

INDUSTRIAL COMMISSION OF WISCONSIN

GEO. P. HAMBRECHT, *Chairman* FRED M. WILCOX THOMAS F. KONOP

E. E. WITTE, *Secretary*

R. MCA. KEOWN, *Engineer*

Revised code effective January 10, 1918.

Reprinted April, 1920

ELEVATOR CODE

INTRODUCTION

The first Wisconsin elevator code became effective in 1913. It was formulated by a committee representing elevator manufacturers, architects, insurance companies, and the city of Milwaukee, and was based upon experience in elevator accidents and upon the existing practice of reputable manufacturers. The committee's report was distributed broadcast for criticism, and a public hearing was held. The report was then revised and finally adopted by the commission.

After working under this code for four years the desirability of a revision became apparent. After a careful study of recent accident experience and of regulations in other states and cities, a revised code was adopted by the committee and distributed for criticism. A public hearing was held in Milwaukee, after which further changes were made and a final revision was recommended by the committee, formally adopted by the Industrial commission, and became effective January 10, 1918. Slight amendments to orders 423, 424, 430, 450, 452, to clarify the meaning of these orders were all adopted February 2, 1920, and became effective April 22, 1920. Order 499 was adopted March 23, 1920, and became effective April 24, 1920.

The present elevator committee includes the following:

- C. F. Ringer, architect, former inspector of buildings, Milwaukee.
- F. Jermain, Otis Elevator company.
- George Mueller, inspector of elevators, Milwaukee.
- G. N. Chapman, inspector of safety, Aetna Insurance company.
- R. MCA. Keown, engineer, Industrial Commission.

The elevator orders are adopted by the commission under authority of sections 2394—41 to 2394—71 of the revised statutes. These orders

have the force and effect of law. Any interested party may petition the commission for a hearing on the reasonableness of any of its orders, and if the petition be denied, he may appeal to the Circuit Court. Violation of any order is punishable by a fine of from ten to one hundred dollars per day for each offense. The statutes specifically authorize the charging of fees for elevator inspections, as described in order 418.

TABLE OF CONTENTS

By Pages

Section 1,	Definition,	3.
Section 2,	Plans, Inspections and Certificates,	4.
Section 3,	Shaftway Enclosures,	5.
Section 4,	Landing Doors and Gates,	6.
Section 5,	Pits and Penthouses,	8.
Section 6,	Cars,	9.
Section 7,	Cables and Counterweights,	11.
Section 8,	Loads and Stresses,	14.
Section 9,	Guide Rails,	15.
Section 10,	Machines and Safety Devices,	15.
Extracts from General Safety Orders and Electrical Safety Orders,		18.
Alphabetical Index,		21.

ELEVATOR CODE

SECTION 1. DEFINITIONS.

Order 400. An elevator is an elevating and lowering device, other than a dumb waiter, provided with a platform and cage which is located in a permanent shaftway and is designed or used to carry persons or materials.

Order 401. A dumb-waiter is an elevating and lowering device provided with a platform which is located in a permanent shaftway, is designed and used to carry materials only, is not more than 16 square feet in area and not more than five feet high, has a carrying capacity of not more than 500 pounds, and has its shaftway enclosed on the loading side for a height of at least 30 inches above each floor, except where it terminates under a counter top.

Note. Only the following orders apply to dumb-waiters: 421, 423, 433, 497, 498.

Order 402. A passenger elevator is an elevator used chiefly for carrying persons.

Note. A combination or service elevator is classed as a passenger elevator.

Order 403. A freight elevator is an elevator used chiefly for carrying materials.

Order 404. A carriage-type elevator is an elevator which is supported by cables attached to the platform at four or more points.

Note. New carriage-type elevators without overhead frame are practically limited, by order 488, to one-story travel not exceeding 18 feet.

Order 405. A sidewalk elevator is an elevator located below a sidewalk or other public thoroughfare, and which has no lifting or counterweighting mechanism above the upper landing level.

Note. For special requirements for sidewalk elevators, and also for elevators of the same type but not located below a sidewalk, see orders 434, 435.

Order 406. A hand-power elevator is an elevator which is operated by hand only and which has no power attachment. All other elevators are power elevators. See order 484.

Order 407. A full-automatic gate is one which opens and closes automatically as the car approaches and leaves the landing. A gate or door which is equipped with a device, such that the elevator cannot be started unless the door or gate is closed, is considered equivalent to a full- or semi-automatic gate.

Order 408. A semi- or half-automatic gate is a gate which must be opened by hand but which closes automatically when the car leaves the landing. See order 407.

Order 409. The travel of an elevator is the vertical distance from the lowest to the highest landing.

Order 410. Approved means approved by the Industrial Commission.

Order 411. New installations, or elevators hereafter installed, include,

(1) Every elevator for which the contract was not let before January 10, 1918.

(2) The shaftway enclosure, guides and machine of an elevator which is moved to a new location or materially extended.

(3) Any complete part of an existing elevator which is materially altered or replaced.

All other elevators and parts are existing installations or heretofore installed.

The elevator orders apply to both new and existing installations unless otherwise specified.

SECTION 2. PLANS, INSPECTIONS AND CERTIFICATES.

Order 415. Approval of Plans. Before starting work on any new installation or alteration, plans shall be submitted to the Industrial Commission for approval, together with an application, properly filled out, on a blank form furnished by the commission. Plans shall be in duplicate. But this order shall not apply in cities where elevator permits are issued by the city in a manner approved by the Industrial Commission.

Order 416. Inspections by Insurance Companies. The Industrial Commission will accept inspections of insured elevators by inspectors of insurance companies on the following conditions:

(1) Each elevator shall be inspected semiannually, as near as may be; except that in plants outside the city of Milwaukee, which are covered by a compensation insurance policy only, such inspections shall be made at least annually.

(2) A detailed report of each inspection shall be filed with the commission within 14 days after inspection on a printed form to be approved by the commission. Such report shall show all respects in which the elevator fails to comply with the elevator orders. If there are any special circumstances which, in the inspector's opinion, would require a modification of any general order, such facts shall be fully stated in the report, together with the inspector's recommendations.

(3) A certificate of inspection on a form approved by the commission shall be posted by the insurance company in a conspicuous place in the elevator car, and shall show the date of inspection, name of insurance company, name of inspector, safe carrying capacity (see order 476), and whether steel cables are used (see order 461).

(4) The insurance company shall use all reasonable diligence to secure compliance with the commission's orders. If unsuccessful, it shall so report to the commission. If it then becomes necessary for the commission to inspect the elevator, the regular charge of two dollars will be made (see order 418).

(5) The competency of each elevator inspector shall be certified to by the insurance companies in writing to the commission prior to making inspections, and inspectors are to be approved by the commission.

Order 417. Inspection by City. In the city of Milwaukee, and in any other city which shall provide a competent city elevator inspec-

tor, the Industrial commission will accept inspections by such city, provided the conditions of paragraphs (1), (3) and (4) of order 416 are complied with, substituting "city" for "insurance company."

Order 418. Inspection Fees. A charge of two dollars will be made by the Industrial commission for each inspection of each elevator, provided such inspection is made more than six months after the installation of the elevator. No charge will be made for inspection at the time when the elevator is installed.

SECTION 3. SHAFTWAY ENCLOSURES.

Order 420. Passenger Elevators—Fireproof Enclosures. The shaftway of every passenger elevator hereafter installed shall be completely enclosed on all sides with a fireproof enclosure, made either of wired glass in metal frame, or of solid plaster not less than two inches thick on metal lath and metal frame, or of brick, concrete or tile of sufficient thickness to give rigidity. All windows in such enclosure, except in outside walls, shall have metal frames, metal sash and wired glass. All entrances and doorways shall be provided with fire doors. Such doors and their frames shall be made entirely of metal, or of not less than two thicknesses of matched lumber, enclosed with tin. The glass in such doors, if any, shall be wired glass. These doors must be self-closing in case of fire. Fire doors must not swing on a vertical axis except where the restricted space will not permit the use of a sliding or rolling door, and except as provided in order 431. Every fireproof enclosure shall be extended to the roof, or shall be covered at the top with a fireproof floor. (See orders 444-446.)

Note. If placed in a fireproof stair tower, the elevator need not have an additional fireproof enclosure. Such elevators shall be guarded to a height of six feet above all floors and stairs, as specified in order 423.

Order 421. Freight Elevators—Fireproof Enclosure. The shaftway of every freight elevator and dumb-waiter hereafter installed in a building more than two stories in height (excluding basement) or where the travel of the elevator car exceeds 30 feet, shall be completely enclosed on all sides with a fireproof enclosure as specified in order 420, except that no 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 is either

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

provided further, that in any three-story building of frame construction, with or without basement, the elevator enclosure above the basement may be semi-fireproof, instead of fireproof, but the basement enclosure must be fireproof. A semi-fireproof enclosure consists of wood studs with metal lath and plaster on both sides. Doors and windows shall be the same as required for fireproof enclosures.

Order 422. Freight Elevators—Basement Enclosure. The shaftway of every elevator hereafter installed shall be completely enclosed in the basement with a fireproof enclosure as specified in order 420, except freight elevators in buildings not over one story in height above the basement.

Order 423. Freight Elevators—Shaftways Guarded. The shaftway of every freight elevator and dumb-waiter, where a fireproof en-

closure 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 must be solid. If the guards are made of wire screen, the wire must be not less than No. 10 gauge, and the mesh not greater than one inch, measured along the wire from center to center of wires at points where they cross.

Order 424. Outside Windows Guarded. All outside windows in elevator shafts, up to and including the fourth story, or where the sill is not more than 15 feet above an adjoining roof, shall be completely guarded on the outside with either (1) metal bars not less than $\frac{1}{2}$ -inch in diameter, and not more than ten inches center to center, or (2) wire screen of wire not less than $\frac{1}{4}$ -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.

Note (a). Bars or grating are also required on the inside of the window if the car is open on two sides and no car gate is provided—see order 453. In such cases the spacing of bars is governed by the general requirements for shaftway enclosures in order 423.

Note (b). For counterweight runway guards see order 471.

Order 425. Projecting Floors, etc. All projections in elevator shaftways such as floors, beams, sills and bolts, unless guarded against by the 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 shall make an angle of not less than 60 degrees with the horizontal. On new installations, such guards shall be made of smooth metal not less than 1-16 inch in thickness, with solid backing, or of smooth concrete.

Note (a). For non-slippery sills, see order 454.

Note (b). For additional toe-guards on sidewalk elevators see order 434.

SECTION 4. LANDING DOORS AND GATES.

Order 430. Passenger Elevators—Landing Doors. All passenger elevators shall be equipped at each landing with doors which shall entirely fill the opening to the shaft. All such doors shall be constructed of solid metal, wired-glass, or screen of not less than No. 10 wire with $1\frac{1}{4}$ inch square mesh, or of grill work the openings in which shall not be more than $1\frac{3}{4}$ inches square, or if openings in screen or grill are other than square if the greatest dimensions of openings are more than $1\frac{3}{4}$ inches, the openings shall not be over 1 inch wide. (For new installations, fireproof doors are required—see order 420.) All doors shall be equipped with self-acting locks or other appliances which cannot be opened from the outside except by means of a key, which key shall be placed in charge of a responsible person.

Existing wooden doors will be accepted, but if such doors contain grill work or screen, the openings must not be larger than specified above.

All landing doors must be of sufficient strength to withstand a lateral pressure of 250 pounds at the center.

Note. On existing doors where the openings in the grill work are larger than specified above, a wire screen may be stretched across the inner face of the door.

See Note on interlocking devices, at the end of order 432.

Order 431. Freight Elevators—Landing Gate. All freight elevators shall be equipped at each landing with either

(1) Doors, as specified above for passenger elevators. Such doors are accepted only where an operator is stationed on the car. In new installations, such doors shall be equipped with an approved device such that the elevator cannot be started unless the door is closed and locked. When provided with such devices, such doors may swing on vertical axes. Every electrical interlocking device shall have an emergency switch on the car, whereby the car may be operated even though the doors are open. Such switch shall be placed under glass and shall be used only in emergency. Or,

(2) Vertically-sliding gates. (Solid doors which comply with the following requirements, may be considered as gates.) At top and bottom landings the gates shall be full-automatic or semi-automatic; at other landings they shall be semi-automatic, or may be full-automatic if approved in writing by the Industrial commission. All gates shall be not less than 5½ feet high, except that gates not less than 3½ feet high may be used (a) at top landings, and (b) at other landings where conditions do not permit a 5½ foot gate, provided the car speed does not exceed 75 feet per minute.

Note. Gates 5½ feet high are recommended in all cases, and may be provided even in low stories by having the gate pass by the floor above. Collapsible gates are not recommended.

Exception. In old installations where there is a vertically-rising trap door at the top floor, and at least 3 feet of headroom above the trap door when the car is at such floor, and the trap door is so located or so guarded that it cannot be used as a passageway, then a landing gate is not required at such top floor.

Landing gates at openings in outside walls shall extend down to the sill where practicable, and in no case shall the bottom rail be more than six inches above the sill. Other gates shall have bottom rails not more than twelve inches above the sill, except in basements where conditions do not permit. The openings between the slats or bars shall not be greater than three inches except on side of operating cable where the opening shall be large enough to permit the operation of the cable.

All landing gates must be of sufficient strength to withstand a lateral pressure of 250 pounds at the center.

Order 432. Power Freight Elevators—Locking Devices. In new installations of power freight elevators every landing gate except full-automatic gates shall be equipped with an approved device such that the gate cannot be opened unless the car is at the landing. Such devices shall be constructed and located so that they cannot easily be put out of order, and so that they cannot be reached by hand from the floor when the gate is closed. Such devices shall be kept in order at all times.

Note. Such devices would have prevented many accidents. They are recommended for all elevators, both freight and passenger. For freight elevator gates they can be easily provided in connection with the semi-automatic closing device.

Order 433. Dumb-waiters—Doors. Every electric dumb-waiter shall be provided with landing doors, so arranged that the dumb-waiter cannot be started, unless all doors are closed. Where a fire-proof shaftway is required, all doors must be fire doors (see orders 421-420).

Order 434. Sidewalk Elevators. All sidewalk elevator shafts shall be covered at the top with doors, designed and constructed to carry a safe load of 250 pounds per square foot. The doors and frames

shall have a rough surface and no part thereof shall project above the sidewalk level. The doors shall open only sufficiently for proper service, and when open must form a suitable guard for the opening, or other guards must be provided. All power sidewalk elevators shall be equipped with a device to prevent their operation until the doors are open. The doors must be closed when the elevator is not in actual use.

A beveled toe-guard shall be provided under the edge of the sidewalk, and under other projections if any, as required by order 425. If the elevator platform rises above the sidewalk, similar toe-guards shall be provided under the platform on all exposed sides.

Sidewalk elevators which travel only one story are subject to the following orders only: 425, 434, 477, 498. Sidewalk elevators which travel more than one story are subject to all the elevator orders.

Order 435. Elevators of the Sidewalk Type. Elevators of the sidewalk type, located within a building, and travelling less than one story, shall be equipped with toe-guards as specified in order 425; the sides of the car, or sides of the shaftway, or both (if required) shall be guarded with an enclosure constructed as specified in order 423 and of such height as will afford reasonable safety. Landing gates shall be provided if required.

Elevators of the sidewalk type, located within a building, and travelling one story or more, shall comply with all the elevator orders.

SECTION 5. PITS AND PENTHOUSES.

Order 440. Depth of Pit, and Overtravel. For new installations, the depth of pit and the overtravel shall be not less than the following:

Power Elevators: Speed	Pit	travel
Not over 50 feet per minute	2 feet	2 feet
Over 50 but not over 150 feet per minute.....	3 feet	4 feet
Over 150 but not over 350 feet per minute.....	4 feet	5 feet
Over 350 feet per minute	4 feet	6 feet
Handpower elevators	1 foot	1 foot

The overtravel for the counterweights shall be as great as required for the car. The car overtravel is the distance which the car can rise above the top landing without striking overhead. The counterweight overtravel is the distance which the counterweight can rise above its normal position when the car is at the lowest landing.

Note. In some cases a deeper pit is necessary. The architect should consult the elevator manufacturer on this point.

Order 441. Construction of Pits Hereafter Installed. The pit shall be equal in area to the shaftway. The walls and floor shall be constructed of incombustible material forming a tight enclosure of sufficient strength to stop the car or counterweight in case it drops.

Order 442. Use and Maintenance of Shaftways and Pits. No elevator machine or other machinery shall be located in the pit. Elevator shaftways and pits shall be kept clean, and shall not be used for the storage of any material or the running of any rope, wire or pipe, except such as is needed for the operation of the elevator, and except branch pipes with sprinkler heads; but in old installations, pipes in the shaftway may remain unless carrying steam with pressure exceeding 15 pounds, and wires may remain if placed in conduit. Elevator shaftways and pits shall not be used as passageways.

Order 443. Bumpers. All passenger and power freight elevators hereafter installed shall be provided with spring, rubber or oil bumpers or other approved type of bumpers, which must rest on a substantial foundation in the pit under the car. The car must be so constructed as to withstand the impact of the bumpers.

Exception. Oil bumpers may be attached to the bottom of the car if securely fastened, but it is preferable to install them in the pit.

The bumpers shall be such that they will absorb, within the limits of their moving parts, all the energy of the car loaded to full capacity descending at full normal speed.

Order 444. Penthouse—Where Required. 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 446-447; except that where a new elevator is installed in an existing building, or in a new building where the elevator terminates below an occupied floor, provided the overhead machinery consists only of sheaves and governor, such penthouse may be omitted and the headroom may be decreased if approved in writing by the Industrial commission.

Order 445. Penthouse Construction. Every penthouse in a fireproof building shall be made of incombustible material throughout. Every penthouse in a non-fireproof building shall be made of incombustible material, or of frame construction covered on the outside with incombustible material. In new installations the entrance to the penthouse, or the floor under the sheaves, must be located outside of the shaftway, and the access to same must be made safe and easy.

Order 446. Floor Under Overhead Machinery. There shall be a floor immediately under the machinery and sheaves, if any, at the top of the shaftway of every power elevator. If the elevator machine is placed at the top of the shaftway, such floor shall cover the entire shaftway, shall be of fireproof or mill construction (except that steel beams need not be fireproofed), and shall be built and supported for a safe load of not less than 300 pounds at the center.

Note. For strength of beams, etc., under machinery and sheaves, see order 477.

Order 447. Floor or Screen Under Sheaves. If the overhead machinery consists only of sheaves and governor, then the floor below, if of wood, shall be solid and at least 2½ inches thick, or at least ¾-inch thick if supported by joists every 16 inches; if of metal, shall have no openings greater than one inch. It shall be built and supported to carry a safe load of not less than 300 pounds at the center. It shall fill the shaftway if the area of the shaftway does not exceed 50 square feet and if the average headroom above such floor is at least 5 feet; otherwise such floor need extend only 2 feet outside of all sheaves and machinery which should be reached for oiling and inspection; in such cases there shall be a 6-inch toe-board at the edge of the floor, and where the space between the floor and the wall of the shaft exceeds 12 inches, a handrail shall be provided 30 inches above the floor. This order shall also apply to the secondary sheaves of traction elevators.

This order shall also apply to hand power elevators having no screen over the car, excepting old installations where there is not room for such floor.

SECTION 6. CARS.

Order 450. Passenger Elevators—Car Enclosures. Every passenger car shall be completely enclosed on all sides, excepting the entrance. Openings in the enclosure shall not be larger than $1\frac{3}{4}$ inches square; or if longer than $1\frac{3}{4}$ inches, such openings shall not be more than one inch wide. If wire mesh is used, the wire shall be not less than No. 10, with mesh not greater than $1\frac{3}{4}$ inches square, or if other than square, and if the greatest dimensions of openings are more than $1\frac{3}{4}$ inches, the openings shall not be over 1 inch wide.

Note. On passenger cars where the openings in the grill work are larger than specified above, a screen may be stretched around the outside of the car.

In new installations the sides of the car shall be constructed of solid panels to a height of not less than $3\frac{1}{2}$ feet; where counterweights run there must be a solid guard for the full height of the car. The car enclosure shall be made of incombustible material. The floor may be made of wood.

In both old and new installations the roof of the car shall be constructed of solid material. A portion of such roof measuring not less than 20 by 30 inches where possible, and not less than 12 by 24 inches in any case, shall be so constructed that it can be readily removed by a person inside the car. In new installations where two or more passenger elevators run in the same shaftway, doors shall be provided to enable persons to pass from one elevator to the other. Such doors shall be locked and the key kept in possession of the operator.

No glass shall be used in any passenger car, except to cover certificates, annunciators and lamps. Mirrors are strictly forbidden.

A metal handrail one inch in diameter and not less than three feet above the floor shall be placed on all sides, except at seats.

No elevator shall have more than one compartment.

Note. For capacity of passenger cars see order 475.

Order 451. Passenger Elevators—Car Doors. If the car of a passenger elevator has more than one entrance, the entrance or entrances other than the one facing the operator shall be equipped with a gate or door which completely fills the opening and which must be kept closed while the car is in motion. In new installations, such gate or door shall be provided with an approved device such that the elevator cannot be started unless such gate or door is closed and locked.

On push button elevators, every 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.

See order 456.

Order 452. Freight Elevators—Car Enclosure. Every freight elevator car shall be solidly enclosed on all sides, except the entrance side. The height of such enclosure shall be at least 6 feet, except as follows:

(1) For new installations, the enclosure shall be at least 7 feet high in front of the counterweight runway, if the counterweights are less than 3 inches from such enclosure.

(2) For hand power carriage hoists travelling not more than two stories (including both old and new installations) the enclosure shall be at least $3\frac{1}{2}$ feet high, except in front of the counterweight runway.

On the side of the operating cable, sufficient space to operate the cable shall be allowed in all cases.

Every freight elevator car shall be completely covered at the top, except as follows:

(1) On a freight elevator travelling only one story, no cover is required if the shaftway above the lowest story is completely enclosed and the gate is full-automatic and extends down to the floor.

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

(3) No cover is required for a hand power elevator where the bottom rail of each gate rests on the floor. In such case a floor or screen must be provided under the sheaves—see order 447.

Every such cover shall be built and supported to carry a safe load of not less than 300 pounds at any point, and shall either be solid or be made of wire screen of not less than No. 10 wire and with mesh not greater than one inch, and shall either be solid or be made of wire screen of not less than No. 10 wire and with mesh not greater than 1 inch, measured along the wire from center to center of wires at points where they cross.

Every cover shall have 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. Such section shall be at least 12 inches wide, shall extend the full width of the entrance, and shall be constructed so it will rise if it meets an obstruction as the car descends. If heavy, it shall be counterweighted so as to rise easily.

Order 453. Freight Elevator—Car Gate. If a freight elevator car has more than one entrance, and the floor levels at such entrances are not the same, then the entrance or entrances farthest from the operator's position shall be equipped with a car gate. If the floor levels are the same, such car gate shall be provided unless the shaftway enclosure, at the entrance or entrances farthest from the operator's position, is nowhere farther than five inches from the car platform. All car gates shall run in guides, shall extend to the floor and be at least 6 feet high, and shall contain no openings greater than 3 inches. All car gates hereafter installed shall either be semi-automatic or be equipped with an approved device such that the elevator cannot be started unless the gate is closed.

Order 454. Entrance Sills. All sills to entrances of elevator cars and shaftways must have a non-slippery surface.

Order 455. Light. Ample light shall be provided for all elevator cars and landings.

Note. On passenger elevators the threshold of the car and the landings should be well lighted to prevent persons from stumbling if the car does not stop level with the floor.

Order 456. Operation of Passenger Elevator Car. Every passenger elevator, except automatic push-button elevators, must have a competent operator stationed on the car. The operating lever, wheel or switch must not be operated by any other person.

The landing doors must not be opened until the car reaches the landing and must be closed and locked before the car leaves the landing.

SECTION 7. CABLES AND COUNTERWEIGHTS.

Order 460. Factor of Safety for Cables. The factor of safety for all hoisting and counterweight cables, based on the cable manufacturer's schedule, shall be not less than 8 for passenger elevators; 7 for

freight elevators whose speed exceeds 75 feet per minute; 6 for freight elevators whose speed does not exceed 75 feet per minute, and for dumb-waiters.

TABLE OF SAFE LOADS FOR CABLES

Note: In determining the load on the hoisting cables, where no car counterweight is provided, the weight of the car must be added to the live load or capacity.

	Diameter inches	Factor of Safety		
		8 (Passenger)	7 (Freight, over 75 ft. per min.)	6 (Freight, not over 75 ft. per min.)
(Swedish Iron)	3/8	600	685	800
	7/16	725	830	965
	1/2	975	1115	1300
	9/16	1175	1345	1565
	5/8	1500	1715	2000
	3/4	2115	2415	2830
	7/8	2950	3370	3930
	1	3625	4150	4830
(Cast Steel)	3/8	1200	1370	1600
	7/16	1625	1860	2170
	1/2	2100	2400	2800
	9/16	2500	2860	3330
	5/8	3125	3570	4170
	3/4	4375	5000	5830
	7/8	5750	6570	7670
	1	7500	8570	10000

Order 461. Sign Where Steel Cables Used. In new installations where steel cables are used, the elevator manufacturer shall place a metal sign in a conspicuous place in the car, reading as follows:

STEEL CABLES MUST BE USED FOR THIS ELEVATOR

In old installations where steel cables are used, the above notation shall appear on the inspection certificate.

Order 462. Standard for Cable Inspection. Cables are considered unsafe and shall be condemned when through broken wires, wear, rust, undue strain, or other deterioration, the strength of the cables has decreased 25 per cent.

Note. When broken wires or other signs of deterioration are discovered, the cables should be carefully watched. Cables should be frequently lubricated, it adds much to their durability.

Order 463. Hoisting Cables, Number Required. Every elevator which requires hoisting cables shall have not less than two hoisting

cables, except that on old installations a single hoisting cable will be permitted if the factor of safety is not less than 10.

Order 464. Drums and Sheaves, Minimum Size. The diameter of drums and sheaves for power elevators hereafter installed shall be not less than the following:

Diameter of cables, inches	Diameter of drums and sheaves, inches.
$\frac{3}{8}$	20
$\frac{7}{16}$	20
$\frac{1}{2}$	20
$\frac{9}{16}$	22
$\frac{5}{8}$	24
$\frac{3}{4}$	30
$\frac{7}{8}$	36
1	40

Note. A larger diameter than the above minimum is strongly recommended.

Order 465. Turns Required on Drum. In new installations of drum type elevators, the hoisting and counterweight cables shall have at least one and one-half turns on the drum when the car is at the bottom and top landings respectively.

Order 466. Cables, Fastenings at Terminals. Where practicable, on elevators hereafter installed, each hoisting and counterweight cable shall be independently fastened at its terminal to the crosshead of the car frame or counterweight frame, respectively.

Where adjustable draw bars or equalizers are used, the manufacturer's standard construction of such draw bars and equalizers for the given condition of installation and type of apparatus shall be submitted to the Industrial commission for approval and only such approved construction shall be used in similar cases.

In no case, however, on elevators hereafter installed shall more than one cable be fastened into the same clevis except on car counterweights.

Order 467. Drum and Car Counterweights. All electric passenger elevators hereafter installed where the lifting cables wind around a drum and where the speed exceeds 150 feet per minute shall be equipped with car counterweights suspended from separate cables. All drum type passenger and freight elevators hereafter installed, shall be equipped with drum counterweights.

Note. The equipment of elevators with proper counterweights is very essential to safety and it is recommended that on elevators heretofore installed, the above standards be followed where possible.

Order 468. Counterweights, Cables Required. Each set of counterweights on freight elevators hereafter installed, the weight of which exceeds 1,000 pounds, or the travel of which exceeds 25 feet, or the speed of which exceeds 60 feet per minute, shall have not less than two cables. Each set of counterweights on all passenger elevators hereafter installed shall have not less than two cables.

Order 469. Cables Protected. Where cables of one set of counterweights pass through or by another set of counterweights, they shall be provided with a suitable covering to prevent chafing or wearing.

Order 470. Counterweights Bolted. In each set of counterweights on all power elevators hereafter installed, unless 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 holes in all of the weights, tightly bolting them together. Counterweights on hand power elevators shall be bolted together with not less than two bolts. Counterweights of elevators heretofore installed shall be bolted or strapped together to keep the individual weights in position.

Order 471. Counterweight Runways Guarded. Where counterweight runways are located in the elevator shaft way, the outside (side away from the elevator) shall be entirely enclosed with a solid guard. The inside shall be entirely enclosed with a solid guard from a point 12 inches above the bottom of the pit to a point 8 feet above the bottom of the pit, 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 chains connected to the bottom of the counterweight.

Where counterweight runways are located outside the elevator shaftway, they shall be entirely enclosed on all sides with a solid guard.

Note. Guards should be made of metal not less than 16 guage. See also the following order.

Order 472. Counterweight Stops. 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 6 inches above the highest landing.

In every power elevator hereafter installed, an I-beam or other obstruction shall be strongly secured at the upper limit of travel of the counterweights so that the counterweights cannot be drawn out of the runway. Such obstruction shall be so arranged that the counterweights will be stopped squarely, without twisting. The counterweight guide rails shall be strongly fastened together every 4 feet, from the top of the guide rails down to a point opposite the bottom of the counterweight when the car is at the lowest landing. This requirement shall also apply to existing elevators which travel more than 35 feet and whose counterweight runways are not properly fastened together or guarded at the top.

SECTION 8. LOADS AND STRESSES.

Order 475. Capacity of Passenger Elevators. Every passenger elevator hereafter installed shall be designed for a live load of not 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 live load may, if approved by the Industrial commission, be reduced to 30 pounds per square foot, but not less than 1,200 pounds.

Order 476. Capacity Plates. A metal plate with raised letters not less than one inch long, stating the live load for which the elevator was designed, shall be placed in a conspicuous position on the car of every elevator.

Order 477. Stresses. Every elevator and every part thereof (except cables) and all supporting members, hereafter installed, shall be

designed and constructed to carry the stationary loads plus $1\frac{1}{2}$ times the moving loads, using the safe working stresses specified in the state building code.

For cable stresses see order 460.

SECTION 9. GUIDE RAILS.

Order 480. Every power freight elevator whose speed exceeds 150 feet per minute, and every passenger elevator, hereafter installed, shall have wrought iron or steel guide rails for car and counter-weights. Where wrought iron or steel guide rails are not required, guide rails made of hardwood, or a combination of wood and steel securely bolted together, may be used. All guide rails must be made of sufficient strength, must rest on a proper foundation, and must be securely supported so that they will not spread.

SECTION 10. MACHINES AND SAFETY DEVICES.

For size of sheaves and drums see order 464.

For mechanical and electrical safeguards see orders 1-19 and 1110-1220, reprinted at end of this bulletin.

Order 483. Prohibited Types. Belt- or chain-driven machines shall not be used for passenger elevators hereafter installed.

Hand rope control shall not be used for passenger elevators hereafter installed, except hydraulic passenger elevators on pressure not exceeding 60 pounds.

Order 484. Power Attachments to Hand Power Elevators. Power attachments must not be applied to hand power elevators unless all requirements for power elevators are complied with.

Note. Application and plans must be submitted—see order 415.

Order 485. Slack Cable Device. A slack cable device which will automatically shut off the power and stop the machine, if the cables slacken or break, shall be provided on all power elevators where the cables wind around a drum; except belt-driven freight elevators heretofore installed where the machine is in good condition and where such device cannot be provided without rebuilding the machine.

Order 486. Automatic Limit Stops. Automatic stops which will stop the car at the highest and lowest landings, independently of the operating device, shall be provided for every power elevator except direct lift plunger elevators with hand rope control and speed not exceeding 75 feet per minute at two-thirds capacity.

Order 487. Plungers. The plunger of every plunger elevator shall be provided with a ring, or shall be fluted, to prevent its leaving the cylinder. Cast iron plungers shall not be used for elevators which travel more than 30 feet.

Order 488. Catching Device and Speed Governor. An automatic device which will catch and stop the car if it drops, shall be attached to every elevator except,

(1) Direct lift plunger elevators, and,

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

A speed governor shall be connected to the catching device of every power elevator which travels more than one story or more than 18

feet. The governor shall be set to operate at 40 per cent excess speed, but need not be set at a lower speed than 150 feet per minute, and shall not be set at a higher speed than 700 feet per minute.

In all new installations of catching devices to which speed governors are attached, the dogs or clamps of the catching device shall be attached to the under side of the car platform.

Every type of catching device shall be subjected to an actual drop test made at the risk and expense of the 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 catching device must stop and hold the elevator car within a drop of ten feet. No catching device shall be used which has not been so approved.

In every new installation, the speed governor and catching device must be put to a running test with full load on platform.

Note. The speed governor is the only equipment which will operate the safety device when the car attains excessive speed from broken machinery or other cause. Safety devices without speed governors operate only when the cable breaks.

Purchasers of safety devices should make sure that the type of device has been properly tested and approved by the Industrial commission.

Order 489. Governor Cables. Wire governor cables shall be used on all elevators whose travel exceeds 75 feet, or whose speed exceeds 150 feet per minute, except where a type of catching device is used which does not require a continuous pull to fully set the same. Hemp rope with wire center may be used in place of wire cables, if approved by the Industrial commission.

Note. On elevators equipped with wire governor cables, the governor should be specially constructed so as to grip the cable and throw in the safety clutch.

Order 490. Hand Rope Locks. Every power freight elevator with hand rope control shall be provided with a lock on the car so arranged that the hand rope can be locked at each landing to prevent the operation of the car by persons on other floors.

Order 491. Sheave and Idler Guards. The hand rope shall be equipped with a guard, to prevent injury, at the point where the sheaves lead the rope from the shaftway to the machine. All sheaves and idlers under which are led hoisting or counterweight cables, shall be provided with proper guards to prevent the cables leaving the sheave or idler if the cables become slack. Every idler sheave around which is led an operating rope or governor rope shall be provided with a proper guard to prevent the rope leaving the sheave.

Order 492. Centering Rope. Every hand rope controlled elevator, except hydraulic elevators, shall be provided with a centering rope.

Order 493. Warning Chains. Warning chains shall be hung from the platform, in front of all entrances, on all power freight elevators except where landing doors are provided which can be opened only from the shaftway, or the opening of which immediately stops the car.

Such chains shall be at least five feet long, not more than five inches apart, made of not less than No. 10 wire with long links.

Note. For bumpers see order 443.

Order 494. Electric Brake and Circuit Breakers. Every electric freight elevator hereafter installed whose speed exceeds 75 feet per

minute, and every electric passenger elevator hereafter installed, shall be equipped with:

1. An electric brake.
2. An overload circuit breaker or an enclosed fuse. If a circuit breaker is provided for this purpose it must be outside of and in addition to the elevator control equipment.

Note. A circuit breaker which can be reset from the elevator car is recommended. See order 1220.

3. A no-voltage circuit breaker. This may be provided as a part of the control equipment.

Note. On all hand rope, lever, or wheel control elevators, a positive no-voltage release feature is recommended, consisting of a device to require the centering of the hand rope before the circuit breaker can be reclosed. This may be accomplished by the addition of a relay interlocked with the control apparatus.

4. An emergency switch in the car by which the car may be stopped.

Order 495. Limit Switches; Reverse Phase Relay. Every electric freight elevator hereafter installed, whose speed exceeds 75 feet per minute, and every electric passenger elevator hereafter installed, shall be equipped with limit switches placed in the shaftway and arranged to shut off the motor, apply the brake, and gradually stop the car, if the car passes the highest or lowest landing.

Every electric elevator driven by polyphase alternating current, whether heretofore or hereafter installed, shall be protected against damage due to phase reversal by either

- (1) Limit switches as above specified, arranged to cut all wires, or all except one, and so connected that after the car overtravels, it cannot be moved until the phase reversal is corrected; or
- (2) An approved reverse phase relay.

Note. A reverse phase relay designed for protection against single phasing, as well as phase reversal, is strongly recommended. This is also desirable for fire prevention.

Order 496. Switches and Wiring. Switches and fuses shall be placed in metal cabinets near the machine. If wires carrying current for light or power for the operation of the elevator are run inside the shaftway, they must be in conduit.

Note. Other wires are not permitted in the shaftway—see order 442.

Order 497. Signal System. Every elevator and every power dumb-waiter shall be equipped with a signal system or warning bell, so arranged that it can be safely and conveniently operated.

Order 498. Elevators Kept Clean. All elevators and other mechanical devices used for similar purposes must be kept in good repair, and clean and free from excessive grease and dirt.

Order 499. Recabing Hydraulic Elevators. Where more than one vertical hydraulic cylinder is placed in the same hatchway, or where the horizontal cylinders are placed in duplex or triplex, the operation of all the said elevators must be stopped by closing the main water supply valve before recabing any one of the elevators.

EXTRACTS FROM GENERAL SAFETY ORDERS AND ELECTRICAL SAFETY ORDERS.

The following extracts from the commission's general orders on safety and electrical safety code are reprinted here for the convenience of manufacturers and the public. The safety orders are printed in full in separate pamphlets, which will be sent on request; and all such orders apply to elevators as well as other machinery. The following extracts cover those features which occur most often in elevator installations.

The term "guarded" when used in these orders shall mean so covered, fenced or enclosed that a person in the course of his employment is not liable to come in contact with the point of danger and be injured.

The term "exposed to contact" when used in these orders shall mean that the location of a thing is such that a person, while in the course of his employment, is liable to come into contact with it and be injured.

Order 1. Belts—Guards. All belts, ropes or chains driving machinery or shafting, and all secondary belts, ropes or chains; in short, all belts, ropes or chains exposed to contact, except belts which are so small or those which move so slowly that there is no possibility of danger, must be guarded.

In all cases the point where the belt, rope or chain runs on to the pulley, sheave or sprocket, must be guarded.

All horizontal belts, ropes or chains driving machinery or shafting, seven feet or less from the floor, where exposed to contact, must be guarded.

Order 2. Pulley—Guards. All pulleys over 18 inches in diameter, which are exposed to contact, must be guarded.

Order 5. Pulleys near Shaft Hanger. Pulleys must be so placed as to allow the width of the belt between two pulleys, or between the pulley and the shaft hanger, or a hook must be provided, or a guard placed adjacent to the pulley to prevent the belt from leaving the pulley.

Order 6. Clutches. All clutches must be guarded.

Order 11. Gears. All gears, where exposed to contact, must be entirely enclosed or equipped with a flange guard which must enclose the teeth of the gears. All arm or spoke gears and all web gears with holes in the web, which are over 18 inches in diameter, where exposed to contact, must be entirely enclosed.

Order 17. Set Screws. All set screws on moving parts, where exposed to contact, must be countersunk or protected by a solid collar, or a headless set screw must be used. No part of the set screws must project above the surface.

Order 19. Sprockets. All sprockets exposed to contact, must be guarded.

Grounding.

Order 1110. Noncurrent Carrying Metal Parts. All exposed non-current-carrying metal parts of electrical equipment, control, and protective devices operated at over 150 volts to ground shall be permanently and effectively grounded as provided in these rules, except when under special conditions the hazard can be more satisfactorily reduced in another way.

Order 1111. Distribution Systems. The neutral of a three-wire direct-current system shall be grounded at supply stations; one side of a two-wire direct current system may be grounded at one supply station; all secondary distribution systems shall be grounded at the building services or near the transformers, additional ground connections within the building are not permitted; single phase three-wire systems shall have neutrals grounded; polyphase systems shall in general be grounded so as to minimize the voltage from ground to unguarded current carrying parts and permit convenient grounding.

Order 1112. Instrument Transformer Secondaries. Instrument transformer secondaries, unless installed to comply with primary circuit requirements, must be permanently and effectively grounded.

Order 1113. Grounding Methods. The ground connection should be made to water piping systems if available, never to gas pipes. Other large buried metal structures and grounded steel building frames may be used when water pipes are not available.

Order 1114. Fuses and Cut-Outs in Ground Conductors. No fuses or automatic cut-outs shall be inserted in ground conductors or grounded conductors in such a way as to defeat the purposes of these rules.

Order 1115. Construction of Ground Conductors. The ground conductor shall have adequate mechanical protection and be of metal which will not corrode excessively. It should be continuous and of sufficient size to insure its continuity in spite of accidental ground or lightning discharges. Circuit ground conductors within buildings or otherwise within reach of public should have insulating covering equal to that required for circuit conductors.

For stations and utilization No. 6 copper wire is the minimum individual ground connection permissible but additional smaller wires may be used for this purpose, provided that they are in no case smaller than the conductor to which they are attached or than the largest conductor supplying equipment to the frames of which they are attached, nor smaller than No. 10 copper. A No. 18 copper wire for signaling systems is the minimum size of an individual ground wire.

Connection between frames of equipment and grounded conductors of a circuit shall not be made except through the earth or a metallic buried piping system.

Spaces Where Electrical Equipment is Located.

Order 1200. Rooms and Spaces. The rooms or spaces in which electrical equipment or conductors are installed, shall not be used for the storage of material or for manufacturing processes causing hazards other than those incident to the supplying or utilizing of electrical energy unless all current-carrying parts are so guarded as not to be exposed to contact while they are alive. Indoor stations shall be dry and well ventilated and free from inflammable gas and flyings.

* * *

Order 1201. Illumination and Extension Cords. Wherever employees are required to work about exposed live parts of electrical equipment, good artificial illumination from duplicate sources shall be supplied. Arrangements must be made to permit the use of all necessary extension cords and the replacing and control of lamps without coming into dangerous proximity to live electrical equipment. Portable conductors must be connected to fixed wiring through plugs that disconnect all poles by one operation.

Order 1202. Guards and Warning Signs. Adequate fences, partitions, locks, and signs shall be provided and maintained to prevent unauthorized persons from entering rooms and spaces where they might otherwise come in contact with live or moving parts of electrical equipment, or interfere with the operation of station or utilization equipment. * * *

Exposed Current-Carrying Parts.

Order 1210. Parts Not on Switchboards. Current-carrying parts except on switchboards must be guarded unless isolated by the following elevations:

100 to 750 volts 8 feet
* * * * *

Order 1213. Working Spaces When Guards Are Removed. Equipment with live parts ordinarily guarded, that must occasionally be operated by an authorized person with guards removed, shall be provided with sufficient working spaces to permit the following horizontal clearances to be maintained between the operator's body and the live parts:

150 to 750 volts one foot
* * * * *

Order 1214. Switchboard Arrangement. Switchboards shall be suitably arranged and placed, having points of control readily accessible, and instruments, relays, etc., suitably located for reading or adjustment. The number of bare parts of different potentials shall be reduced to a minimum and effectively separated. Barriers are recommended for voltages in excess of 750.

Order 1215. Switchboards Fuses and Exposed Parts. Fuses should be so placed as to permit ready replacement. * * *

Order 1218. Switches. Suitable switches capable of manual operation and accessible to authorized persons shall be installed on all leads to equipment or supply lines except grounded conductors, instrument transformers or within manholes or transformer vaults. These switches shall be so arranged or marked as to identify the circuit or equipment controlled, so installed as to minimize the danger of accidental operation, marked with capacity and voltage safely handled, and where necessary to safe operation must be capable of being tagged and blocked. Except where operating as disconnectors and so marked, they shall be capable of operation under overload. Where practicable the blades of knife switches should be dead when such switches are open.

Order 1220. Fusible Cut-Outs. Fusible cut-outs on circuits above 150 volts to ground shall be so arranged that fuses are either inaccessible until disconnected, equipped with suitable disconnecting switches, or can be handled conveniently with insulating devices.

INDEX

By Order Numbers.

- Approval of plans, 415.
- Bumpers, 443.
- Cable inspection, standard for, 462.
- Cables and counterweights, 460-472.
- Cables, factor of safety, 460.
- Cables, fastenings at terminals, 466.
- Cables for governor, 489.
- Cables, hoisting, number required, 463.
- Cables protected, 469.
- Capacity of passenger elevators, 475.
- Capacity plates, 476.
- Car doors, passenger, 451.
- Car enclosures, freight, 452.
- Car enclosures, passenger, 450.
- Car gates, freight, 453.
- Carriage type elevator, 404.
- Cars, 450-456.
- Catching device and speed governor, 488.
- Centering rope, 492.
- Certificate of inspection, 416.
- Circuit breakers and fuses, 494, 496.
- Cleanliness, 498.
- Counterweights bolted, 470.
- Counterweights, cables required, 468.
- Counterweights required, 467.
- Counterweight runways guarded, 471-472.
- Counterweight stops, 472.
- Definitions, 400-411.
- Doors or gates at landings, 430-433.
- Doors or gates on cars, 451, 453.
- Draw bars, 466.
- Drum, cable turns required, 465.
- Drums and sheaves, minimum size, 464.
- Dumb-waiter, 401.
- Electrical hazards, guarding of, p. 19.
- Electrical brakes, 494.
- Emergency switch, 494.
- Enclosure of cars, 450, 452.
- Enclosure of shaft ways, 420-425.
- Equalizers, 466.
- Fireproof enclosures, 420-423.
- Floor or screen under sheaves, 447.
- Floor under overhead machinery, 446.
- Freight elevator defined, 403.
- Full automatic gate defined, 407.
- Fuses, 494, 496.
- Gates and doors at landings, 430-433.
- Governor, 488.
- Governor cables, 489.
- Grounding, p. 19.
- Guarding of belts, gears, set screws, etc., p. 18.
- Guarding of electrical hazards, p. 19.
- Guarding of sheaves, 491.
- Guide rails, 480.
- Hand power elevator defined, 406.
- Hand power elevators, power attachments to, 484.
- Hand rope, guards for sheaves, 491.
- Hand rope locks, 490.
- Hoisting cables, number required, 463.

Insurance company inspections, 416.
Landing doors and gates, 430-433.
Light, 455.
Limit stops, 486.
Limit switches, 495.
Loads and stresses, 475-477.
Locking device for landing gates, 432.
Machine and safety devices, 483-498.
Machines, prohibited types, 483.
New installation defined, 411.
No-voltage circuit breaker, 494.
Operating cable, see hand rope.
Operation of passenger elevator cars, 456.
Outside windows guarded, 424.
Overload circuit breakers and fuses, 494, 496.
Overtravel, 440.
Passenger elevator defined, 402.
Penthouse construction, 445.
Penthouse, floor or screen under, 446, 447.
Penthouses, where required, 444.
Phase reversal relay, 495.
Pipes not permitted in shaftway, 442.
Pits and penthouses, 440-447.
Plungers, 487.
Projecting floors, 425.
Reverse phase relay, 495.
Screen over car, 452.
Screen under sheaves, 447.
Semi-automatic gate defined, 408.
Shaftway enclosures, 420-425.
Sheaves and drums, minimum size, 464.
Sheaves, guards for, 491.
Sidewalk elevator, defined, 405.
Sidewalk elevators, special requirements, 434-435.
Signal system, 497.
Sills, 454.
Slack cable device, 485.
Speed governor, 488.
Steel cables, sign where used, 461.
Stresses, 477.
Stresses in cables, 460.
Switches and switchboards, guarding of, p. 20.
Switches and wiring, 496.
Switches, emergency, 494.
Switches, limit, 495.
Toe guards, 425.
Travel of elevator defined, 409.
Warning bell, 497.
Warning chains, 493.
Wires not permitted in shaftway, 442.
Wiring and switches, 496.