

Part V

REQUIREMENTS APPLYING TO SPECIAL TYPES OF ELEVATORS

SECTION I. DUMBWAITERS.

Order 479.—Dumbwaiters. New and Existing Installations.

(a) The shaftway openings of every electric dumbwaiter shall be provided with landing doors, so arranged that the dumbwaiter cannot be started unless all doors are closed. Where a fireproof shaftway is required all landing doors shall be fire doors. (See orders 410-411).

(b) Every dumbwaiter shaftway opening at the floor level shall be protected by a gate in compliance with orders 438 and 439. Every other dumbwaiter shaftway shall be enclosed on the loading side to a height of at least 30 inches above each floor.

(c) Every dumbwaiter shall have a solid cover over the full area of the car. For shaftway enclosure see orders 411-413 inclusive.

SECTION II. SIDEWALK ELEVATORS.

Order 480.—Sidewalk Elevators.

(a) Every sidewalk elevator shaftway shall be covered at the top with doors designed and constructed to carry a load of 250 pounds per square foot within the safe limits of stresses. The surface of the doors shall be rough and no part of them shall project above the sidewalk level when closed. The doors shall open only sufficiently for proper service, and when open shall form a suitable guard for the opening. The dimensions of the sidewalk opening shall, in no case, exceed 5 feet at right angles to the curb, and 7 feet parallel with the curb.

(b) On each side of a sidewalk opening not fully protected by a door or other guard to a height of not less than 30 inches, a full screen or solid guard panel shall be pro-

vided. This guard panel shall be so installed that it cannot be pushed into the opening.

(c) Every power sidewalk elevator shall be equipped with a device to prevent its operation until the doors over the top of the shaftway are open. The doors shall be closed when the elevator is not in actual use.

(d) Beveled toe-guards shall be provided under the edges of the sidewalk, and under other projections, if any, as required by order 415. If the elevator platform rises above the sidewalk, similar toe-guards shall be provided under the platform on all exposed sides. (See order 487—g).

(e) A power sidewalk elevator which travels only one story, or not more than 30 feet, is subject to the following orders only: 400, 401, 402, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418—(a), 418—(b), 418—(c), 418—(d), 418—(e), 418—(f), 418—(g), 418—(h), 418—(i), 418—(j), 418—(k), 418—(l), 418—(m), 418—(n), 418—(o), 418—(p), 418—(q), 418—(r), 418—(s), 418—(t), 418—(u), 418—(v), 418—(w), 418—(x), 418—(y), 418—(z), 419, 420, 421, 422, 423, 424, 425, 426, 427—(a) and (g), 438 and 439, as applied to lower terminal freight elevator landings, 441—(a), 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468 where the travel is more than 15 feet, 473—(c), (d), (g), (j) and (m), 474, 476—(b), 478—(a), and 480. Hydraulic sidewalk elevators shall also be subject to such paragraphs of orders 485, 486, 487, and 488 as may reasonably be applicable to sidewalk elevators.

(f) A sidewalk elevator which travels more than one story or more than 30 feet is subject to all the freight elevator orders.

Recommendation: The back wall of the shaftway should not be more than 1 inch from the car.

(g) Every hand power chain hoist sidewalk elevator shall comply with orders 438 and 439 as applied to lower terminal freight elevator landings, order 478—(a), and with 480—(a) and (b).

(h) Every sidewalk elevator car or platform hereafter installed shall be enclosed to a height of 1 foot on the sides not used for entrance.

Order 481.—Freight Elevators of the Sidewalk Type.

(a) Every power elevator of the sidewalk type, located within a building, and traveling less than one story, shall be equipped with toe-guards as specified in order 415; the side of the car, or sides of the shaftway or both shall be provided with an enclosure constructed as specified in order

412 and of such height as will afford reasonable safety, and shall be subject to the orders enumerated in order 480—(e).

(b) Every elevator of the sidewalk type; located within a building and traveling one story, or more than 30 feet, shall comply with all the freight elevator orders.

(c) Every elevator of the sidewalk type located below the stage of a theater and traveling one story only shall have the opening on the stage floor equipped with a flush hatchway cover, which, when the elevator is down, shall be closed forming part of the stage floor. The hatchway cover shall be lifted by the elevator in its upward travel by a device consisting of corner posts and framework attached to the car platform and of sufficient height to provide proper headroom. Each corner post shall be provided with a stud or projection engaging a socket on the under side of the hatchway cover so that it cannot readily be dislodged. The opening in the stage floor shall be protected by toeboards as required in order 415. The shaftway in the basement shall be enclosed with metal guards as described in order 412 and a swinging door equipped with a lock shall be provided at each entrance. The speed of any elevator installed in such a manner shall not exceed 50 feet per minute. The carrying capacity of the car platform shall be as required in order 427—(a).

SECTION III. HAND POWER HOSPITAL ELEVATORS AND HAND POWER INVALID LIFTS.

Order 482.—Special Requirements.

(a) The car of every hand power invalid lift and of every hand power hospital elevator shall be completely enclosed on the top and on the sides not used for entrance.

(b) The minimum carrying capacity of a hand power invalid lift and of a hand power hospital elevator shall be not less than 35 pounds per square foot of platform area inside of the car enclosure. (See order 419—(b), for car buffers.)

SECTION IV. HYDRAULIC ELEVATORS. NEW INSTALLATIONS.

Order 485.—Construction and General Requirements.

(a) Every piston rod of tension-type hydraulic elevators shall have a factor of safety of not less than 8, based

on the cross-sectional area at the root of the thread. A true bearing shall be maintained under the nut at each end of the piston rod to prevent eccentric loading on the rod.

(b) Every hydraulic elevator machine, whether of the vertical or horizontal type, shall be so constructed and so roped that the piston will be stopped before the car can be drawn into the overhead work. A stop of ample strength shall be provided to bring the piston to rest when under full pressure without causing damage to the cylinder or cylinder head.

(c) The traveling sheaves for vertical hydraulic elevators shall be guided. The guide rails and guide shoes shall be of metal. The side frames of traveling sheaves for vertical hydraulic elevators shall be made of structural steel or of forged steel.

(d) Pressure tanks shall be made and tested in accordance with the requirements of the Boiler Code issued by the Industrial Commission.

(e) Every pressure tank that may be subjected to vacuum shall be provided with one or more vacuum valves to prevent collapse of the tank.

(f) Every pressure tank shall be so located and supported that inspection may be made of the entire exterior.

(g) Every discharge tank open to the atmosphere shall be so designed that when completely filled the factor of safety shall be not less than 4 based on the ultimate strength of the material. Every discharge tank shall be covered to prevent the entrance of foreign material and shall be provided with a suitable vent to the atmosphere.

(h) The outlet of each pressure tank shall be so located as to prevent the entrance of air or other gas into the elevator cylinder.

(i) Automatic stop valves shall be packed with cup leathers, or other means shall be used to prevent sticking of the valve stems.

(j) Each pump connected to the pressure tank of a hydraulic elevator shall be equipped with a relief valve, so installed that it cannot be shut off. The relief valve shall be of sufficient size and so set as to pass the full capacity of the pump at full speed without exceeding the safe working

pressure of the pump or tank. The relief valve shall be piped to discharge into the discharge tank or into the pump suction. Two or more relief valves may be used to obtain the capacity.

(k) Every elevator pump, unless equipped with a pressure regulator which controls the motive power, shall be equipped with an automatic by-pass.

(l) Every hydraulic elevator operated from a pressure tank where the fluid pressure is obtained by directly admitting steam, air or other gas to the tank shall comply with all the rules covering hydraulic elevators. For limitations in use see order 460.

Order 486.—Safety Equipment.

(a) The handrope on every hydraulic elevator shall be equipped with a limit stop to prevent damage to the valve mechanism.

(b) Every tank for a hydraulic elevator shall be fitted with a quarter inch pipe connection for attaching a test gauge, when the tank is in service so that the accuracy of the pressure gauge can be ascertained.

(c) Every pressure tank shall be equipped with a water gauge glass to indicate the height of the water in the tank. Pet cocks may be used where pressure is obtained by steam, air, or other gas.

(d) Each pressure tank shall be equipped with a pressure gauge which correctly indicates pressure to at least one and one-half ($1\frac{1}{2}$) times the normal working pressure of the tank. This gauge shall be connected to the tank by a brass or other non-corrodible pipe in such a manner that the gauge cannot be shut off from the tank except by a cock with a "T" or lever handle. (The "T" or lever must be set in line with the direction of the flow). The cock shall be in the pipe near the gauge.

(e) The cylinders of hydraulic elevator machines, except plunger type machines, shall be provided with means for releasing air or other gas.

(f) Every hydraulic elevator shall be provided with an independent automatic means for gradually stopping the car at the terminal landings.

Order 487.—Plunger Type Elevators.

(a) The piping system of plunger type elevators shall be provided with proper air chambers to stop the water hammer on both directions of travel.

(b) The sections of the piston shall be rigidly joined, and the bottom section shall be so designed and installed that it cannot leave the cylinder.

(c) A cast iron plunger shall not be used in any case where the elevator travel is more than 50 feet.

(d) Every plunger type elevator operating on greater than 150 pounds pressure shall have extra heavy pressure fittings throughout.

(e) There shall be no lead piping in the water line between the plunger cylinder and the operating valve.

(f) The construction of the operating valve shall be such that the opening and closing of the valve will gradually stop the flow of water to and from the cylinder.

(g) No plunger elevator of the sidewalk type with sliding extended car guide rails shall rise more than 4 feet above any sidewalk.

Order 488.—Maintenance.

(a) The piston rods of hydraulic elevator machines, except plunger type machines, shall be exposed for inspection at least once every two years. The preparation for such inspections shall be made by the owners or parties using the elevators.

(b) The discharge tank and the pressure tank of every hydraulic elevator shall be cleaned at least once every two years. The water level in the pressure tank of a hydraulic elevator shall be maintained at about two-thirds of the capacity of the tank.

Order 489.—Recabing Hydraulic Elevators.

Where more than one vertical hydraulic cylinder is placed in the same shaftway, or where the horizontal cylinders are placed in duplex or triplex, the operation of all such connected elevators shall be stopped by closing the main water supply valve before recabing any one of the elevators.

SECTION V. ESCALATORS.

Order 190.—Construction of Escalators.

(a) The angle of inclination of an escalator shall not exceed 30 degrees with the horizontal.

(b) The width of an escalator shall be measured between the balustrading at a vertical height of 24 inches above the nose line of the tread, and no escalator shall be less than 22 inches nor more than 48 inches wide. Every escalator more than 29 inches in width shall have a horizontal tread formation.

(c) Every escalator shall be provided on each side with solid balustrading. On the escalator side the balustrading shall be smooth, without depressed or raised paneling or molding. There shall be no abrupt change in the width between the balustrading on the two sides of any escalator. Should any change in the width be necessary the change shall be not more than 8 per cent of the greatest width. In changing from the greater to the smaller width the change in the direction of the balustrading shall not exceed 15 degrees from the line of the escalator travel. Each balustrading shall be equipped with a handrail moving at the same speed and in the same direction as the travel of the escalator. The use of glass panels for balustrading is not permissible.

(d) Escalator treads and landings shall be of material affording a secure foothold, such as wood or material used for safety treads. If a landing is made of concrete, it shall have edge insertions of metal, wood or other anti-slip material.

(e) Every escalator truss or girder shall be so designed and installed that, in case of the failure of the track system to retain the running gear in its guides, the truss will safely retain the steps and running gear. A factor of safety of not less than 5, based on the static loads, shall be used in designing escalator trusses or girders.

(f) The track arrangement shall be designed to prevent the displacement of the treads and running gear if the tread chain breaks.

(g) The rated load on an escalator 22 to 24 inches in width shall be computed by the following formula:

$$\text{Rated load} = 110 A$$

The rated load on an escalator wider than 24 inches but not exceeding 48 inches shall be computed by the following formula:

$$\text{Rated load} = 4.6 WA$$

On these formulae, "W" is the width of the escalator in inches, and "A" is the horizontal projected length in feet of the exposed treads. The rated load is expressed in pounds.

Order 491.—Safety Requirements for Escalators.

(a) The speed of an escalator in the direction of travel shall not exceed 100 feet per minute.

(b) Every escalator shall be driven by an individual electric motor. Two or more escalators placed side by side and operated as a single unit may be driven by one motor.

(c) Every escalator chain shall have a factor of safety of not less than 10 except where the chain is made of cast steel links (which shall be thoroughly annealed), in which case the factor of safety shall not be less than 20.

(d) Every escalator drive shall be provided with an electrically released, mechanically applied brake, which shall stop the escalator automatically when the power is interrupted.

(e) There shall be an emergency stop button, or other type of switch, accessible to the public and conspicuously located at the top and bottom of each escalator. The operation of either one of these buttons, or switches, shall open the power circuit, apply the brake and stop the escalator. It shall be impossible to start the escalator by means of these buttons or switches. They shall be marked thus:

ESCALATOR

*

STOP BUTTON

(f) Where starting buttons or switches are accessible to the public they shall be of the key operated type or they shall be enclosed in boxes provided with locks and keys.

(g) Every escalator operating in the ascending direction shall be equipped with a safety mechanism so that in case of accidental reversal of the escalator the power shall be cut off, the brake applied, and the escalator stopped. On a reversible escalator this safety mechanism shall be arranged to be in-operative when the escalator is descending and operative when the escalator is ascending.

(h) Every escalator shall be provided with a safety mechanism, which will open the power circuit, apply the brake, and bring the escalator to a gradual stop, in case the speed exceeds the normal running speed by 40 per cent.

(i) Every escalator shall be provided with a safety device to open the power circuit, apply the brake, and bring the escalator to a gradual stop, in case the tread chain or chains break.

(j) Where an escalator is equipped with a tightening device, operated by means of a tension weight, provision shall be made to retain this weight in the escalator truss in case the weight should fail.

(k) Every escalator operated by a motor driven by polyphase alternating current shall be provided with a relay of the potential type or other suitable means which will prevent starting the motor while—

- (1) the phase rotation is in the wrong direction, or
- (2) there is a failure in any phase.

(l) There shall be a suitable light in every escalator machine room as a permanent fixture, which can be lighted without passing over or reaching over any part of the machinery.

(m) Reasonable access to the interior of the escalator shall be provided for inspection and maintenance.

Order 492.—Tests.

A practical test of an escalator installation shall consist of the following:

(1) Speed Test—The application of the overspeed safety device shall be obtained by causing the escalator to travel at the governor tripping speed. If an escalator is operated by a motor driven by alternating current the gov-

error may be tripped by hand with the escalator traveling at its normal rate of speed.

(2) Reversal Tests. The application of the reversal safety device shall be made by releasing the machine brake and operating the escalator by hand in the reversed direction.

(3) Broken Chain Test. The application of the broken chain safety device shall be obtained by operating the safety by hand.

(4) Miscellaneous Safety Devices. Tests of the machine brake and of the emergency stopping buttons or switches shall be made to determine whether they function properly.

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Appendix

Extracts from Other Industrial Commission Codes

GENERAL ORDERS ON SAFETY

The General Orders on Safety require adequate guards for such hazardous parts as gears, pulleys, belts, sprockets, protruding set-screws in revolving parts, keys and keyseats in revolving shafting, couplings with protruding parts and revolving shafting. All such parts, where exposed to contact must be guarded in accordance with these general orders.

STATE BUILDING CODE

Order 5100. Fireproof Construction.

A building is of fireproof construction if all the walls, partitions, piers, columns, floors, ceilings, roof and stairs are built of incombustible material; and if all metallic structural members are protected by an incombustible fire resisting covering of low heat conductivity, of not less than 2 inches thickness of concrete or 3 inches thickness of other approved material, for columns; not less than 2 inches thickness for girders; and not less than 1½ inches thickness for other structural parts. This thickness shall be outside of the extreme edges of structural members. Such covering shall consist of Portland cement concrete, brick, terra cotta, or tile, laid in cement mortar, or other approved material and shall be properly reinforced, bonded, wired or otherwise secured in place. Steel reinforcement shall be protected as in order 5313. The plastering shall not be applied to wood lath or wood furring strips.

Floor panels may be built of approved metal (see Order 5316), designed to resist all stresses independent of any protective covering, protected on the upper and lower sides. Steel lumber joists shall not be spaced more than 24 inches center to center well bridged with proper tension strips. Upper slab shall be reinforced concrete not less than 2 inches thick over all structural metal. Expanded metal or metal lath of proper weight and rigidity to span the joist spacing, well fastened to joists, may be used for reinforcement, but no metal less than 24 gauge shall be used. Lower side of joists shall be protected by not less than $\frac{7}{8}$ inch cement plaster on expanded metal or metal lath. The upper slab and plastered ceiling shall create air spaces between the metal floor supports completely isolated from the open atmosphere. All beams and girders supporting the floor panels shall be fully protected. Connections of metal joists to beams, girders, and other bearings shall be in a manner approved by the Industrial Commission. All steel lumber joists shall receive a protective coat of lead and oil or bituminous paint before being placed in position. Metal lumber shall not be used in floor panels having less than 3 feet of well ventilated air space below or in floor panels over damp basements.

Note. Expanded metal or metal lath weighing not less than 3 $\frac{1}{4}$ lbs. per square yard should be considered the minimum for joist spacing of 23 $\frac{1}{2}$ inches, and 2 $\frac{3}{4}$ lbs. per square yard for joists spacing of 15 $\frac{1}{4}$ inches.

The trimmings and finished floor may be of wood, provided all spaces behind or below same are filled with incombustible material. Partitions entirely contained within a private apartment may be non-fireproof provided the partitions enclosing such apartment are fireproof.

A wood roof with incombustible roof covering will be permitted on a fireproof building not more than 85 feet high, provided the ceiling of the uppermost story is of fireproof construction not suspended from the roof.

A room or a portion of a building is of fireproof construction if it complies with all of the above requirements, and is separated from the rest of the building by means of fireproof walls, floors and ceiling, in which all openings are protected by means of firedoors or fixed standard fire windows.

For outside windows and doors see order 5201.

Note (a). A "fireproof" floor, ceiling, or wall is one of "fireproof construction." A "standard fire wall," "fireproof partition," etc., are defined in orders 5108-5113. "Incombustible" includes any material which will not burn or support combustion.

Note (b). To secure the best protection against a severe fire, the finish, floors, trim, doors, windows, etc., should be made entirely of incombustible material.

The fireproof covering of exterior columns should be at least 4 inches thick to resist a severe fire.

Note (c). The fireproofing of steel roof trusses may, if approved by the Industrial Commission, be omitted in cases where no increased hazard will result.

Order 5101.

A building is of mill construction if all walls are built of incombustible material, and if all wood girders and joists are at least $5\frac{1}{2}$ inches thick. No wood girder or joist shall measure less than 63 square inches and no wood posts less than 90 square inches in sectional area, except that $7\frac{1}{2}$ x $7\frac{1}{2}$ inch (or larger) posts may be used in the top story only. All structural steel or iron (not including post caps, bases, and joists hangers) shall be fireproofed with not less than one inch of incombustible material or with metal lath and cement or gypsum plaster. The lower thickness of each floor shall be not less than $2\frac{5}{8}$ inch lumber with grooves and splines at the joints; this shall be covered with felt or building paper, and with a separate finished floor not less than $\frac{3}{8}$ inch thick.

Note. Floor joists should be at least $7\frac{1}{2}$ inches thick. The roof shall be at least $2\frac{1}{2}$ inches thick and shall have an incombustible roof covering; if an airtight roof covering (such as felt or tin) is not used, then the roof planking shall be in two thicknesses, with felt or building paper between.

There shall be no openings in the floor unless protected by standard fire doors, and no concealed air spaces except such as are enclosed by incombustible material.

All stairways and elevators shall be enclosed with standard fireproof enclosures.

For outside windows and doors see order 5201.

Order 5110.—Standard Fire Door.

A standard fire door shall consist of a wooden core encased with tin, or shall be entirely of metal; and shall be of design approved by the Industrial Commission. The door frame shall be metal. The door shall close automatically in case of fire.

Order 5111.—Standard Fire Window.

A standard fire window shall have a metal frame, metal sash, and wired glass of design approved by the Industrial Commission. No pane shall be less than $\frac{1}{4}$ inch thick nor of greater area than 720 square inches. The window either shall be fixed or shall close automatically in case of fire.

CONCRETE CONSTRUCTION

Order 5313.—Unit Stresses and Reinforcement.

The following unit stresses (pounds per square inch) shall not be exceeded.

Reinforced Concrete 1:2:4 mix:—

Compression in concrete, extreme fiber, (assuming a straight line stress distribution)	700
Tension in concrete	none
Compression in steel—15 times the compression in concrete at the same point	
Tension in steel	16,000
Bond between concrete and steel	30
Shear in concrete	40
Compression on net core area of concrete column, with longitudinal and transverse reinforcement each equal to at least 1 per cent of the core volume	800
Compression on net core area of a similar column but with concrete of a 1:1½:3 mix	900
Compression on net core area of a column with less reinforcement than the above	500

Plain Concrete:—

	Com- pression	Shear	Tension due to bending
1:2:4 mix	400	40	35
1:2½:5 mix	300	35	30
1:3:6 mix	250	30	25

Note. The foregoing are maximum stresses, suitable for concrete which will develop a crushing strength of at least 2,000 pounds per square inch in 28 days, with a 1:2:4 mix. Where fine sand (very common in Wisconsin) or soft stone is used, the stresses should be decreased or the proportion of cement increased. The following table indicates what strength may be expected with different aggregates, with good coarse sand and good workmanship.

Aggregate	1:1:2	1:1½:3	1:2:4	1:2½:5	1:3:6
Granite, trap rock	3300	2800	2200	1800	1400
Gravel, hard limestone and hard sandstone	3000	2500	2000	1600	1300
Soft sandstone and sandstone	2300	1800	1500	1200	1000
Cinders	800	700	600	500	400

Joint Committee on Concrete and Reinforced Concrete.

The minimum longitudinal reinforcement of a column or beam shall be four $\frac{1}{2}$ inch round rods. The minimum trans-

verse reinforcement of a column or beam shall be the equivalent of $\frac{1}{4}$ inch round rods, averaging not more than 12 inches apart. The steel shall be protected by at least $1\frac{1}{2}$ inches of concrete for columns, 1 inch for beams, and $\frac{1}{2}$ inch for slabs; but this protection shall not be less than the diameter of the rod in any case. In any column longer than 15 times its least diameter the unit stresses shall be properly decreased. The transverse reinforcement shall not be considered in calculating the strength of a column.

Every concrete structure shall be designed in accordance with this code and with the rules and principles of standard practice.

Note (a). For proper fire-resistance the protection of reinforcement is recommended to be at least $\frac{1}{2}$ inch greater than required above.

Note (b). "Standard practice" is well illustrated in the final report of the Joint Committee on Concrete and Reinforced Concrete.

To quote from introduction to this report: "In their use concrete and reinforced concrete involve the exercise of good judgment to a greater degree than do any other building materials."

STEEL AND IRON CONSTRUCTION

Order 5316.

The following unit stresses (pounds per square inch) shall not be exceeded:

	Rolled Steel	Cast Steel	Wrought Iron	Cast Iron
Tension on net section	16,000	16,000	12,000	
Compression on gross section (max). See formula below	12,000	12,000	10,000	8,000
Tension on extreme fiber	16,000	16,000	12,000	8,000
Compression on extreme fiber	16,000	16,000	12,000	10,000
Extreme fiber of pins	25,000			
Shear:				
Pins and power-driven rivets	10,000			
Hand-driven rivets	8,000			
Machine Bolts	7,000			
Rolled steel shapes	12,000			
Plate girder webs, net section	10,000			
Brackets				2,000
Bearing:				
Pins and power-driven rivets	20,000			
Hand-driven rivets	16,000			
Machine bolts	14,000			
Compression:				
Steel			17,100—57—	L
				R
Wrought iron			12,000—60—	L
				R
Cast iron			10,000—60—	L
				R

Where L...length in inches.
R...radius of gyration in inches.

Every steel or iron structure shall be designed in accordance with this code and with the rules and principles of standard practice.

All steel or iron shall conform to the standard specifications of the American Society for Testing Materials in force October 1, 1914. (Furnished on request.)

WOOD CONSTRUCTION

Order 5317.—Unit Stresses.

The following unit stresses (pounds per square inch) shall not be exceeded:

	Tension		Compression		Transverse	Shear
	With grain	Across grain	With grain	Across grain	Extreme fibre	
White oak.....	1,200	125	1,100	500	1,500	150
White pine.....	700	50	900	200	1,000	80
Long leaf yellow pine.....	1,200	60	1,500	350	1,700	150
Short leaf yellow pine.....	1,000	50	1,100	300	1,400	100
Douglas fir.....	1,000	50	1,300	325	1,600	110
Norway pine.....	800	50	1,000	250	1,200	100
Eastern spruce and fir.....	800	50	800	200	1,000	80
Hemlock.....	600	50	900	200	1,100	80

The stress in compression members shall not exceed $C \left\{ 1 - \frac{L}{60D} \right\}$ where
C = "compression with grain"
L = length in inches
D = least width in inches

Note. The above are maximum stresses, suitable for timber which is free from injurious defects and of sufficient density. Defects include decay, knots, shakes, checks, etc. Decay is dangerous because it tends to spread and because it is difficult to determine the extent to which the timber is weakened. Knots and cross grain in the center half of beams near the bottom edge are especially serious. Deep checks and ring shakes are of importance when they occur in the middle half of the height of the beam or when they run diagonally across the faces; for beams containing such checks, the allowable stress in horizontal shear should be decreased.

The density of the wood is important because the strength of timber increases with the density; this in turn is in proportion to the per cent of "summerwood" (i. e. the hard, dark part of the ring). In yellow pine and Douglas fir the summerwood should form at least 25 per cent of the total if the above stresses are to be used.

These stresses should be decreased at least 20 per cent for timber exposed to moisture.

For further details on the strength and grading of timbers, see Bulletin 108 and other publications of the U. S. Forest Service.

GENERAL ORDERS ON SAFETY IN CONSTRUCTION

Order 3520.—Elevators.

Every elevator as defined in Order 400-(1) of the Elevator Code issued by the Industrial Commission shall conform to all of the requirements of the Elevator Code, except that this requirement need not apply to the final completion of doors and cabs. Where the permanent doors and cabs are not completed temporary enclosure shall be provided.

Order 3521.—Riding on Elevators and Derricks.

No contractor or employer shall permit anyone to ride on derricks or other hoisting apparatus, except elevators which conform to the Elevator Code issued by the Industrial Commission.

Order 3522.—Hoisting Signals.

Bell, whistle or electric signals shall be provided for platform elevators, concrete hoists, etc., and in all other cases wherever practicable.

Note. Electric bell (or telephone) signals are the most reliable and are cheaper to maintain. Hoisting signals should be given by competent men only. Signals should be located so that the man cannot operate the signal if he is standing on the elevator platform.

Order 3523.—Partition Between Elevators.

If two or more elevators are located in the same shaft, and one elevator is put into temporary service before the others are completed, then the elevator in use (together with its counterweights) shall be separated from the other elevators by a continuous partition. This partition shall either be solid or consist of a screen of not less than No. 10 U. S. Standard Gauge wire with not more than one inch openings.

Order 3524.—Working in Shafts.

Workmen of more than one craft or doing different classes of work shall not be permitted in a shaftway at the same time unless a temporary floor protection as described

in Order 3531 is provided between all upper and lower workmen or groups of workmen.

Note. When men are working in a shaft, all material, etc., on upper floors should be kept well away from the shaft. See Orders 3504, 3510, and 3509 which requires a railing around every floor opening.

Order 3525.—Hoisting in Shaft Prohibited.

When elevator constructors or others are working in an elevator shaft no other material, tools or any other objects whatsoever shall be hoisted or lowered in such shafts.

Order 3526.—Protection of Machine Operatives.

Every hoisting engine, air compressor, concrete mixer or other machine used in construction work, shall be properly covered over to protect the operatives stationed at the machine unless the horizontal distance from such machine to the nearest point where work is being done is at least one-half the vertical height of such point above the machine.

Order 3527.—Hoisting Machines Enclosed.

All hoisting machines, irrespective of the motive power, shall be housed in to protect the operatives from November 15th to March 15th. This order does not apply to machines used on a job for not more than three days.

Order 3550.—Inspection of Equipment.

All derricks, elevators, hoists, chains, slings, cables, ropes, shackles, blocks and all other equipment shall be maintained in safe condition while in use, and shall be competently inspected by the employer or his agent at least once each month while in use. If such equipment has not been used for 30 days or more, then careful inspection shall be made before using.

STATE ELECTRICAL CODE

Order 1310.—Guarding Live Parts.

(a) *Equipment.*

(1) All ungrounded current-carrying parts of equipment operating at voltages higher than 100 volts to ground, shall be suitably guarded, if elevated less than 8 feet above floor or platform, or if exposed to contact above that level.

(b) *Conductors.* (For wires in Elevator Shafts see Elevator Code Order 420.) (See also Order 1357—e.)

(1) All exposed conductors, not included in (2) (3) and (4) below, when brought closer to floor or platform than 8 feet, or when exposed to mechanical injury above that level, shall be guarded by inclosure in conduit, armored cable or surface metal raceways.

(2) All conductors in schools, theaters, assembly halls, hotels, hospitals and public garages shall be guarded by inclosure in rigid or flexible conduit, armored cable or surface metal raceways.

(3) Conductors operating at voltages higher than 300 volts to ground shall be guarded by inclosure in conduit, in all buildings and at all elevations.

(4) Bus-bars and other open bare ungrounded conductors operating at voltages higher than 100 volts to ground, which are elevated less than 8 feet above floor or platform, shall be inclosed by suitable guards.

Order 1313.—Grounding.

(c) *Noncurrent-Carrying Metal Parts.*

All exposed noncurrent-carrying metal parts of equipment operating at voltages above 100 volts to ground shall be bonded together and permanently and effectively grounded.

Note: 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 where water pipes are not available.

Order 1312.—Wiring in Conduit Raceways and Armored Cable.

(b) *Support of Vertical Conduit Wiring.*

(1) Wires in vertical conduit risers shall be supported within the conduit system in accordance with the following:

No. 14-A. W. G. to 0-A. W. G. inclusive, every 100 feet.

No. 00-A. W. G. to 0000-A. W. G. inclusive, every 80 feet.

Above 0000-A. W. G. to 350,000-C. M. inclusive, every 60 feet.

Above 350,000-C. M. to 500,000-C. M. inclusive, every 50 feet.

Above 500,000-C. M. to 750,000-C. M. inclusive, every 40 feet.

Above 750,000-C. M. every 35 feet.

(2) Any of the following methods of support shall be used:

I. Approved clamping devices constructed of or employing insulating wedges inserted in the ends of conduits.

II. Junction boxes with covers inserted in the conduit system at the required intervals, in which insulating supports of approved type are installed and secured in a satisfactory manner so as to withstand the weight of the wires attached thereto.

III. Junction boxes with covers in which wires are supported on two or more insulating supports so placed that the conductors will be deflected at an angle of not less than 90 degrees, and carried a distance of not less than twice the diameter of the wire from its vertical position, and where necessary wires are additionally secured to these insulators by tie wires.

Order 1350. General Requirements for Switches.

(h) *Guarding Live Parts of Switches.* All manual switches, including service entrance switches, shall have suitable casings or inclosures of such design as to permit of operation without opening the inclosure and so that the operator is at all times protected against danger. Cases shall be locked, sealed or made inaccessible, to other than qualified persons, by other suitable methods.

Order 1357.—Motors and Generators.

(e) *Wiring.* Where speed-limiting devices or remote-control switches are electrically operated, the control circuits by which such devices are actuated shall be adequately guarded by conduit or otherwise, against mechanical injury.

(f) *Under or Low-Voltage Protection.* Where the re-starting of the motor on restoration of voltage may result in injury to persons or apparatus, under or low-voltage protection, which will cause and maintain the interruption of power to the main circuit upon reduction or failure of voltage, shall be supplied. (See also Order 1350—f-2.)

Exception: When the motor and driven machinery are isolated and accessible to qualified persons only, the provision of a disconnecting switch eliminates the hazard to persons.

(g) *Reverse-Phase Relays for Motors.*

(1) Electric freight or passenger elevators, operated by polyphase alternating current motors, shall be provided with protective devices (relays) which will prevent starting the motor if phase rotation is in the wrong direction or if there is a failure in any phase.

Exception: Limit switches placed in the elevator shaftway in accordance with Order No. 463 of the elevator code will make unnecessary the installation of reverse phase relays.

Order 1384.—*Special Precautions.*

(a) *Location of Cut-outs, Switches, etc.* Cut-outs, switches and receptacles shall be placed at least four feet above the floor.

(b) *Hatch Limit Switches.* Hatch limit switches of elevators shall be located at least four feet above the lowest floor level.

THE INDUSTRIAL LIGHTING CODE

Order 2112.—*Artificial Light.*

When the natural light is less than twice the minimum permissible intensities of illumination set forth in the following table, artificial light shall be supplied and maintained in accordance with the table.

Note: The measurements of illumination at the work will be made with a properly standardized portable photometer.