for a safe load of not less than 300 pounds at the center in addition to the machinery load.

(b) The openings in floors through which cables, ropes, or transmission lines are passed shall be fitted with suitable guards to prevent any loose material from coming in contact with such cables, ropes, or transmission lines, and also to prevent any loose parts from dropping through the openings.

(c) Every overhead platform on which elevator machinery or equipment is placed shall be equipped on the open sides with standard handrails and toeboards.

Order 424.—Floors or Screens Under Sheaves. New and Existing Installations.

(a) If the overhead machinery consists only of sheaves and governor the floor below, if of wood, shall be solid and not less than $2\frac{1}{2}$ inches thick, or not less than $\frac{7}{8}$ inch thick if supported by joists spaced not more than 16 inches center to center. If such floor is a metal grating there shall be no opening greater than 1 inch in width. It shall be built and supported to carry a safe load of not less than 300 pounds at the center. The floor shall cover the shaftway if the area of the shaftway does not exceed 50 square feet and if the average headroom above such floor is not less than 5 feet; if the area is larger than 50 square feet or the headroom is less than 5 feet such floor need extend only two feet outside of all sheaves and machinery which must be reached for oiling and inspection. In such cases there shall be a toeboard not less than 6 inches in height at the edge of the floor, and where the space between the floor and the wall of the shaftway exceeds 12 inches, a handrail shall be provided 30 inches above the floor. This order shall also apply to the secondary sheaves of full wrap traction elevators, and to hand power elevators having no screens over the cars, excepting existing installations where there is not room for such floors.

(b) To prevent broken parts or material from falling into the shaftway a suitable guard shall be provided underneath every overhead deflecting sheave except in existing installations where there is not sufficient clearance for such guards.

Order 425.—Guards for Counterweight Runways. New and Existing Installations.

(a) Where a counterweight runway is located in the elevator shaftway the outside (the side away from the elevator), if exposed to contact shall be protected the full height with a solid guard and, if there is no other means provided for inspection of the counterweight stack, a removable panel at least twelve inches longer than the counterweight stack shall be provided at the bottom.

(b) The inside of every counterweight runway shall be entirely enclosed with a solid guard from a point not

more than 18 inches above the bottom of the pit to a height of 90 inches, except for

- (1) hand power elevators;
- (2) existing power elevators where there is not room for such guards;
- (3) elevators whose counterweights are equipped with compensating devices connected to the bottom of the counterweights.

(c) Where a counterweight runway is located outside the elevator shaftway, the runway shall be solidly enclosed on all sides but a removable panel 12 inches longer than the counterweight stack shall be provided on the outside at the bottom.

Note: Guards in shaftways should be made of metal of not less than 16 gauge.

Order 426.—Counterweight Stops.

(a) In every hand power elevator which does not have a limit stop at the top, a solid footing shall be provided on which the counterweight will rest when the car is six inches above the highest landing.

(b) In every power drum type elevator hereafter installed an I-beam or other obstruction shall be strongly secured at the upper limit of travel of the counterweights so that they cannot be drawn out of the runway. Such obstruction shall be so arranged that the counterweights will be stopped squarely, without distortion. The counterweight guide rails shall be strongly fastened together every 4 feet from the top of the guide rails of every power elevator hereafter installed to a point opposite the bottom of the counterweight stack when it is at the upper limit of normal travel. This requirement shall also apply to every existing installation in which the travel is more than 35 feet if the counterweight runway is not properly fastened together or guarded at the top.

SECTION II. CARS.

Order 427.—Construction of Cars. New Installations.

(a) Every freight car platform hereafter installed shall be constructed to support a load of not less than 50 pounds per square foot. Every elevator carrying automobiles shall have a car platform of sufficient strength to sup-

port safely 70 per cent of the total live load concentrated equally on two wheels at either end of a superimposed automobile located any distance from the entrance sill.

(b) Every power freight elevator hereafter installed shall have a steel sling designed with a factor of safety of not less than $7\frac{1}{2}$ based on the rated load uniformly distributed.

Exception: The requirements of the preceding paragraph need not apply to elevators of the plunger type which are not provided with counterweights.

(c) Every car sling for hand power elevators hereafter installed shall be made of metal or sound seasoned wood and shall be designed with a factor of safety of not less than 4 for metal and 6 for wood based on the rated load uniformly distributed.

(d) Every power passenger elevator hereafter installed shall have a steel sling designed with a factor of safety of not less than $7\frac{1}{2}$ based on the rated load uniformly distributed.

Exception: The requirements of the preceding paragraph need not apply to elevators of the plunger type which are not provided with counterweights.

(e) Cast iron in tension shall not be used for suspension members of any car sling except for cable anchorages.

(f) If there is a railroad track on an elevator car, the tops of the rails shall be flush with the car floor.

(g) The frame members of every elevator car shall be securely bolted or riveted and braced. Welding in an approved manner will be accepted.

Order 428.—Enclosures for Passenger Elevator Cars.

(a) Every existing passenger elevator car shall be enclosed on all sides, excepting the entrance opening. This enclosure shall be solid from floor to cover in front of the counterweight runway, and openings in other sections shall be not larger than $1\frac{3}{4}$ inches square; or if larger than $1\frac{3}{4}$ inches, not wider than 1 inch. If wire mesh is used, the wire shall be not less than No. 10 U. S. Standard Gauge, with mesh not greater than $1\frac{3}{4}$ inches, measured along the wire from center to center of wires at points where they cross.

(b) The car walls of every passenger elevator hereafter installed shall be constructed of solid panels to a height of not less than 6 feet, and the panel in front of the counterweight runway shall be solid to the cover. Wood veneer finish may be used inside of metal cars. The car enclosure shall be made of incombustible material. The floor covering may be made of wood.

(c) The roof of every passenger car shall be constructed of solid material. A portion of every such roof, measuring 20 inches by 30 inches where possible, and not less than 12 inches by 24 inches in any case, shall be so constructed that it can be readily removed by a person inside the car.

(d) In new installations where two or more passenger elevators run in the same shaftway, doors, or removable panels, shall be provided to enable persons to pass from one elevator to the other. Such doors shall open into the cars, and shall be fastened with prominent thumbscrews.

(e) No passenger elevator car enclosure shall deflect more than $\frac{1}{4}$ inch for every 5 feet of enclosure length when subjected to a force of 75 pounds applied at any point perpendicular to the car enclosure. The car enclosure shall be secured to the car floor and sling so that it cannot work loose and become displaced in ordinary service.

Order 429.—Furnishings for Passenger Elevator Cars. New and Existing Installations.

(a) No glass shall be used in any passenger car except to cover certificates, emergency switches, annunciators and lamps. (Mirrors will not be permitted.)

(b) A metal handrail not less than 1 inch in diameter and approximately $3\frac{1}{2}$ feet above the floor shall be placed on each side, except on the entrance side or sides of any passenger car.

(c) No seats, except one for the operator, and except for elevators designed to carry invalids, shall be placed in any elevator car.

Order 430.—Car Gates for Passenger Elevator Cars.

(a) The entrance to every passenger elevator car hereafter installed which travels faster than 150 feet per

minute shall be equipped with a car gate or car door. If the car of any new or existing passenger elevator has more than one entrance, the secondary entrance shall also be equipped with a gate, or door, completely filling the opening.

(b) In every electric passenger elevator car hereafter installed the secondary gate, or door, if any, shall be equipped with an approved device such that the elevator cannot be started unless such gate or door is closed. On every automatic push button elevator each entrance to the car shall be equipped with a gate, or door so arranged that the elevator cannot be operated unless all gates, or doors, are closed. This will not prohibit the use of a device which makes it possible to operate the elevator from the hall button with the car gate open only when the elevator is unoccupied and the shaftway doors are closed and latched.

(c) The horizontal dimension of any opening in required car gates and doors on passenger elevators shall not exceed 3 inches.

Note: If an electric contact is used on a car gate it need not prevent the motion of the car toward the landing while the car is being controlled by a car leveling device.

Order 431.—Enclosures for Freight Elevator Cars.

(a) Every freight elevator car shall be solidly enclosed on all sides, except the entrance side. The height of every such enclosure shall be at least 6 feet, except as follows:

(1) On every elevator hereafter installed the enclosure shall be at least 7 feet in height in front of the counterweight runway, and shall extend from floor to cover on every car where a cover is required or provided.

(2) On every hand power carriage type elevator traveling not more than two stories the enclosure shall be at least 3½ feet in height, except in front of the counterweight runway, where it shall be 7 feet high.

(3) On the side of the operating cable, sufficient space to operate the cable shall be allowed, but in no case shall the opening be more than 15 inches wide.

(b) Every freight elevator car shall be equipped with a metal cover the equivalent in strength, rigidity and

protection of wire screen of wire not less than No. 10 U. S. Standard Gauge with mesh not greater than one inch measured along the wire from center to center of wires at points where they cross, supported and reinforced to carry a safe load of not less than 300 pounds at any point, except as follows:

(1) On a freight elevator traveling only one story no cover is required if the shaftway above the lowest story is enclosed to a height of 6 feet and the body of each gate at the top landing extends to the floor.

(2) On a freight elevator car 10 feet or more in length, open at one end only (except at the lowest landing), and traveling not more than two stories, but not to exceed 30 feet, a cover is required over only that half of the car next to the open end.

(3) No cover is required over a hand power elevator car where the bottom rail of every landing gate above the lowest landing rests on the floor. In every such case a floor or screen shall be provided under the overhead machinery as specified in order 424—(a).

(4) On any hand power elevator operating outside of a building, except sidewalk elevators, the cover shall be solid and form a part of the car enclosure or cab.

(c) Every car cover shall be equipped with a hinged section facing each entrance, unless such entrance occurs only at the lowest landing, or unless there is a car gate on such side. This hinged section shall be at least 12 inches wide, shall extend the full width of the entrance to within 5 inches of the landing sill, and shall be constructed so it will rise easily if it meets an obstruction as the car descends. (See order No. 432—(a) for covers on H. P. hospital elevators and H. P. invalid lifts).

Note: On an existing elevator the wire screen enclosure may remain if the mesh is not greater than 1 inch, and is properly braced and fastened. The wire must be of sufficient size to give rigidity.

Order 432.—Entrances to Freight Elevator Cars. New and Existing Installations.

There shall be not more than two entrances to any freight elevator car except when approved in writing by the Industrial Commission.

Order 433.—Car Gates for Freight Elevator Cars.

(a) If a freight elevator car has more than one entrance, and the difference in the landing floor levels at such entrances is more than 30 inches, the secondary entrance shall be equipped with a car gate. If the distance between the edge of the car and the shaftway enclosure on the side of the secondary entrance is more than 7 inches at any point the car gate shall be provided, or the shaftway enclosure on that side shall be altered so that it will come within the specified limit.

(b) Every car gate shall run in guides, shall extend to the floor and be at least 6 feet high, and in the case of a vertically sliding gate, shall contain no openings greater than 3 inches measured in a horizontal direction.

(c) Every car gate which weighs more than 35 pounds or which is more than 8 feet in width shall be counterbalanced with a secondary rope and weight.

(d) Every car gate hereafter installed shall be semi-automatic or be equipped with an approved device such that the elevator cannot be started unless the car gate is closed.

(e) Every freight elevator car operating in a shaftway outside a building and which is inclosed only at the ground landing, shall be protected on the landing side by a semi-automatic car gate, or by a gate with electric contacts, and in either case complying in other respects with order 433.

Note: If an electric contact is used on a car gate it need not prevent the motion of the car toward the landing while the car is being controlled by a car leveling device.

SECTION III. SHAFTWAY LANDING DOORS AND GATES.

Order 435.—Passenger Elevator Shaftway Landing Doors.

(a) In every passenger elevator hereafter installed the shaftway shall be equipped at each landing with a horizontally sliding door, or doors, which shall entirely fill the opening to the shaftway. Every such door shall be an approved fire door and shall be solid to a height of not less than 12 inches above the floor level. Upper sections of such doors may be of wired glass, or of solid metal. Every landing door shall be of sufficient strength to resist a lateral pressure of 100 pounds applied at the center.

Exception: In cases where the doors in outside walls of elevator shaftway enclosures are not required by the Building Code to be fire-

proof the phrase in the preceding paragraph reading "every such door shall be an approved fire door" does not apply.

Note: Order 5111 of the Building Code limits the size of any pane of wired glass to 720 square inches.

(b) Existing wooden doors will be accepted, but if such doors contain grill work or screen the openings shall not be larger than described in order 428—(a). Doors shall not swing on vertical axes except on automatic push button elevators, and except where restricted spaces will not permit the use of sliding doors.

(c) On an existing installation solid metal or metal screen on substantial door framing will be accepted. The screen shall be the equivalent in strength, rigidity and protection of wire screen described in order 428—(a).

Exceptions:

- (1) On an existing door where the openings in the grill work are larger than specified in order 428—(a), a screen may be stretched across the inner face of the door.
- (2) On an existing installation where a regular operator is stationed on the car existing grill work will be accepted unless an especially hazardous condition exists.
- (3) Other than horizontally sliding doors may be used in an existing installation if the restricted space will not permit a horizontally sliding door.

(d) Doors in every passenger elevator shaftway enclosure, except in the case of push button elevators, shall be equipped with self-locking devices which cannot be opened from the outside except by means of a key not easily duplicated, which key shall be placed in charge of a responsible person.

Order 436.—Passenger Elevator Shaftway Landing Door Interlocks.

(a) Shaftway landing door interlocks shall be provided on every passenger elevator installation. Such interlocks shall be provided on existing installations not later than June 1, 1928.

Exception: The interlock shall not prevent the movement of the car within the leveling zone when the car is being moved by a car leveling device.

(b) No shaftway landing door interlock shall be constructed or installed so that its functioning is dependent upon the action of a spring (or springs) in tension, or upon the closure of an electric circuit.

(c) On every passenger elevator installation, except push button elevators, provision shall be made for opening one landing door from the landing side.

Order 437.—Automatic Push Button Elevators; Electric Contacts.

Electric contacts shall be provided on the car gate or gates of every automatic push button controlled elevator. Such electric contacts shall be provided on every such existing installation not later than June 1, 1928.

Order 438.—Freight Elevator Shaftway Landing Doors and Gates.

(a) All openings in the shaftway enclosure of every freight elevator shall be protected at landings in one of the following ways:

(1) Doors, as described in order 435 for passenger elevators. Such doors will be accepted only where an operator is stationed on the car, except on push button controlled elevators. In new installations such doors shall be equipped with shaftway door interlocks or door electric contacts. Doors which are equipped with shaftway door interlocks or door electric contacts may swing on vertical axes.

(2) Vertically sliding gates. Where the car speed does not exceed 50 feet per minute the gates at the terminal landings shall be semi-automatic, full automatic, equipped with gate electric contacts, or provided with interlocks. At intermediate landings the gates shall be semi-automatic, equipped with gate electric contacts, or provided with interlocks. If approved in writing by the Industrial Commission full automatic gates may be installed at intermediate landings of elevators where the car speed does not exceed 50 feet per minute.

Where the car speed exceeds 50 feet per minute vertically sliding gates, whether at terminal or intermediate landings, shall be semi-automatic, equipped with gate electric contacts, or provided with interlocks.

(3) Balanced gates, or balanced doors. Such gates or doors will be permitted only when they are equipped with gate electric contacts or door electric contacts.

General Exceptions: In an existing installation where there is a vertically-rising hatch cover at the top floor, if there is not less than

three feet of headroom above the cover when the car is at such floor, and the cover is so located or guarded that it cannot be used as a passageway, then a landing gate is not required at such top floor landing.

(b) In every case where fire doors are used as gates at freight elevator shaftway landings the doors shall be equipped with shaftway landing door interlocks or shaftway door electric contacts.

(c) On every existing hand power elevator traveling not more than 30 feet, or serving not more than two floors and basement, or three floors without basement, where vertically hinged shaftway landing doors are used, the doors shall be equipped with self-locking devices designed to prevent opening the doors from the outside except by means of a key, or so arranged that the doors can be opened only when the car is at, or within three inches of, the floor level.

Note: Where possible vertically rising gates should be installed in preference to doors.

(d) Gates over 8 feet wide may be full automatic provided the car speed is not over 50 feet per minute and an operator is stationed on the car, or where there is provided means of stopping the elevator without reaching over, through, or under the gates.

(e) Every full automatic gate shall be so arranged that it will be fully closed when the car has traveled a distance of not more than 8 feet from the landing.

(f) In new installations where the car speed exceeds 50 feet per minute, and in existing installations where the car speed exceeds 75 feet per minute, shaftway landing gates shall be not less than 5½ feet high. If the car speed does not exceed 50 feet per minute in new installations, and 75 feet per minute in existing installations, landing gates may be 3½ feet high.

(g) Every landing gate at an opening in an outside wall shall extend to the sill when closed. The bottom bar of each landing gate above the lower terminal landing shall extend to within 12 inches of the sill when closed, except in existing installations, where conditions require more space to secure sufficient headroom for safety, a clearance of not more than 20 inches between the lower bar of a closed gate and the floor will be permitted.

(h) In a new installation a bar gate not less than 12 inches in total depth may be used at a basement landing

where conditions will not permit a standard gate, except that the distance from the floor to the bottom of such a bar gate when closed shall be not more than 30 inches. Existing installations equipped with bar gates at lower terminal landings will be accepted if the gates are self-closing.

(i) No collapsible gate shall be installed at any shaftway landing in new installations.

Order 439.—Freight Elevator Shaftway Landing Gates; Construction.

(a) The net width of an opening between the slats or bars of a landing gate shall be not more than 3 inches, except that on the side toward the operating cable, where such cable is provided, there may be an opening large enough to permit the operation of the cable, but not more than 5 inches in width. On elevators in plants where racks are used on cars center slots or openings in the landing gates will be permitted to allow passage of the racks.

(b) The main horizontal cross members of every landing gate, to which members the vertical slats or bars are fastened shall extend into the guides, or against uprights at the gate posts, so that pressure exerted on the gate from the landing side will not cause the gate to move into the shaftway in case the slat or bar fastenings become loose or disarranged.

(c) Every gate shall be well braced to secure rigidity and shall be of sufficient strength to withstand a lateral pressure of 250 pounds at the center.

Note: A gate constructed of wire screen of not less than No. 10 U. S. Standard Gauge, with mesh not greater than 3 inches, measured along the wire from center to center of wires at points where they cross, will be considered the equivalent of a wood gate.

(d) Every gate shall move in guides which shall be so constructed that the gate upright or shoe on the gate will have a lap of at least 1 inch on the guide strip or in the guide post furrow.

(e) Each gate guide post shall be installed and securely fastened so as to prevent warping and shall be set so it will not be damaged by trucks or material being passed to or from the car. Every gate guide post attached to a

brick, tile or plaster wall shall be fastened with through bolts, or their equivalent.

Note: The use of wood plugs inserted in a wall for fastening a gate guide post will not be accepted.

(f) Where a gate upright or shoe on the gate is continuous the runway furrow in the guide post shall be at least $\frac{1}{4}$ inch wider than the gate upright or shoe.

(g) Every gate shall be properly balanced, adequately counterbalanced, and hung with substantial cord or flexible cable over pulleys not less than 3 inches in diameter.

(h) Gate or door counterweights shall be boxed in, or shall run in metal guides from which they cannot be dislodged. The bottoms of the boxes, or guides, shall be of such construction that the counterweights will be retained if the ropes break.

Order 440.—Power Freight Elevator Shaftway Landing Doors and Gates; Locking Devices. New installations.

In new installations of power freight elevators every landing door and gate, except full automatic doors and gates, shall be equipped with an approved device such that the door or gate cannot be opened unless the car is at, or within 3 inches of, the landing. Such device shall be so constructed and located that it cannot be easily put out of order or reached from the floor when the door or gate is closed.

SECTION IV. CABLES.

Order 441.—Factors of Safety for Cables. New and Existing Installations.

(a) The factors of safety for hoisting and counterweight cables, based on the cable manufacturer's schedule, shall be not less than is given in the following table:

FACTORS OF SAFETY FOR HOISTING CABLES

Car speed in feet per min.	Factors of Safety		
	Passenger Elevators	Freight Elevators	Dumbwaiters
50 or less	7.0	6.7	5.3
100	7.8	7.0	5.7
200	8.5	7.6	6.3
300	9.1	8.2	6.9
400	9.7	8.7	7.5
500	10.2	9.1	8.0
600	10.6	9.5	
700	11.0	9.8	
800	11.25	10.0	
900	11.4	10.2	

(b) Unless the ultimate strength and material of a cable are known, the load shall be limited to the load allowed for an iron cable of the same diameter.

(c) No car or counterweight cable shall be repaired or lengthened by splicing.

Order 442.—Cable Data. New Installations.

(a) For permanent record there shall be posted in a conspicuous place on the car beam of every elevator hereafter installed a metal sign bearing the following original data:

CABLE SPECIFICATIONS

Kind of Cable	Number of Cables	Diameter in Inches	Rated Ultimate Strength	Date of Installation
Hoisting				
Car Counterweight				
Machine Counterweight				

(b) Where steel cables are required, or needed, this fact shall be indicated on the metal sign.

(c) On new installations and whenever cables are renewed there shall be attached to the cable fastening or car beam another metal tag bearing the following data:

CABLE INSTALLATION DATA

Diameter of Cables _____
 Material of Cables _____
 Rated Ultimate Strength _____
 Date Installed _____

Order 443.—Renewing of Cables. New and Existing Installations.

Cables are considered unsafe and shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has decreased 25 per cent. When for any reason it becomes necessary to renew one or more cables of a group supporting a common load, all cables in that group shall be renewed.

Order 444.—Number of Cables Required.

(a) Every elevator car which requires hoisting cables shall have not less than two hoisting cables, except that on existing installations a single hoisting cable will be permitted if the factor of safety is not less than 10.

(b) Every traction type elevator hereafter installed shall be equipped with not less than four cables, except where the capacity is not more than 1200 pounds, not less than three cables shall be used.

Order 445.—Turns Required on Drums.

In every new installation of a drum type elevator the hoisting and counterweight cables shall have at least one and one-half turns on the drum when the car is at either the bottom or top landing. This requirement shall also apply, where possible, in the recabbling of existing installations. The winding drum end of every car or counterweight cable shall be secured on the inside of the drum.

Order 446.—Cable Fastenings at Terminals.

(a) On every elevator hereafter installed the ends or terminals of each hoisting and each counterweight cable shall be independently fastened to the cross-head of the car frame and counterweight frame, respectively.

(b) Where an adjustable draw bar or equalizer is used, the details of construction of such draw bar or equalizer for each condition of installation and type of apparatus shall be submitted to the Industrial Commission for approval, and only approved construction shall be used.

(c) On no elevator hereafter installed shall more than one cable be fastened into the same clevis or socket, except on car counterweights.

(d) Where a cable is fastened in a socket the strands of the cable shall be separated and turned in toward the center. The length of the turned portion of a cable shall be not less than $4\frac{1}{2}$ times the diameter of the cable. The knot thus formed shall be drawn tightly into the socket which shall be filled with zinc or babbitt. Cast iron socket thimbles shall not be used. The socket shall be drop-forged steel, steel casting, or formed in a substantial block of malleable cast iron or better, such as semi-steel.

(e) The cable fastening shall be capable of sustaining a load of not less than 80 per cent of the ultimate strength of the undisturbed portion of the cable.

Note: In heat treating the materials while making a cable fastening careful workmanship is needed to avoid harmful change in the socket metal.

Order 447.—Governor Cables.

(a) A wire governor cable shall be used on every new elevator installation where a governor is required, except that in new installations where the governor cable is exposed to excessive moisture or other corrosive elements, hemp rope with wire center shall be used.

(b) In every new installation where a wire governor rope or cable is used the governor sheaves shall be not less than 12 inches in diameter.

SECTION V. COUNTERWEIGHTS.

Order 448.—Drum and Car Counterweights.

(a) Every new installation in which the hoisting cables wind around a drum, and in which the speed exceeds 100 feet per minute, shall be equipped with car counterweights supported by separate cables. Every drum type passenger or freight elevator hereafter installed, except sidewalk type elevators, shall be equipped with a drum counterweight.

(b) Drum and car counterweights shall be made of metal and shall run in substantial guides.

(c) If two sets of counterweights run in the same guides, the car counterweight shall be above the machine counterweight, and there shall be a clearance of not less than 8 inches between them.

(d) If an independent car counterweight is used, it shall not be of sufficient weight to cause undue slacking in any of the cables during acceleration or retardation of the car.

Order 449.—Counterweight Cables. New Installations.

Each set of counterweights on freight elevators hereafter installed in which the weight of the car exceeds 1000 pounds, the travel exceeds 25 feet, or the speed exceeds 60 feet per minute, shall be supported by not less than two cables. Each set of counterweights on passenger elevators hereafter installed shall be supported by not less than two cables.

Order 450.—Protection of Counterweight Cables. New and Existing Installations.

Where the cables of one set of counterweights pass through, or by, another set of counterweights, the cables shall be so protected as to prevent chafing or wearing.

Order 451.—Bolting of Counterweights.

(a) In each set of counterweights on every power elevator hereafter installed, unless the counterweights are contained in a steel frame, the separate weights shall be bolted together with not less than four bolts with lock nuts and cotter pins at each end, at least two of which bolts shall pass through all of the weights, tightly bolting them together. Each set of counterweights on hand power elevators, and on hand power elevators changed to power elevators, (see order 460—m), shall be bolted together with not less than two bolts. Each set of counterweights on existing elevators shall be bolted or strapped together to keep the individual weights in position.

(b) In every counterweight stack over 8 feet high there shall be a middle guide unless all weights are contained in a steel frame.

SECTION VI. LOADS AND STRESSES.

Order 452.—Capacities of Passenger Elevators.

(a) Every passenger elevator hereafter installed shall be designed for the maximum probable live load, but

in no case less than 75 pounds per square foot of car floor area, except that for a hospital elevator not serving an assembly hall or clinic such minimum live load may be reduced to 50 pounds per square foot, but in no case less than 1500 pounds or the maximum load to be carried.

(b) No passenger elevator used for hoisting safes or similar special freight shall be loaded over the rated capacity.

See order 460—(m) for capacity limit for a hand power elevator.

Order 453.—Capacity Plates. New and Existing Installations.

A metal plate with raised letters not less than $\frac{1}{2}$ inch in height, stating the live load for which the elevator was designed, shall be placed in a conspicuous position on the car of every elevator.

Order 454.—Stresses Allowed in Design. New Installations.

Every elevator hereafter installed and every part thereof (except cables), and all structural support of such an installation shall be designed and constructed to carry the total maximum load, plus 100 per cent for impact, using the safe working stresses specified in the State Building Code.

See tables in orders 5313, 5316, 5317, in Appendix to this code.
For cable stresses see order 411.

SECTION VII. GUIDE RAILS.

Order 455.—Guide Rails, General Requirements.

(a) Wrought iron or steel guide rails shall be provided for car and counterweights as follows:

(1) On every power freight elevator hereafter installed whose speed exceeds 100 feet per minute; and

(2) On every power freight elevator whose capacity exceeds 4,000 pounds and travel exceeds 50 feet; and

(3) On every passenger elevator hereafter installed.

Where wrought iron or steel guide rails are not required hardwood guide rails may be used.

Note. Where the use of steel guide rails presents an accident hazard, as in chemical shops or in plants where explosives are manufactured, wood guide rails may be used.

(b) Cast iron guide rails shall not be used. Guide rails shall be of sufficient strength, shall rest on a proper foundation (see order 418—d), and shall be securely supported so that they will not spread.

(c) In new installations of power elevators the guide rails shall not be used to support the overhead machinery.

(d) Guide rails shall extend to the overhead construction.

Order 456.—Sizes and Construction of Guide Rails. New Installations.

(a) Steel car guide rails when required shall be not less than as follows:

Total Weight of Car & Load; Total Weight of Counter- weights or Pair of Rails		Minimum Weight per Lineal Ft. of Each Car Guide Rail (Pounds)	Minimum Weight per Lineal Ft. of Each Counterweight Guide Rail (Pounds)		
Per Pair of Rails			With Guide Rail Safeties	Without Guide Rail Safeties	
Above (Pounds)	To and Including (Pounds)			1 to 1 Roping	2 to 1 Roping
2,500	2,500	6½	6½	6½	6½
15,000	15,000	14	14	6½	6½
	40,000	30	30	6½	14

(b) The size of wood guide rails shall be not less than as follows:

Total Weight of Car and Load per Pair of Maple Guide Rails		Dimensions of Each Guide Rail in Inches
Above Pounds	To and Including Pounds	
5,000	5,000 8,000	2 x 2½ 2½ x 3

(c) Joints in steel or wood guide rails shall be tongued and grooved, or dowelled.

Order 457.—Fastening of Guide Rails. New Installations.

(a) Guide rails installed on brick or concrete shaftway walls shall be fastened at points not more than 8 feet apart. Where anchorage is to substantial floor beam construction, anchorage points may be 12 feet apart; if the

anchorage points are necessarily farther apart than 12 feet the guide rails shall be proportionately stiffened.

(b) Connections to steel guide rails shall be by means of clips, or by through bolts of not less than the following sizes:

For 6½ to 7½ pound rails.....	½ inch bolts
For 14 pound rails.....	⅝ inch bolts
For 30 pound rails.....	¾ inch bolts

(c) Fastenings to brick walls shall be made with through bolts. Wood plugs inserted in a wall for guide rail anchorage are not permitted. In solid concrete walls where through bolts cannot be used fastenings may be secured by lead, sulphur, efficient toggle bolts, expansion bolts, or inserts. Fastenings to hollow tile walls, plaster partitions and similar construction are not permitted.

(d) Material used for aligning steel rails shall be metal so secured as not to drop from its position if the fastening becomes loose.

(e) Steel car guide rails shall be fitted with substantial foundation plates to withstand the impact of the loaded car when suddenly clamped to the rails by the car safety device.

See also order 418--(d).

SECTION VIII. MACHINES AND SAFETY DEVICES.

Order 458.—Minimum Sizes of Drums and Sheaves. New Installations.

The diameter of drums and sheaves on every power elevator hereafter installed, except sidewalk type elevators, shall be not less than the following:

Diameter in inches of cables	Diameter in inches of drums and sheaves
⅜	20
½	20
⅝	20
¾	22
⅞	24
1	30
1 ¼	36
1 ½	40

Note: A larger diameter than the required minimum is recommended.

Order 459.—Machinery—General Requirements.

(a) The factors of safety based on the static loads (the rated load plus the weight of the car, cable, counterweight, etc.) to be used in the design of elevator machines hereafter installed shall be:

Hand Power Elevators	
For wrought iron or steel.....	5
For cast iron, cast steel and other materials....	8
Power Elevators	
For wrought iron or steel.....	8
For cast iron, cast steel and other materials....	10

(b) Drums and leading sheaves on new installations shall be steel or cast iron with machine finished grooves, except on hand power elevators, and no traction U groove shall be more than $\frac{1}{16}$ inch larger than the cable it carries.

(c) Every drum, traction sheave, pulley, gear, or other such part of an elevator installation shall be securely keyed or pinned on its shaft.

(d) Elevator gear housings shall have a sufficient number, and correct size of openings so located as to permit proper inspection of the gears and gear spider fastenings.

(e) Overhead direct connected electric elevator machines hereafter installed shall be mounted on continuous bed plates.

(f) No cable or link chain of any description shall be used to form the operating connection between the machine and the shifting gear or wheel on any single belt elevator hereafter installed or remodeled.

(g) In new installations every shaft shall be fillet finished at every journal or shoulder cut.

Order 460.—Prohibited Installations.

1. New and Existing Installation.

(a) No belt or chain driven machine shall be used in any passenger elevator installation.

(b) No friction gearing or clutch mechanism shall be used for connecting the drums or sheaves to the main driving gear of any elevator.

(c) No passenger car shall have more than two entrances except in existing installations when approved in writing by the Industrial Commission.

(d) No passenger elevator shall be arranged to be controlled from the landing by means of a hold down push button.

Note: By hold down push button is meant a push button so arranged that the elevator car will continue in motion so long as the push button is being pressed.

2. New Installations.

(e) Chains shall not be used for hoisting except on sidewalk elevators, elevators of the sidewalk type within buildings and traveling not more than 14 feet, and on hand power elevators traveling not more than 14 feet.

(f) Belt driven freight elevators hereafter installed shall be limited to a travel of not more than 50 feet in any case and to a speed of not more than 50 feet per minute.

(g) No power elevator which consists of the platform or carriage type of car supported by cables attached at four or more points shall hereafter be installed.

(h) Cast iron worm gears shall not be used in the hoisting mechanism of any elevator hereafter installed.

(i) In any new installation of a direct air elevator, or a combination of air and water; steam, or a combination of steam and water the travel shall not exceed 25 feet.

(j) No elevator of any type hereafter installed shall have more than one compartment, nor shall elevator cars counterbalance each other.

(k) Hand rope control shall not be used for any passenger elevator hereafter installed, except on hydraulic elevators.

(l) The speed of any hand rope controlled elevator hereafter installed shall not exceed 75 feet per minute.

(m) No hand power elevator hereafter installed shall exceed 1,500 pounds capacity, nor shall any hand power elevator of more than 1,500 pounds capacity be hereafter changed to power.

(n) The travel of any hand power elevator hereafter installed shall not exceed 30 feet.

Order 461.—Power Attachments to Hand Power Elevators. New and Existing Installations.

No power attachment, such as worm reduction units, rope clutch or rope grip devices, belts to improvised rope wheels,

or any similar device, shall be installed on any hand power elevator unless all requirements for power elevators are complied with.

Order 462.—Slack Cable Devices.

1. New and Existing Installations.

(a) A slack cable device which will automatically shut off the power and stop the machine if the cables loosen or break shall be provided on every drum type power elevator, except on existing belt driven freight elevators where the machines are in good condition and such devices cannot be provided without rebuilding the machines.

2. New Installations.

(b) Every slack cable switch on elevators hereafter installed shall be so constructed, installed and maintained that it will not automatically reset when the slack in the cable is removed.

(c) Every ceiling drum type elevator machine hereafter installed shall be so located with respect to height that the slack cable device will operate with not more than 6 feet of slack cable.

Recommendation: A ceiling type machine should be located not higher than the first story ceiling as this will permit proper lead to the cable and will result in longer service of each cable.

Order 463.—Limit Stops. New and Existing Installations.

(a) Every elevator which is provided with an electric brake shall be equipped with shaftway limit switches that will automatically interrupt the power circuit and stop the car at each terminal landing. If the motor of such an elevator is operated by alternating current the limit switches shall be so connected as to automatically stop the elevator in case of phase reversal.

(b) In every case passenger elevators and freight elevators controlled by car switches shall be equipped with two limit switches at each terminal of travel, one switch to be a direction cut-off and the other a final cut-out switch.

(c) Every drum type elevator machine shall be equipped with an approved device which will automatically stop the machine when the car reaches either of the terminal landings.

Order 464.—Car Safety Devices and Speed Governors.

(a) A car safety device capable of stopping and sustaining the car with the rated load, in case the cables break or become slack, shall be attached to every elevator except—

- (1) Freight elevators which travel not more than 10 feet.
- (2) Direct lift plunger elevators.
- (3) Carriage-type elevators which travel not more than 18 feet and in no case more than one story, provided the cables and their end fastenings shall have a factor of safety of not less than 10.

(b) A friction clamp car safety device shall be provided for every passenger elevator and every freight elevator hereafter installed in which the speed is more than 100 feet per minute.

(c) If it is desired to stop an ascending car on account of overspeed a safety device shall be attached to the counterweight.

(d) In every new installation of a car safety device, except on a hand power elevator, the dogs or clamps of the safety device shall be attached to the under side of the car platform. The gripping surfaces of a car or counterweight safety device shall not be used to guide the car or counterweights.

(e) Every drum and idler sheave which is underneath the car and which actuates the car safety device shall be so guarded that the rope or cable cannot leave the drum or sheave.

(f) A cut-out switch that will open the motor and brake control circuits shall be provided in connection with every car safety device on every electric elevator hereafter installed.

(g) A speed governor shall be installed in connection with the required car safety device of every power elevator hereafter installed and on each existing power elevator traveling more than 18 feet. The governor shall be set to operate at not more than 40% excess speed, but need not be set at a lower speed than 150 feet per minute. (See paragraph (a) of this order.

(h) Every speed governor hereafter installed shall be of a type which will securely grip the cable and thereby actuate the car safety device, and shall be located where it

cannot be struck by the car or counterweights in case of overtravel.

(i) Every type of car safety device shall be subjected to an actual drop test made at the risk and expense of the elevator manufacturer and under the direction of the Industrial Commission; and complete plans and specifications of such device shall be submitted to the Commission for approval. The test load shall be equal to two-thirds of the capacity. The car safety device shall stop and hold the elevator car within a drop of 10 feet. No car safety device shall be used which has not been so tested and approved.

Note: Tests of car safety devices and other safety appliances by the United States Bureau of Standards will be recognized by the Industrial Commission.

(j) In every new installation the speed governor and car safety device shall be put to a running test with the rated load on the car.

Note: The speed governor is the only device which will operate the safety when the car attains excessive speed due to broken machinery or other cause. A safety device without a speed governor operates only when the cable breaks.

(k) When the elevator capacity exceeds the maximum for which the car safety device was approved a new drop test shall be made and drawings, or prints, with specifications of the safety device submitted to the Industrial Commission for approval.

(l) Every car safety device and every governor shall be kept in proper working condition and shall be subjected to a running test at such intervals as is consistent with good operating practice.

Order 465.—Stop Balls for Hand Ropes. New and Existing Installations.

Every elevator equipped with hand rope control shall be provided with adjustable stop balls, or equivalent device, for the operation of the automatic stopping mechanism at the top and bottom landings.

Order 466.—Guards for Sheaves and Idlers. New and Existing Installations.

In every hand rope controlled elevator the sheaves which lead the hand rope from the shaftway to the machine shall

be guarded to prevent injury to an operator. Every sheave and every idler under which is led any hoisting or counterweight cable shall be provided with a guard that will keep the cable on the sheave or idler if the cable becomes slack. Every idler sheave around which is led an operating rope or a governor rope shall be provided with a guard that will keep the rope on the sheave.

Order 467.—Centering Ropes. New and Existing Installations.

Every hand rope controlled elevator, except hydraulic elevators, shall be equipped with a properly adjusted centering rope so arranged that it can be easily and safely used at any point in the car travel.

Order 468.—Warning Chains. New and Existing Installations.

Warning chains shall be hung from the car platform within 2 inches of the edge of the entrance side or sides of every power freight elevator, except where shaftway landing doors with electric contacts or interlocks are provided. Such chains shall extend at least 5 feet below the bottom of the platform, shall be spaced not more than 5 inches apart, and shall be made of not less than No. 10 U. S. Standard Gauge wire with long links.

Order 469.—Brakes.

(a) Every direct connected electric elevator hereafter installed shall be equipped with an electrically released brake so designed, installed and maintained that it will not be released until the power has been applied to the motor. Under normal operating conditions the action of the brake magnet shall not be retarded by any motor field discharge or counter voltage, nor by any single ground or short circuit.

(b) Every power elevator, except direct connected electric elevators, shall be equipped with a brake so designed, installed and maintained that it will be released whenever the control mechanism is shifted to the starting position, and so that the brake will be applied by means of

springs or gravity whenever the control device is moved to the stopping position.

(c) Every hand power elevator shall be equipped with a brake that will operate effectively in either direction of motion of the elevator. Whenever such a brake has been applied it shall remain locked in position until released.

(d) The brake on every hand power elevator hereafter installed shall be so arranged that it will operate automatically at the top landing.

SECTION IX. CONTROL AND PROTECTION.

Order 470.—Control Mechanism.

(a) There shall not be installed or used any control system which depends upon the completion or maintenance of an electric circuit for the interruption of the power, for the application of electro-mechanical brakes, for the operation of car safety devices, or for the closing of a contactor by an emergency stop button, except that the requirements in this paragraph do not apply to dynamic braking and speed control devices.

(b) The car switch or hand lever on every power elevator hereafter installed which requires such mechanism 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. Except on hydraulic elevators and existing electric lever control elevators, the lever shall return to the neutral position when released, and the lever shall automatically latch in this neutral position.

(c) A properly fused manually operated disconnecting switch opening all lines shall be installed separately in the supply circuit of every electrically driven elevator machine hereafter installed. If possible this switch shall be located adjacent to, and visible from, the elevator machine. No provision shall be made to close the disconnecting switch from any other part of the building. This switch shall comply with order 1350—(h) of the Wisconsin State Electrical Code.

Note: It is recommended that this switch be located in the machine room at the lock-jamb side of the entrance door.

(d) On mechanically controlled elevators the operation of directional switches or operating valves shall, in no case, depend solely upon a belt or a chain. If a handrope is used the cable shall be securely anchored to the operating sheave or drum.

(e) The handrope for control of an elevator shall be accessible from the car at any point in the car travel.

Note: The handrope for the control of an elevator is sometimes made accessible from the landing side by cutting an opening in the shaftway enclosure. To avoid this it is permissible to arrange the handrope by means of auxiliary sheaves so that one run of the handrope will be on the outside of the shaftway enclosure, provided that in every such case the handrope on the outside shall be guarded in an approved manner to a point not less than four feet above each floor.

(f) The overhead tension weight for the handrope of any elevator equipped with lever control apparatus shall be secured by a chain attached to the weight and to a suitable anchorage.

(g) The car of every power freight elevator with handrope control shall be equipped with a cable lock so designed, installed and maintained that the handrope can be locked at any landing to prevent the operation of the car by persons on other floors.

Exception: The requirements contained in the preceding paragraph need not apply to sidewalk elevators, elevators equipped with emergency switches and elevators equipped with interlocks or electric contacts.

(h) The car of every electrically driven elevator equipped with an electric brake shall be provided with an emergency switch (safety or so-called baby switch) to cut off the source of power.

Order 471.—Push Button Controlled Elevators. New and Existing Installations.

Push button controlled elevators shall conform to the following requirements:

(1) Every directional button shall be arranged to return to the open position when the hand of the operator is removed.

(2) The breaking of a circuit to stop a push button controlled elevator shall not depend on the operation of a spring or springs in tension nor upon the completion of an electric circuit.

(3) In an automatic push button elevator the stop button on the car may be used as the emergency switch if it is a button marked "STOP".

Order 472.—Electrical Protection.

(a) Every elevator driven by a polyphase alternating current motor shall be protected against damage due to phase reversal by either:

(1) Limit switches as specified in order 463 arranged to cut all wires, or all except one, which shall be the ground conductor on grounded systems, and so connected that after the car overtravels, it cannot be moved until the phase reversal is corrected, or

(2) A reverse phase relay, or other protective device, which will prevent starting the motor if the phase rotation is in the wrong direction. Such reverse phase relay, or other protective device, shall be provided for existing installations not later than June 1, 1928.

Note: If the elevator is equipped with an electric brake, limit switches wired in series are required by order No. 463.

(b) The proper functioning of a reverse phase relay hereafter installed shall not be dependent upon the closure of an electric circuit to open the motor circuit in case of failure or reversal of phase.

Recommendation: The reverse phase relay should not be put on the control board, as the vibration of the control equipment may interfere with the proper operation of the relay.

(c) The functioning of a door or gate electric contact, to prevent the movement of the car, shall not be dependent upon the action of a spring or springs in tension nor upon the closing of an electric circuit.

Exception: The contact shall not prevent the movement of the car when the emergency release is in temporary use or when the car is being moved by a car leveling device.

(d) Every electrically driven elevator hereafter or heretofore installed shall be protected against damage due to electrical failure as follows:

(1) An automatic overload protective device, such as fuses, overload relays or circuit breakers. If an overload relay or a circuit breaker is provided for this purpose it shall be additional to the elevator control equipment, and shall be so arranged that it cannot be reset from the elevator car.

(2) Under or low voltage protection which will cause and maintain the interruption of power to the main circuit upon reduction or failure of voltage. This

protection may be a part of the control equipment. (See also order 1357—g of the Wisconsin State Electrical Code.)

(e) Every electrically driven elevator hereafter installed which is controlled by a handrope, lever or wheel shall be equipped with a positive no-voltage release device requiring the centering of the handrope before the circuit can be re-closed. This may be accomplished by the addition of a relay interlocked with the control apparatus.

Order 473.—Switches and Wiring.

(a) In new installations in garages the shaftway limit switches and other spark emitting devices shall be placed at least 4 feet above the line of the lowest floor level.

(b) The floor underneath every unit of unenclosed electrical apparatus shall be covered with a fire resistive and insulating material.

(c) Live parts of electrical apparatus in elevator shaftways shall be guarded by suitable enclosures. Metal coverings shall be thoroughly grounded.

(d) Conductors for car control, safety control, lights and signals shall be in separate cables.

(e) The wires to the emergency switch, if such a switch is installed, shall be run as a separate cable so grouped with relation to other wires or cables, if there are any, that the fault in these wires or cables will not prevent the emergency switch or stop button from opening the circuit.

(f) Every safety switch (so-called baby switch) or other safety stop control conductor cable shall be in a separate unit, not in the same cable with the direction wire.

(g) No conduit shall be loaded more than 40 per cent of the internal cross sectional area of the conduit. (See also order 1331—(a) of the Wisconsin State Electrical Code.)

(h) Wires in vertical conduit risers shall be supported as required by order 1342—(b) of the Wisconsin State Electrical Code. The flexible or traveling cables of the operating and lighting circuits where suspended under the

car shall be supported on insulating spools to relieve the wire connections from strain.

(i) Individual conductors of lighting cables shall not be smaller than No. 14 A. W. G. and for control cables not smaller than No. 16 A. W. G. Signal wires, other than those receiving energy from primary batteries or approved bell transformers, shall be encased in approved conduit equipped with approved terminal bushings having an individual outlet hole for each wire.

(j) If the wires of a motor circuit between the motor and the control panel are grouped together without any extra insulation on the separate wires, the complete group shall be taped or corded and painted in a manner to make it a rigid, self-supporting form, not over three feet long, and not in a position liable to mechanical damage or subject to a temperature in excess of 120 degrees Fahrenheit.

(k) Wires between the main circuit resistances and the backs of control panels shall have individual flame-proof outer coverings. Other wiring on the control panels may be of the rubber covered type, provided the wires are laid flat against the panels and held in such a manner as to be immovable and not exposed to mechanical drainage, nor to a temperature exceeding 120 degrees Fahrenheit.

(l) Every conductor cable hung from an overhead machine platform on any elevator hereafter installed shall be secured approximately at the center of the shaftway to prevent swinging. Where the penthouse floor is not of incombustible material the floor under the controller shall be protected with fire resistive, insulating material.

(m) Wiring shall be in approved rigid conduit, except where otherwise specified in this code, and shall conform to the requirements of the Wisconsin State Electrical Code.

Order 474.—Grounding.

Exposed noncurrent carrying metal parts of electrically driven elevators operating at more than 100 volts to ground including frames, conduit, hand ropes, etc., shall be permanently and effectively grounded in accordance with Section 103 of the Wisconsin State Electrical Code.

Note: The ground connection should be made to water piping systems, if available, never to gas pipes. Other large latched metal structures and grounded steel building frames may be used where water pipes are not available.

Order 475.—Signal Systems. New and Existing Installations.

(a) Every elevator and every power dumbwaiter shall be equipped with a signal system or warning bell, so arranged that it can be safely and conveniently operated from any landing, except elevators and dumbwaiters controlled by push buttons and hand power elevators traveling in no case more than 25 feet.

(b) Every automatic push button elevator shall be provided with an emergency call bell in the caretaker's office, with properly placarded push button in the car.

SECTION X. LIGHTING.

Order 476.—Lighting.

(a) **Car Lighting.** Elevator cars shall be adequately lighted when in use. Provision for electric light shall be made if current is available. The intensity of illumination shall be not less than 0.75 foot-candle at the edge of the car platform.

Note: This illumination is the equivalent of a 75 watt lamp at the ceiling of an ordinary elevator car. Threshold lights are also recommended for passenger elevators.

(b) **Landing Light.** While occupied ample light shall be provided at every elevator landing within, or in connection with, any building.

(c) **Penthouse and Overhead Lighting.** Every penthouse shall be provided with suitable artificial light. Every elevator machine room and area about a ceiling type machine, including overhead sheave rooms and lofts, shall be well lighted. Control of such lighting shall be in the approach to the penthouse or overhead equipment. (See Industrial Lighting Code issued by the Industrial Commission.)

SECTION XI. OPERATION, MAINTENANCE AND USE.

Order 477.—Operation of Elevators. New and Existing Installations.

(a) A competent operator shall be stationed on the car of every passenger elevator while in use, except push button elevators.

Note: Section 103.06 of the Wisconsin Statutes prohibits the employment of persons under 18 years of age in the operation of elevators.

(b) No elevator car shall be used for hoisting material which projects from the car at any point, nor shall material be hung underneath the car, except in extreme necessity when the following precautions shall be observed:

(1) No material extending above the top of any elevator car shall be hoisted unless a regular operator is on the car and an attendant is stationed at the floor level where the material is to be delivered.

(2) The car shall be operated at slow speed when it is necessary to use it for this purpose.

(3) Every car gate and car door shall be closed while the car is in motion.

Order 478.—Maintenance. New and Existing Installations.

(a) Elevators, dumbwaiter and escalator equipment shall be kept in safe operating condition, properly lubricated and clean.

(b) Hatch covers of the vertically rising type used on elevators shall not be used for storage purposes, nor as passageways.

(c) Explosives or highly inflammable substances shall not be stored within 20 feet of any elevator shaftway or penthouse.

(d) Material which is not a permanent part of the elevator equipment shall not be permitted on the top or cover of an elevator car.

Note: A sign should be used to plainly designate a freight elevator, at the same time prohibiting unauthorized persons from riding on the car.