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SAFETY STANDARDS

For All

PLACES OF EMPLOYMENT

in

MINNESOTA



1950

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INDUSTRIAL COMMISSION OF MINNESOTA

SAFETY STANDARDS

L A W S A N D C O D E S

For the
Prevention of Accidents
and the
Preservation of Health
in all
Places of Employment

RECEIVED

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MINNESOTA

1950

Adopted by
Industrial Commission of Minnesota
and Issued by
Department of Labor and Industry
Division of Accident Prevention
A. T. EVANS, Director
137 State Office Building
Saint Paul 1, Minnesota

INTRODUCTION

The codes of minimum standards in this book were adopted August 24, 1950, by the Industrial Commission of Minnesota pursuant to authority of Minn. St. 1949, Sec. 175.17, after public hearings held in accordance with Minn. St. 1949, Secs. 15.042-15.049. Representatives of contractors and journeymen organizations participated in the hearings.

The department is grateful for the help and assistance given by safety representatives of employers, insurance companies and officers and representatives of labor organizations in the preparation of the safety codes. Technical advice and assistance in writing the code on environmental sanitation was given generously by Doctor W. E. Park, Director, and G. S. Michelsen, of the Division of Industrial Health, Minnesota Department of Health.

The codes have been approved as to form and legality by the Attorney General of the State of Minnesota, and are on file in the office of the Secretary of State.

Illustrations were furnished through the courtesy of the National Conservation Bureau of New York.

INDUSTRIAL COMMISSION OF MINNESOTA

A. E. RAMBERG,
R. E. FARICY,
R. L. DISTAD,
Commissioners.

SAFETY LAWS OF MINNESOTA

Note.— Numbers and titles of sections are the same as in the Minnesota Statutes of 1949. The figures in brackets are the numbers of the sections in Mason's Statutes.

Protection Against Hazards.

182.01 [4141]. Dangerous machinery — Powers of commission.—The intaking side of all engaging-toothed or other gears, rolls, drums, and slides of every description on any type of machine; the spaces between fixed and moving parts of or at any machine, or between the latter or any part of it and structures near it, leaving insufficient clearance for any person employed thereof or near it; all pulleys and clutches; all belts, cables, bands, and driving ropes or chains; all fly-wheels, shafting, spindles, levers, connecting rods and links, couplings, or projections thereon, or upon reciprocating or moving parts of machines; all counter-weights and balance gears and their suspension; all dangerous parts of machinery; all systems of electrical wiring and transmissions; all dynamos and other electrical apparatus and appliances of every description; and all prime movers in any factory, school, mercantile establishment, mill, workshop, engineering operation, or other places where persons are employed, or otherwise engaged, shall be fenced, boxed, or otherwise protected to the fullest degree practicable. The above shall apply only to all machinery and apparatus above described when located less than six feet above the working floor. All machinery, apparatus, furniture, fixtures, ways, structures, and other equipment shall be so placed or guarded in relation to one another as to be safe for all persons thereabouts employed, and all points which are rendered unsafe by the relative positions of such things shall be securely guarded. Every dangerous place of every description in or near to which any employee is obliged to pass or to be employed, shall be securely fenced, enclosed, or otherwise protected. No grindstone, tool, appliance, or machine of any description, shall be used when the same is known to be cracked or otherwise defective. If a machine or any part thereof is in a dangerous condition, or is not properly guarded, the use thereof may be prohibited by the commission or any factory inspector and a notice to that effect shall be attached thereto. Such unsafe or dangerous machinery shall not be used until made safe. (L. 1913, C. 316, S. 1.)

182.02 [4142]. Belt shifters, loose pulleys, exhaust fans.—Every owner of a factory, mill, or workshop where machinery is in use shall furnish or cause to be furnished, when practicable, belt shifters or other safe mechanical contrivance for the purpose of throwing belts on or off pulleys; and when practicable, machinery shall be provided with loose pulleys. When, in the opinion of the commission, it becomes necessary, exhaust fans of sufficient power or other devices shall be provided for carrying off dust from emery wheels, grindstones, and other dust-creating machinery. (L. 1913, C. 316, S. 2.)

182.03 [4143]. Compulsory communication between workrooms.—Where the machinery in any room is propelled by power transmitted directly from another room or from another building, and the machinery in each workroom cannot be disconnected and stopped in such workroom, communication shall be provided between each workroom in which machinery is placed and the room in which the engineer or other person having control of the power-

generating apparatus is stationed, by means of speaking tubes, electric bells, telephones or appliances that may control the motive power. (L. 1913, C. 316, S. 3; L. 1919, C. 107, S. 1.)

182.04 [4144]. **Prime mover, distance from floor.**—No part of the motors, gearing, belts, pulleys, shafts, or clutches or other apparatus conveying the power of a prime mover to machines shall be less than six feet from the floor unless it is securely guarded. (L. 1913, C. 316, S. 4.)

182.05 [4145]. **Manufacture and sale of unguarded machines prohibited.**—When practicable the points of danger in any machine or mechanism shall be securely guarded by the maker, and the manufacture or sale of any machine or mechanism not so guarded is hereby prohibited. (L. 1913, C. 316, S. 5.)

182.06 [4146]. **Rails and foot guards—Stairways.**—All vats, pans, or other receptacles containing molten metal or hot or corrosive liquids, or otherwise dangerous liquids, below the floor level; all pits or other openings in the floor or surface of the ground; all gangways and inclined footways, or other places from which a person might fall, shall be provided with adequate hand rails and foot guards or other equally effective protection, and in establishments where women are employed, or where it is deemed necessary by the commission, stairways shall be built solid and without openings between the treads. (L. 1913, C. 316, S. 6.)

182.07 [4147]. **What places lighted.**—All stairways and inclined footways and all points where there is a break or change in the floor level or in the character of the floor surface where persons may have to walk or pass, and all dangerous places, all prime movers, and all moving parts of machinery where, on or about which persons work or pass, or may have to work or pass in emergencies, shall be kept properly and sufficiently lighted during working hours. (L. 1913, C. 316, S. 7.)

182.08 [4148]. **Removing safety appliances.**—No employees in any factory, mill, workshop, or upon any engineering work, nor any other person, by permission or otherwise, shall remove, displace, or destroy any guard for dangerous machinery, or other safety device, which the employer shall have provided under the requirements of any law, save under rules established by the employer therefor. Safety appliances removed for the purpose of making repairs, adjustments, or for other purposes permitted or required by the employer, shall be immediately replaced when such purpose is accomplished. (L. 1913, C. 316, S. 8.)

182.09 [4149, 4150]. **Children under 16 not to be employed in certain occupations.**—No children under the age of 16 years shall be employed at sewing belts, or to assist in sewing belts in any capacity whatever; nor shall any such children adjust any belt to any machinery; they shall not oil, or assist in oiling, wiping or cleaning machinery; they shall not operate or assist in operating circular or band saws, wood-shapers, wood-jointers, planers, and paper or wood-polishing machinery, emery or polishing wheels used for polishing metal, wood-turning or boring machinery, stamping machines in sheet metal and tinware manufacturing, stamping machines in washer and nut factories; nor as pin boys in bowling alleys; they shall not operate or assist in operating dough brakes of cracker machinery of any description; wire or iron straightening machines, nor shall they operate or assist in operating rolling mill machines, punches or shears, washing, grinding or mixing mill or calendar rolls in rubber manufacturing; nor shall they operate or assist in operating laundry machinery; nor shall they be employed in any capacity in preparing any composition in which dangerous or poisonous acids

are used; and they shall not be employed in any capacity in the manufacture of paints, colors or white lead; nor shall they be employed in any capacity whatever in the manufacture of goods for immoral purposes, or any other employment dangerous to their lives or limbs or their health or morals. No women shall be required or permitted to oil or clean moving machinery.

No person shall employ or permit any child under the age of 16 years to have the care, management or operation of any elevator, nor shall they be employed in operating any steam boiler or other steam generating apparatus. (L. 1913, C. 316, Ss. 9, 10.)

182.10 [4151]. Crowding of floor space prohibited.—The floor space in any factory, mill, workshop, or mercantile establishment shall not be crowded with machinery in a manner dangerous to employees, or in excess of the sustaining power of floors or walls, nor be overcrowded with materials or products so as to be a menace to employees or in excess of the sustaining power of the floor and walls. (L. 1913, C. 316, S. 11.)

182.11 [4152]. Protection of hoistways, elevators.—Every hoisting apparatus used in the construction of any building; every hoistway, hatchway, elevator well, and wheel hole in any factory, mill, workshop, storehouse, wareroom, or store shall be securely protected on each floor by a substantial barrier at least three feet and six inches high, which shall be kept closed except when necessarily opened for use. Every elevator car used for either freight or passengers shall be provided with some suitable mechanical device by which it can be securely held, in the event of accident, to the rope or hoisting machinery. (L. 1913, C. 316, S. 12.)

182.12 [4153]. Scaffolds, hoists—Duty of inspector—Overhead walks.—When practicable, all scaffolds, hoists, cranes, stays, supports, or other mechanical contrivances, erected or constructed by any person, firm, or corporation, in this state, for the use in erection, repairing, alteration, removal, cleaning, or painting of any house, building, bridge, viaduct, or other structure shall be erected and constructed in a safe, suitable, and proper manner and so erected and constructed, placed, and operated as to give proper and adequate protection to the life and limb of any person employed or engaged thereon, and to any person or employee passing under or in proximity to the same. When a state factory inspector shall find that the scaffolding, or the slings, hangers, blocks, pulleys, stays, braces, irons, or ropes of any swinging or stationary scaffolding, platform, or other similar device used in the construction, alteration, repairing, removing, cleaning, or painting of buildings, bridges, or viaducts within this state or in factories, workshops, mills, or mercantile establishments are unsafe or liable to prove dangerous to the life or limb of any person, he shall at once notify the person responsible for its creation or maintenance, either personally or by mail, and a notice of danger shall also be affixed to the scaffold, platform, or other such device, which shall be made safe before further use. Wherever practicable, scaffolding, staging, runways, oiling platforms, and all other overhead walks or standing places among or suspended from an overhead support, or rising from the ground floor and more than five feet from the ground or floor, shall have a safety rail properly bolted or otherwise fastened, secured, and braced, rising at least 34 inches above the floor of the scaffolding, staging, platform, or other overhead walk or standing place, and extending along the entire length of the outside and ends thereof, and properly attached thereto, unless equal protection is afforded in another manner, and such scaffolding or staging shall be fastened as to prevent the same from swaying from the building or structure to which it is attached or toward which an employee must work.

Persons employed upon swinging scaffolds shall use a life line securely fastened to their persons and to some support other than the swinging scaffold. (L. 1913, C. 316, S. 13.)

182.13 [4154]. **Substantial construction, repair.**—All floors, standing places, stairways, inclined footways, and ladders and all hand rails or similar protection shall be of substantial construction and at all times shall be kept in good order and repair and so as to be firm and safe for the uses to which they are put. (L. 1913, C. 316, S. 14.)

182.14 [4155]. **Buildings of three stories in construction—Planking iron or steel beams.**—On all buildings three stories or more in height, where floor beams are of iron or steel, the contractor for the iron or steel work of such buildings in the course of construction, or the owners of such buildings, shall plank over the entire tier of iron or steel beams on the floor next below the one on which such structural iron or steel is being erected, except such space as may be reasonably required for the proper construction of such iron or steel work, and for the raising and lowering of materials to be used in the construction of such buildings, or such spaces as may be designated by the plans and specifications for stairways, elevator-shafts and other openings. (L. 1913, C. 316, S. 15.)

182.15 [4156]. **Warning notices.**—The employer shall post such warning notices and instructions and cause dangerous places to be indicated in such manner as the commission shall require. (L. 1913, C. 316, S. 16.)

✓ 182.16 [4157]. **Fire escapes — Doors — Hand rails.** — Every building in which laborers are employed shall be provided with sufficient means of escape in case of fire, by more than one way of egress, each of which shall be at all times free from obstruction and ready for immediate use, and every such egress shall be provided with a sign having on it the word "exit" in letters not less than five inches in height and so as plainly to indicate to persons within the building the location of such egresses. Every door leading in or to any such building shall be so constructed as to open outward, when possible, and shall not be so fastened during the working hours as to prevent free egress. Substantial hand rails shall be provided on all stairways in every such building. (L. 1913, C. 316, S. 17.)

182.17 [4158]. **Fire-escapes—Counterbalance stairs.**—If any such building where persons are employed be more than two stories high, it shall be the duty of the owner of such building to provide at least one fire-escape, and as many more as the commission may require, not exceeding one additional escape for every 100 persons employed above the first floor. Every such fire-escape shall be on the outside of the building, connecting on each floor above the first with at least two openings; shall be well fastened and secured, with landings not less than six feet in length and three feet in width; guarded by an iron railing not less than three feet in height. Such landings shall be connected by iron stairs, not less than three feet wide, and with steps of not less than six-inch treads, placed at an angle of not more than 45 degrees, and protected by a well-secured hand rail on both sides, with a counterbalanced stair, two feet wide, reaching from the lower platform to the ground. Such fire-escape shall be sufficient if constructed on any other plan approved by the commission. The openings of each fire-escape shall be as far as practicable from the stairway and elevator shafts, and the ladder of each fire-escape shall extend to the roof. Stationary stairs or ladders shall also be provided on the inside from the upper story to the roof. All doors opening onto a fire-escape shall be metal covered, and all glass used in doors or windows above the first floor opening on to a fire escape or directly under a

fire-escape shall be wire glass set in metal frames. Such fire-escape shall be kept free of snow, ice, and all other obstructions. A suitable disposition shall be made of all inflammable articles and suitable waste cans or barrels shall be provided for the proper handling of sweepings, oily waste or other combustible material as directed by the commission. Such inflammable waste and materials shall be removed from the workrooms each day and not permitted to accumulate. Each factory, mill, and workshop more than two stories high shall also be provided with inside and outside standpipes, and with hose connected therewith, as required in the case of hotels of the same height, and with chemical fire-extinguishers or pails of water or sand on each floor, always ready for use. When a building is equipped with an automatic sprinkler system, installed in accordance with the rules of the board of fire underwriters, inside standpipes or other extinguishing apparatus shall only be required when deemed necessary by the commission. (L. 1913, C. 316, S. 18; L. 1919, C. 108, S. 1.)

182.18 [4159]. Notices—Liability of owners.—Every order, suggestion, or notice served upon any employer of labor, owner or manager of any building, or other person, shall be certified by a receipt for the same taken by the officer or employee of the Department of Labor and Industry serving such order, suggestion, or notice, which receipt shall be signed by the owner, manager, or superintendent of the employer. No liability to any person other than an employee shall attach to any owner of any factory, mill, workshop, engineering works, or mercantile establishment, because of the provisions of sections 182.01 to 182.20, until notice to comply with the terms thereof has been served upon such owner by an officer or employee of the Department of Labor and Industry, and reasonable time to comply with such notice has elapsed. (L. 1913, C. 316, S. 19.)

182.19 [4160]. Prosecutions for violations, when commenced.—Every person who violates or fails to comply with any requirement of sections 182.01 to 182.20, or disregards any order, notice, or direction of any member or employee of the Department of Labor and Industry made in accordance with its provisions, or who obstructs or interferes with any inspection being made pursuant thereto, or who removes from any machine any notice stating that such machine is dangerous and unsafe, or who operates any such machine while such notice is attached and such machine is still unguarded and unsafe, shall be guilty of a misdemeanor, the minimum penalty whereof shall be a fine of \$25.00 or imprisonment for 15 days. When notice is required before prosecution, no criminal proceeding shall be commenced until 30 days after such notice, nor then, if within such time the requirements of the notice have been met. If such requirement be to put a water-closet or privy in sanitary condition, where the only defect is due to carelessness in its management, or to put an elevator in safe condition, only 48 hours shall be allowed. In case of application to the court to restrain, the time aforesaid shall not begin to run until the decision thereon. (L. 1913, C. 316, S. 20.)

182.20 [4161]. Interpretation and definition of terms.—The term "prime mover," as used in sections 182.01 to 182.20 includes all steam, gas, oil, or other kinds of engines, and also all electrical apparatus which generates, converts, or transmits power.

The words "guard," "guarded," "safeguard," "safeguarded" and "protection" shall be given a broad interpretation, so as to include any practicable method of mitigating or preventing a specific danger. (L. 1913, C. 316, S. 21.)

182.21 [4163]. Corn shredders—Safety devices to be approved by commission—Prohibiting sale.—No person, firm, or corporation shall sell, offer

or expose for sale any machine to be operated by steam or other power for the purpose of husking or shredding corn or corn stalks unless the machine shall be provided with reasonable safety devices approved by the commission for the protection from accidents from the snapping rollers and husking rollers and so guarded that the person feeding the machine shall be compelled to stand at a reasonably safe distance from the snapping rollers. (L. 1911, C. 354, S. 1.)

182.22 [4164]. **Machines purchased prior to act.**—No person, firm, or corporation shall use, operate, or permit to be used or operated any such machine purchased prior to the passage and publication of sections 182.21 to 182.23, unless during all the time such machine shall be used and operated it shall be in charge of a competent person whose sole duty shall be to oversee and attend to the operating and use of the same. (L. 1911, C. 354, S. 2.)

182.23 [4165]. **Violations—Penalties.**—Any such person, firm, or corporation who shall violate any of the provisions of sections 182.21 and 182.22 shall be punished by a fine of not less than \$25.00, nor more than \$100.00, for each offense. (L. 1911, C. 354, S. 3.)

182.24 [4166]. **Employers must furnish helmets.**—It shall be unlawful for any employer of labor in this state to require or permit any employee to engage in any occupation or process of employment in which there is danger of serious injury to the eyes of such employee, or of surrounding workmen, from flying objects or particles thrown by machines or tools, or from the splashing of hot substances or chemicals, unless and until the employer shall furnish to each employee subjected to such hazards goggles, helmets, or other practical protective devices to prevent such injuries. (L. 1921, C. 113, S. 1.)

182.25 [4167]. **Employee must wear helmet.**—It shall be unlawful for any employee to engage in any occupation or process of employment mentioned in section 182.24 unless he shall wear or use the protective devices furnished by the employer during the entire time he is engaged in such occupation or employment. (L. 1921, C. 113, S. 2.)

182.26 [4168]. **Application of sections 182.24 to 182.28.**—The provisions of sections 182.24 to 182.28 shall not apply to persons employed in steam and electric transportations. (L. 1921, C. 113, S. 2½.)

182.27 [4169]. **Commission to approve devices.**—The goggles and helmets required in section 182.24 shall be of a design and material approved by the commission for the purposes required, and furnished separately for each employee using them without cost to the employee and no employee shall be required nor shall he use the goggles or helmet furnished to another until the same has been adequately sterilized to prevent the transmission of diseases. (L. 1921, C. 113, S. 3.)

182.27 [4170]. **Failure to furnish helmets.**—Every employer neglecting or refusing to furnish the goggles, helmets, or other protective devices so required, after being notified to do so by the commission or its assistants, or who requires an employee to use the goggles or helmet provided for another employee before the same has been properly sterilized, and any employee who neglects or refuses to use the devices furnished by the employer, or who uses the goggles or helmet furnished to another before it has been properly sterilized, shall be guilty of a misdemeanor, punishable by a fine of not less than \$25.00, or by imprisonment for not less than 15 days. Violations of sections 182.24 to 182.28 shall not affect the right of an employee to compensation or to damages under the laws of this state for injury sustained by

neglect to comply with the requirements thereof. These sections shall not apply to nor include farm labor. (L. 1921, C. 113, S. 4.)

616.23. Doors of public buildings to swing outward. The doors of all theaters, amphitheatres, opera houses, public halls, dance halls, saloons, taverns, public and private clubs, churches, schools, or places used for public entertainments, exhibitions, or meetings, which are used exclusively or in part for admission to, or egress from, the same, shall be so hung and arranged as to open outwardly and, during any exhibition, entertainment or meeting held therein, shall be kept unlocked and unfastened, and in such condition that, in case of danger or necessity, immediate escape from such building shall not be prevented or delayed. Every owner, agent, or lessee of any such building who shall rent the same or allow it to be used for any of the aforesaid public purposes, without having the doors thereof hung and arranged as hereinbefore provided, shall for each violation of any provision of this section be guilty of a misdemeanor and be punished by a fine of not less than \$25 nor more than \$100 and in default of payment of fine and cost shall be confined in the county jail for not less than 15 nor more than 60 days.

Sanitation of Places of Employment.

182.29 [4171]. All places of employment.—The term “all places of employment,” as used in sections 182.29 to 182.47, means any place, either inside or outside, where any business or industry is carried on and in which persons are employed, and includes factories, mills, workshops, laundries, dyeing and cleaning establishments, mercantile establishments, offices and office buildings, hotels, restaurants, theaters and other places of amusement, transportation systems, public utilities, engineering works, the erection of buildings, and yards; but shall not be construed to apply to domestic service or agricultural labor. (L. 1919, C. 491, S. 1.)

182.30 [4172]. Duty of employer.—In all places of employment it shall be the duty of the employer to keep the floors and walls of buildings or parts of buildings, the grounds surrounding such buildings, and the machinery, fixtures, and utensils in such buildings over which he may have control in a clean and sanitary a condition as the nature of the industry will permit. Where wet processes are used the floors must be so drained that there is no measurable depth of water in which employees must stand while working. Where practicable, dry standing room must be provided for all employees. Suitable receptacles shall be provided and used for the storage of waste and refuse; such receptacles shall be maintained in a sanitary condition. All waste, refuse, sweepings, and decomposed matter shall be removed from such buildings daily and in such manner as not to cause a nuisance. All cleaning shall be done, as far as possible, out of working hours; but, if done during working hours, shall be done in such a manner as to avoid unnecessary raising of dust or noxious odors. All such places of employment shall be well drained and the plumbing thereof at all times kept in proper repair and in a clean and sanitary condition. In all such places of employment the floors shall be scrubbed and the walls cleaned whenever and so often as the commission deems it necessary. (L. 1919, C. 491, S. 2.)

182.31 [4173]. Arrangements and conditions of interior of buildings.—Every place of employment used for the preparation, manufacture, sale, or storage of food products shall be properly lighted, drained, plumbed, and ventilated and conducted with strict regard to the influence of such conditions

upon the health of persons therein employed and the purity and wholesomeness of the food products therein prepared, manufactured, sold, or stored. The side walls and ceilings of all rooms used for the purposes named in this section shall be of a material that can easily be cleaned and kept clean and limewashed or painted when in the opinion of the commission the same is necessary. The floors in such places shall be impermeable and made of cement or tile laid in cement, brick, wood, or other suitable, non-absorbent material which can be flushed and washed clean with water or otherwise kept in a clean and sanitary condition. The doors, windows, and other openings of such places shall, where practicable, be fitted with stationary or self-closing screen doors and wire window screens during such months as they are necessary to exclude flies and other insects. No employee of any such place shall expectorate or discharge any substance from his mouth or nose on the floor or interior side wall of any room used for the purposes mentioned in this section. Cuspidors shall be provided for the use of employees, and each cuspidor shall be emptied and washed out daily with disinfectant solution and a portion of such solution shall be left in each cuspidor while in use. No water-closet, earth-closet, privy, ash pit, or sleeping room for employees shall be in or communicate directly with any room used for the purposes mentioned in this section. All employees of such places engaged in the manufacture and handling of bakery products shall wear clothing of washable material, which shall be used for that purpose only, and such garments shall be kept clean at all times. (L. 1919, C. 491, S. 3.)

182.32 [4174]. Ventilation.—In every place of employment the employer shall provide, in each workroom thereof, proper and sufficient means of ventilation and maintain proper and sufficient ventilation. If excessive smoke, steam, gas fumes, vapors, dust, or other impurities are created or generated by the manufacturing process or handicraft carried on therein in sufficient quantities to obstruct the vision, or to be irritating, obnoxious, or injurious to the health or safety of the employees therein, the rooms shall be ventilated in such manner as to remove them or render them harmless so far as is practicable. If in the opinion of the commission it is deemed necessary, it may order the installation of exhaust fans and other mechanical means of a proper construction to effectively remove from the point of origin such smoke, steam, gases, fumes, vapors, dust, or other impurities. If the removal of such smoke, steam, gases, fumes, vapors, dust, or other impurities is, because of the nature of the process, impracticable, the commission may, if it deems it necessary to the health of the workers in any place of employment, order the isolation of such process or handicraft in a separate room or building. (L. 1919, C. 491, S. 4.)

182.33 [4175]. Limitation of employees in room.—No more employees shall be required or permitted to work in a room in any place of employment than will allow to each of such employees not less than 400 cubic feet of air space, unless by a written permit of the commission such amount of air space for each employee may temporarily be reduced to not less than 250 cubic feet of air space. No such permit shall be issued for a room in which smoke, gas, fumes, dust, or vapors are generated or in which there are fires consuming oxygen. (L. 1919, C. 491, S. 5.)

182.34 [4176]. Heat and ventilation.—In every place of employment the workrooms shall, so far as the nature of the industry will permit, be properly heated during cold weather. In every place of employment where excessive heat be created in any of the workrooms by the nature of the process therein carried on it shall be the duty of the employer to provide heat deflectors, exhaust fans and such other mechanical means that are necessary to protect

from the heat and to carry off, so far as practicable, such excessive heat and to cool off such workrooms. It shall be unlawful in any place of employment to establish any process or handicraft which creates excessive heat in any workroom the ceiling of which is less than eight feet from the floor of such workroom or the floor of any balcony in such workroom.

The use of salamanders or other heaters that discharge smoke or gas into a workroom in which workers are employed is prohibited. (L. 1919, C. 491, S. 6.)

182.35 [4177]. Toilet facilities.—In every place of employment there shall be provided adequate toilet facilities, which shall be located conveniently to and easily accessible from all places where persons are employed. Each water-closet, urinal, lavatory, or slop sink located in a toilet room must be connected with a sewer system where a sewer system is available. Indecent or suggestive marks, pictures or words are forbidden in toilet rooms, and such defacement when found by the employer must be at once removed. (L. 1919, C. 491, S. 7.)

182.36 [4178]. Sanitation.—All toilet rooms not having sewer connection and maintained outside of buildings where persons are employed shall on new installations be at least 25 feet from such buildings. In all places of employment where the workers are exposed to excessive heat, humidity, or fatigue from physical exertion, there shall be a covered passageway connecting said buildings with such toilet or toilets. (L. 1919, C. 491, S. 8.)

182.37 [4179]. Separate toilets.—In all places of employment where five or more persons are employed and are of opposite sex, separate toilets for each sex shall be provided and maintained. Such toilets shall be so marked as to designate plainly and distinctly the sex for whose use they are intended, and no person shall be allowed to use the toilet room assigned to the opposite sex. (L. 1919, C. 491, S. 9.)

182.38 [4180]. Construction of toilets.—The toilets in all places of employment must be so constructed as to insure privacy. The outside partitions of all toilet rooms shall be of solid construction, and may be opaque or translucent, but not transparent, and extend from floor to ceiling, or such rooms shall be independently ceiled over. All partitions separating toilet rooms provided for the different sexes shall be constructed of such materials as are not transparent or translucent, and they shall be sound-proof, and no opening in such partitions shall be permitted. If the water-closet is not located within a separate compartment in the toilet room, the entrance to such toilet room, shall be provided with a screen of sufficient height and width to insure privacy. The floors of all toilet rooms shall be tight, smooth and constructed of a material that can be kept in a sanitary condition. The walls and ceiling shall be tight and of such substance that can be readily cleaned and kept clean. (L. 1919, C. 491, S. 10.)

182.39 [4181]. Toilets in perfect condition.—In all places of employment the toilet rooms, and every part thereof, including the floor, walls and ceiling, and all fixtures therein, must be kept in a clean condition. All toilet rooms and water-closet compartments shall be adequately illuminated by natural or artificial light. All toilet rooms not lighted by windows that open easily shall be adequately ventilated to the outside air by artificial means. All toilet facilities shall be adequately protected to prevent the entrance and breeding of flies, so far as practicable. All toilet rooms, wherever practicable, shall be adequately heated at all times. (L. 1919, C. 491, S. 11.)

182.40 [4182]. Ratio of toilets.—In all places of employment, water-closets shall be provided in the following number and ratio: When there are 100 or less persons on a shift employed, there shall be one water-closet for every 20 persons; when there are 100 to 500 persons on a shift, there shall be one water-closet to every 30 persons; when there are 500 to 1,000 persons on a shift, there shall be one water-closet to every 35 persons, and when there are over 1,000 persons on a shift, there shall be one water-closet to every 40 persons.

When there are more than 100 men employed on a shift, there shall be provided, in addition to the water closets required by this section, one urinal for every 50 men.

Urinals shall be either individual or slab urinals. At least two feet of slab urinal shall be considered the equivalent of one individual urinal. (L. 1919, C. 491, S. 12.)

182.41 [4183]. Washing basins and individual towels.—Every place of employment shall provide, without expense to the employee, adequate facilities for washing the hands and faces of the employees. Individual towels shall be provided by the employer, and the use of towels in common is prohibited.

In all places where food is prepared or manufactured; in all places where poisonous or injurious materials are handled by the employees, and in all places where the employees are required by the nature of the process at which they are employed to become covered with oil, grease, soot, or other material not easily removed, the employer shall provide hot and cold water and soap in sufficient quantities to permit employees to make themselves clean. (L. 1919, C. 491, S. 13.)

182.42 [4184]. Dressing rooms.—In every place of employment in which a change of clothing is necessary for any of the employees in doing their work, suitable dressing rooms shall be provided and shall be separate for the sexes. All such dressing rooms shall be kept in a clean and sanitary condition and be adequately ventilated. In all places of employment where poisonous compounds are handled by the employees, facilities for hanging and storing both working and street garments shall be provided so that they will not come in contact with each other, or with the garments of others. All such dressing rooms shall be enclosed by means of solid partitions or walls, separated from toilet rooms, and have at least one window opening to the outer air or other means of properly ventilating such rooms. (L. 1919, C. 491, S. 14.)

182.43 [4185]. Eating of food.—In every place of employment it shall be unlawful to keep or eat any food in a room in which the dust or fumes of poisonous compounds are present. In such places of employment the employer shall provide a suitable place in which employees may eat their meals. No employee engaged in handling such poisonous compounds shall go out or be allowed to go out for lunch or to eat his or her lunch on the premises without first washing his hands and, if necessary, washing his face. (L. 1919, C. 491, S. 15.)

✓ 182.44 [4186]. Seating capacity.—In all places of employment where women are employed, the employer shall provide and maintain suitable seats, with proper backs where practicable, for the use of such women employees, and permit the use thereof by such employees to such an extent as may be reasonable for the preservation of their health. In all places where women are engaged in work which can be properly performed in a sitting posture, suitable seats, with backs where practicable, shall be supplied in every fac-

tory for the use of all such women employees and permitted to be used at such work. The commission may determine when seats, with or without backs, are necessary and the number thereof. (L. 1919, C. 491, S. 16.)

182.45 [4187]. Drinking water.—Every place of employment shall provide, without expense to the employees, an adequate supply of pure drinking water. When practicable, ice used for cooling purposes shall be applied in such manner that the ice itself shall not come in contact with the drinking water and the water from the melting ice shall not become mixed with the drinking water. In all places of employment where no running water can be provided, the receptacle for holding the drinking water shall at all times be kept in a clean and sanitary condition and must be kept covered to prevent dust or impurities from entering such receptacle. (L. 1919, C. 491, S. 17.)

182.46 [4188]. When owner responsible.—When any building is occupied by more than one place of employment and the halls, stairs, toilets, or other portions of the building are used jointly by more than one tenant or in which conditions prohibited by sections 182.29 to 182.47 are jointly created by more than one tenant, it shall be the duty of the owner of such building to carry out the provisions of those sections. The owner of any such building may arrange by agreement with one or more of his tenants to assume responsibility for carrying out such provisions. (L. 1919, C. 491, S. 18.)

182.47 [4189]. Enforcement of sections 182.29 to 182.47.—It shall be the duty of the commission to enforce the provisions of sections 182.29 to 182.47. Thirty days' notice shall be given for any new installations required by those sections before any criminal proceedings shall be commenced; but the commission may, for good cause shown, extend the time to a longer period. All orders to place toilets, floors, and receptacles in a sanitary condition shall be complied with within forty-eight hours. Any person, firm, or corporation violating the provisions of those sections, or failing to comply, in the time specified, with any order of the commission, shall be guilty of a misdemeanor, punishable by fine or imprisonment at the discretion of the court. Any person, firm, or corporation aggrieved at any order of the commission issued pursuant to those sections may apply for a restraining order to the district court in the manner and as provided in section 175.25 [4251]. (L. 1919, C. 491, S. 19.)

BASEMENT WORKROOMS MAY BE PROHIBITED.

182.48 [4191]. Underground apartments.—No basement, cellar, underground apartment, or other place which the commission shall condemn as unhealthy and unsuitable shall be used as a workshop, factory, or place of business in which any person or persons shall be employed. (L. 1909, C. 289, S. 1.)

182.49 [4192]. Violation of section 182.48.—Any person, firm, or corporation violating any of the provisions of section 182.48 shall be guilty of a misdemeanor; and, upon conviction thereof, punished by a fine of not more than \$100, nor less than \$25, or by imprisonment for not more than 90, nor less than 30, days or by both fine and imprisonment, for each offense. (L. 1909, C. 289, S. 2.)

Safety and Health in Foundries.

183.05 [4054]. Foundries—Entrance—Gangway—Aisles.—An iron or steel foundry means a place where iron or steel, or both metals, are melted and poured into sand molds in the making of castings, together with all

cleaning, core-making, drying, and wash-rooms and toilet-rooms used in connection therewith.

The term "entrance" as used in sections 183.05 to 183.34, means main doorways opening directly to the outer air.

The term "gangway" as used in sections 183.05 to 183.34, means well-defined passageways dividing the working floors of foundries, but not the spaces between molds. Spaces between molds shall be divided into three classes, which shall be known as "bull-ladle aisles," "hand-ladle aisles," and "buggy-ladle aisles." (L. 1919, C. 84, S. 1.)

183.06 [4055]. Foundries exempt from laws relating to factories and workshops.—Except as otherwise specified, the provisions of sections 183.05 to 183.34 shall, as to the subjects covered therein, exempt foundries from the laws relating to factories and workshops. (L. 1919, C. 84, S. 2.)

183.07 [4056]. Protection of entrance to foundries.—Entrances to foundries shall be protected from November first to April first of each year by a covered vestibule, either stationary or movable, so constructed as to eliminate drafts and of such dimensions as to answer ordinary purposes, such as the passage of wheelbarrows, trucks, and small industrial cars. This shall not apply to entrances used for railroad or industrial cars handled by locomotives or motors, or for traveling cranes; or for vehicles, or for large industrial cars moved by hand; these entrances may remain open only for such time as is necessary for the ingress and egress of such cars, trucks and trains.

No locomotive shall be permitted to remain inside the foundry during the loading or unloading of the cars. (L. 1919, C. 84, S. 3.)

183.08 [4057]. Size of gangways.—Main gangways where metal is carried by hand, bull or truck ladles shall not be less than five feet wide. Truck-ladle gangways which are not main gangways shall be not less than four feet wide. Bull-ladle aisles between floors shall be not less than three feet wide. Single hand-ladle or buggy-ladle aisles between floors shall be not less than 18 inches wide. Where trolleys are used over molding floors for pouring metal, the aisles shall be of sufficient width to permit the safe ingress and egress of employees and the safe use of the ladles. The provisions of this section shall apply to all foundries hereafter established. In existing foundries, where it is impractical to widen the gangways and aisles to the width required in this section, the commission, or its assistants, may permit gangways and aisles to be of a narrower width. (L. 1919, C. 84, S. 4.)

183.09 [4058]. Gangways kept free—Material of which constructed.—During the progress of casting, every gangway or aisle shall be kept entirely free from pools of water or obstructions of any nature. Every gangway, where industrial tracks are used, shall be constructed of a hard material of substantial character, and the top of the rails shall be flush with the floor. Every gangway shall be kept in a good and safe condition at all times. (L. 1919, C. 84, S. 5.)

183.10 [4059]. Mechanical ventilation.—Where smoke, steam, gases, or dust arising from any of the operations of the foundry are dangerous to the health or eyes, and where a natural circulation of air does not carry off the greater part of such smoke, steam, gases, or dust, there shall be installed and operated adequate mechanical means of ventilation. (L. 1919, C. 84, S. 6.)

183.11 [4060]. Molding room.—The cleaning and chipping of castings shall be done in cleaning rooms, except that castings may, when necessary, be chipped or cleaned in the molding room or where cast, provided sufficient

protection is furnished by the use of a curtain or screen, or some other means equally good, to protect employees therein.

This section shall not apply if mechanical appliances are used for cleaning castings and the dust and particles arising therefrom are effectively removed. (L. 1919, C. 84, S. 7.)

183.12 [4061]. Exhaust systems in tumbler mills.—Where tumbler mills are used, exhaust systems shall be installed to effectively carry off the dust arising from the cleaning of castings, except where the mill is operated outside the foundry. This section shall not prohibit the use of a water barrel for cleaning castings. Sand blast operations shall be carried on in the open air or in a separate room used solely for that purpose. The milling of cupola cinders, when done inside the foundry, shall be carried on by an exhaust mill or water mill. (L. 1919, C. 84, S. 8.)

183.13 [4062]. When compressed air cannot be used.—No cores shall be blown out of castings by compressed air unless such work is done outside the foundry or in a special or dust-proof enclosure. Employees engaged in cleaning castings by compressed air or sand blast shall wear eye guards and helmets, to be furnished by the employer. (L. 1919, C. 84, S. 9.)

183.14 [4063]. Hoods and pipes to be supplied.—When fumes, gases, and smoke are emitted from drying ovens in such quantities as to be detrimental to the health or eyes of the employees, hoods and pipes or other adequate means of ventilation shall be provided. (L. 1919, C. 84, S. 10.)

183.15 [4064]. Artificial light.—Where natural light is insufficient to properly light the foundry, artificial light of sufficient power shall be provided.

The continuous use of hand torches or other lamps that emit injurious smoke and gases is prohibited. (L. 1919, C. 84, S. 11.)

183.16 [4065]. Heat.—Proper and sufficient heat shall be provided and maintained in every foundry. The use of the open salamander stove, or stoves of that type, for heating purposes shall be prohibited, except in cases of emergency. (L. 1919, C. 84, S. 12.)

183.17 [4066]. Drying of ladles.—All hand and bull-ladles shall be dried outside of the foundry, or in accordance with section 183.10. A sufficient number of sheet iron shields shall be available in foundries for use in covering hand and bull-ladles. (L. 1919, C. 84, S. 13.)

183.18 [4067.] Drying of clothes.—Suitable facilities shall be provided for drying the clothing of such employees as may be found necessary. (L. 1919, C. 84, S. 14.)

183.19 [4068]. Water-closets.—In every foundry where water-closets or privy accommodations are permitted to remain outside of the foundry, the passageway leading from the foundry to the water-closets or privy accommodations shall be so constructed that the employees in passing thereto or therefrom shall not be exposed to outdoor atmosphere, and such passageways, water-closets or privy accommodations shall be properly heated during cold weather. (L. 1919, C. 84, S. 15.)

183.20 [4069]. Number of closets.—Water-closets shall be provided in every foundry and for each sex according to the following table:

Number of Persons	Number of Closets	Ratio
1 to 10	1	1 for 10
11 to 25	2	1 for 12½
26 to 50	3	1 for 16⅔
51 to 80	4	1 for 20
80 to 125	5	1 for 25

(L. 1919, C. 84, S. 16.)

183.21 [4070]. Individual lockers.—Individual lockers, arranged for locking, shall be provided for employees, and shall be placed either in a room used exclusively for that purpose, in the wash-room, in the drying-room, or at convenient places in the foundry. The necessity for individual lockers shall be determined by the commission or its assistants. (L. 1919, C. 84, S. 17.)

183.22 [4071]. Inspection of appliances.—Ladles, shanks, tongs, slings and yokes, skimmers and slag hoes used in the pouring of molten metals shall, prior to their use, be inspected daily as to their safety for the men preparing and using same; and, in addition, a regular inspection, as to their safety, shall be made once a month by a man designated for that purpose.

A monthly inspection shall also be made of the chains and cables on counterweights in connection with drying ovens, and reports of such inspection shall be made on prescribed forms and be kept on file for examination by the state factory inspector. (L. 1919, C. 84, S. 18.)

183.23 [4072]. Breaking of castings.—The breaking of castings by the use of a drop inside the foundry during the general working hours is prohibited. Where a drop is used for the breaking of castings or scrap outside of the foundry, a permanent shield of heavy planking or other adequate protection shall be provided. (L. 1919, C. 84, S. 19.)

183.24 [4073]. Females not to be employed in core rooms.—No female shall be employed in placing cores into ovens or in taking cores out of ovens. (L. 1919, C. 84, S. 20.)

183.25 [4074]. Number of pounds specified.—No female employed in any core-making room shall be permitted to make or handle cores when the combined weight of core, core box and plate at which she is working shall exceed 25 pounds. (L. 1919, C. 84, S. 21.)

183.26 [4075]. Brass foundry—Cellar—Basement.—A “brass foundry” means a place where brass, aluminum, copper, tin, zinc, gold, silver, or composition metals containing any of the foregoing metals are melted or poured into sand molds in the making of castings. Foundries where only aluminum is melted shall be covered by the provisions of sections 183.05 to 183.34 governing iron and steel foundries.

The term “cellar,” when used in sections 183.05 to 183.34, means a room or part of a building which is one-half or more of its height below the level of the curb on the ground adjoining the building, excluding areaways.

The term “basement,” when used in sections 183.05 to 183.34, means a room or a part of a building which is one-half or more of its height above the level of the curb. (L. 1919, C. 84, S. 22.)

183.27 [4076]. Application to brass foundries.—The provisions of sections 183.05 to 183.34 relative to dust, smoke, gases or fumes, ventilation, sanitation, heat, light, gangways and aisles, safety appliances, drying and locker accommodations, as specified for iron and steel foundries, shall apply to brass foundries. (L. 1919, C. 84, S. 23.)

183.28 [4077]. Detail construction in brass foundries.—In all brass foundries, when the crown plate of an upright melting furnace is elevated above the surrounding floor in excess of 12 inches, the furnace shall be equipped with a platform with a standard rail; such platform shall be constructed of metal or other fireproof material, and shall extend along the front and sides of the furnace, flush with the crown plate, and shall be at least four feet in width, and shall be clear of all obstructions during pouring time. If the platform is elevated above the floor in excess of 12 inches, the lowering from same of crucibles containing molten metal shall be done by mechanical means.

Where the combined weight of crucible, tongs, and molten metal exceeds 250 pounds, the same shall be removed from the furnace and deposited on the floor by mechanical means. (L. 1919, C. 84, S. 24.)

183.29 [4078]. Protection for legs and feet.—All persons removing pots containing molten metal from furnaces and handling same shall be provided with protection for legs and feet. (L. 1919, C. 84, S. 25.)

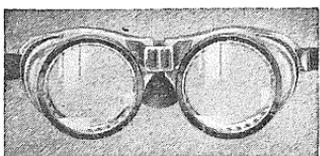
183.30 [4079]. Gangways.—In all brass foundries gangway dirt and floor scrapings shall not be riddled in the room where workmen are employed, unless they are so dampened as to prevent dust arising therefrom. (L. 1919, C. 84, S. 26.)

183.31 [4080]. Casings for stoves.—Stoves used for drying molds, when located in the rooms used by workmen, shall be surrounded by a casing of fireproof material to the full height of the stove. (L. 1919, C. 84, S. 27.)

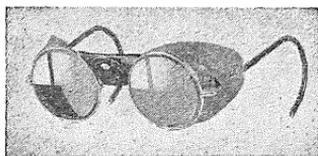
183.32 [4081]. Clearances.—No brass foundry shall hereafter be constructed with a clearance of less than 14 feet between the lowest point of the ceiling and the floor, except that where a peak, sawtooth, monitor or arch roof is constructed the side walls may be of a minimum height of 12 feet. (L. 1919, C. 84, S. 28.)

183.33 [4082]. Reopening of foundries.—In case any foundry that was legally operated in a cellar or basement on January 1, 1919, shall be discontinued or unused for a period of more than four consecutive months, it can thereafter be reopened as a foundry only by complying with all the provisions of sections 183.05 to 183.34 relating to future foundries. The occasional operation of a foundry for the purpose of evading this section shall not be deemed a continuance of use thereof. (L. 1919, C. 84, S. 29.)

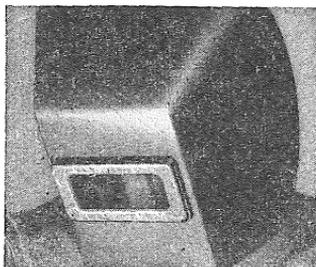
183.34 [4083]. Enforcement of sections 183.05 to 183.34.—The commission and its assistants shall enforce the provisions of sections 183.05 to 183.34. Any person, firm, or corporation violating any of the provisions of those sections shall, if after written notice by the commission or its assistants of such violation they shall not after 30 days have complied with such notice, be guilty of a misdemeanor and punished by a fine not exceeding \$100.00 or by imprisonment not exceeding 90 days. If an employee neglects to use the devices furnished under the provisions of those sections he shall be guilty of a misdemeanor, punishable by a fine not exceeding \$10.00 or imprisonment for not exceeding ten days. (L. 1919, C. 84, S. 30.)



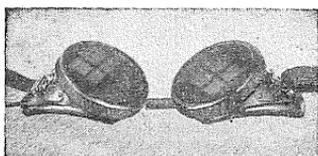
Coverglass Chipper's Goggle.



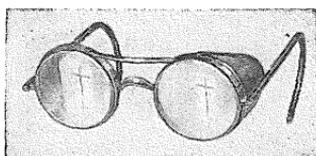
Metal Frame Spectacle Goggle.



Electric Welder's Face Mask.



Welding Goggle.



Spectacle Type Goggle.



Foot and Leg Protection.

GENERAL SAFETY CODE

Acids and Caustic Liquids.

Storage tanks for dangerous liquids shall be so located that possibility of injury to persons through tank failure is minimized.

Storage tanks shall be so installed as to provide opportunity for complete inspection. Concrete foundations are recommended.

Strong acids and caustic liquids shall be handled in bulk by the following methods only: Gravity systems; compressed air or inert gas displacement systems; pressure pump systems. Wherever possible these systems shall extend to working spaces, so that it will be unnecessary to carry such liquids in small containers.

CARBOYS, JUGS AND BOTTLES.

Carboys, hermetically sealed, may be under internal pressure at high temperatures, and shall not, therefore, be stored where exposed to direct sunlight or other sources of excessive heat.

The condition of the wooden containers of newly received acid carboys shall be checked.

When small quantities of acids or caustic liquids must be handled manually, carboy trucks, safe containers, inclinators and bottle carriers shall be provided. Unboxed carboys shall not be used and air pressure shall not be applied to carboys. Carboys shall be emptied only by means of an inclinator, or by means of a pump which, without causing either suction or pressure in the bottle, draws the liquid from it. When carboys are empty, they shall be rinsed out with water and drained. Before adding water, carboys shall be inverted to make absolutely sure that they are empty.

PROTECTIVE CLOTHING.

Operators engaged in handling corrosive liquids, repairing pipe lines, etc., shall be provided with goggles and rubber gloves, and, where necessary, with rubber aprons and boots. It is desirable that shower heads equipped with quick operating valves be provided in areas where acids are handled.

REPAIR OF ACID AND CAUSTIC LIQUID LINES, PUMPS, ETC.

Before being dismantled pipe lines, pumps, etc., which are to be repaired shall be drained, blown down with compressed air, relieved of all pressure and kept free from pressure. Particular attention shall be paid to branch lines where pockets may exist.

All pumping on the system with which parts under repair are connected shall be stopped unless blank flanges are installed in lines to segregate such parts from the pumps.

A flange connection should be broken by being covered with a shield of sheet lead or rubber through which the wedge should be driven.

After completion of a repair job, all spillage of liquids shall be thoroughly washed away with water.



Fig. 67. Safety Carboy Inclinor.

UNLOADING ACID AND CAUSTIC-LIQUID TANK CARS.

Before loading or unloading is started, all valves shall be carefully checked and inspected to make certain that they are in operating condition.

Air pressures exceeding 20 pounds shall never be used.

Portable warning signs shall be placed on railway tracks near each end of the car, warning trainmen to avoid hitting the car while it is being loaded or unloaded.

Hose used for acid shall be inspected regularly for defects, washed by immersion in water after use and hung up in such a way that it will drain and dry out.

A lubricated valve shall be provided between the tank car and the hose.

Provision shall be made for quickly relieving air pressure on the car in case of an emergency.

Electrical Equipment

From the Handbook of Industrial Safety Standards Issued by the National Conservation Bureau and Adopted as a Safety Code for Minnesota.

GENERAL REQUIREMENTS.

Guarding Live Parts.—All live parts at voltages exceeding 300 volts to ground shall be guarded, if clearances from the platform or any other permanent supporting surface for workmen are less than shown in Table A.

Table A—Minimum Clearances From Live Parts.

(1) Voltage Between Phases.	(2) Minimum vertical clearance of unguarded parts.		(3) Minimum horizontal clearance of unguarded parts.		(4) Minimum Clearance from Guards to parts. Radius of guard zone.*
	Feet	Inches	Feet	Inches	Inches
300.....	8	8	3	2	2
2,300.....	8	9	3	3	3
6,600.....	8	10	3	4	4
11,000.....	9	0	3	6	6
22,000.....	9	3	3	9	9
33,000.....	9	6	4	0	12
44,000.....	9	10	4	4	16
66,000.....	10	5	4	11	23
88,000.....	11	0	5	6	30
110,000.....	11	7	6	1	37
132,000.....	12	2	6	8	44

*The guard zone means the space of minimum clearance from guards to electrical parts.

Exposed parts of equipment at 100 volts or more to ground shall not be accessible to unqualified persons.

Parts over or near frequently traveled passageways, etc., shall be guarded or given clearances sufficiently in excess of those specified above to insure reasonable safety. Guards shall be of sufficient rigidity and strength to prevent them from being displaced or dangerously deflected by a man slipping or falling against them. Railings are not substitutes for complete guards, but if used, shall be located at a horizontal distance of at least three feet from the nearest point of the guard zone which is less than 7½ feet above the floor. Insulating covering on parts exceeding 750 volts to ground shall not be considered adequate protection, but for parts less than 750 volts to ground in dry places and where not exposed to mechanical injury, varnished cloth or other equivalent insulation suitable for the voltage involved may be used as a guard.

GROUNDING.

Protective Grounding.—All electrical equipment, if operating at more than 150 volts to ground, shall have the exposed non-current carrying metal parts, such as frames of generator motors and switch boards, cases of transformers, lightning arrestors and switches, guard rails and screens permanently grounded.

HAZARDOUS LOCATIONS.

Hazardous Locations.—Electrical equipment of all voltages, in locations where explosives, or flammable gas or dust, lint, fumes, etc., exist in dangerous quantities, or where there is dampness, shall be grounded.

Arrangement of Grounds.—Ground connections may be made to water pipes, or other metal in proper contact with earth or bodies of water, such as penstocks, water gates, etc.

When artificial grounds are necessary, metal plates buried in ground, prepared with charcoal and other chemicals to decrease the ground resistance shall be used. Present day practice favors the use of metal pipes driven in the ground. This method permits a ground distributed over a wide area, and is easily installed.

Grounding Equipment During Repairs.—Electrical equipment or conductors normally operating at more than 150 volts on or about which work is occasionally done while separated from a source of electrical energy by switches or disconnectors only, shall be provided with some means, such as switches, connectors, or readily accessible ground conductors, for grounding them.

Working Space.—Where required: Adequate and readily accessible working space with secure footing shall be maintained about all electrical parts or equipment which require adjustment or examination when exposed while in service.

Clearance: The horizontal clearance from the farthest edge of the working space to the nearest live parts of more than 150 volts to ground, exposed after removing guards, shall be not less than three feet plus the guard zone radius as given in column 4 of Table A.

Identification.—When necessary for safety, electrical equipment shall be suitably labeled for identification. Where important, the label shall specify voltage and intended use.

Illumination.—Sufficient illumination shall be provided in rooms and spaces where electrical apparatus or machinery is located.

The means of illumination, whether natural or artificial, shall be maintained ready for use at all times.

Emergency Source.—A separate emergency source of illumination shall be provided where an operator is required continuously, to permit the proper operation of the switchboard when the usual source of illumination is affected by disturbances.

Fire Extinguishers.—Each room or space shall be provided with adequate approved fire-extinguishing appliances conveniently located and conspicuously marked.

Non-conducting extinguishers: Fire in electrical equipment shall be extinguished with the vaporizing non-conducting liquid type or the carbon dioxide type, and some other inert gas type extinguishers.

Installation.—All electrical equipment shall be installed in accordance with the provisions of the National Electric Code.

Where current carrying parts, insulation of leads, or electrical devices or equipment are exposed to injury by being installed on locations where dripping oil, excessive moisture, steam, vapors, or similar agents exist, suitable shields or enclosures should be provided.

SWITCHBOARDS.

Material.—Switchboards shall be made of non-combustible material and be kept free from moisture.

Illumination.—Sufficient illumination shall be provided both for the front and rear of the switchboard.

Location.—Switchboards shall, where practicable, be so placed that the operator will not be endangered by any live or moving parts of machinery or equipment near the board.

Accessibility.—Switchboards shall be accessible to authorized operators from both sides when the connections are on the back. The space back of the board shall be kept clear of rubbish and shall not be used for storage. Clearance for working space in back of board should be in accordance with the rule for Guarding Live Parts and Table A but not less than four feet.

Arrangements.—Switchboards having no current carrying parts ("dead front" boards) shall be provided where practicable, particularly in theaters and similar places where rapid handling is necessary and attention must be given to signals.

Oil-filled Apparatus.—Where practicable, equipment containing oil and mounted on switchboards shall be separated from other kinds of equipment by non-inflammable barriers, or otherwise adequately isolated. Oil sills or other devices shall be provided to retain escaping oil. Whenever located on balconies this shall always be done. Drainage for escaping oil shall be provided where practicable.

Guarding.—(a) General: Switchboards operating at more than 300 volts to ground and located near passageways shall be protected by rails, barriers, or enclosures.

(b) Live parts on the front of the board: Where parts on the front of the board are not guarded or isolated by elevation and subjected to more than 300 and not more than 750 volts, the switchboard shall be provided with insulating mats, floors or platforms so arranged that the operator cannot inadvertently touch such live parts without standing upon the mats, floors or platforms. Switchboards accessible to unqualified persons shall have no live parts exceeding 150 volts to ground exposed within eight feet of the floor. Parts of 100 volts to 150 volts to ground should not be accessible to unqualified persons.

(c) Mats and platforms shall afford a non-slip and non-trip surface and shall conform to the standards for such guards.

OIL FILLED APPARATUS.

Oil Circuit Breakers.—When located on floors of buildings or in galleries, oil circuit breakers shall be separated from other apparatus by adequate non-inflammable barriers, or otherwise adequately isolated.

When located outdoors, they shall be adequately isolated.

Transformers; Induction Regulators.—When in buildings these shall preferably be located on lower floors or in basements. When this is not practicable, adequate provision shall be made to prevent leakage on other apparatus. When the apparatus contains large quantities of oil, each unit or group shall preferably be placed in a separate fireproof compartment suitably ventilated. Such large transformer tanks shall where practicable be so arranged that approved fire-quenching material may be introduced above the oil inside the tank or in the surrounding compartment except where tanks are completely filled with oil or where the space above the oil is filled with an inert gas.

Provision shall be made for quick and suitable drainage whether the apparatus is located in or outdoors.

Exception to these rules may be made where the transformer is equipped with dielectric cooling liquid which is non-inflammable and non-explosive.

When located outdoors the transformer shall be adequately isolated in outdoor enclosures so arranged that unauthorized persons cannot come in contact with any part of the casing or wiring.

Current Transformers, Secondary Circuits.—These, including constant-current and instrument transformers, shall be provided with means for short circuiting their secondaries ahead of all instruments or other devices so as to permit the removal of the latter without opening the secondary circuits.

ROTATING EQUIPMENT.

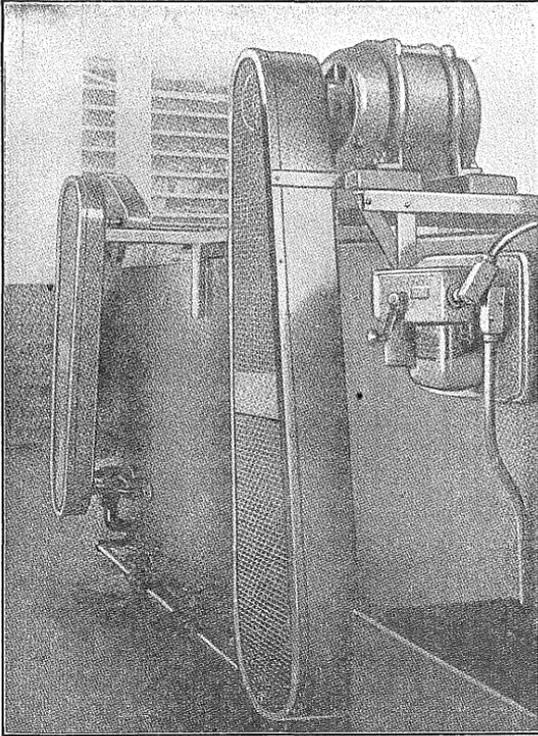
Speed Limiting Devices.—(a) Prime movers driving generating equipment shall be provided with automatic speed limiting devices, in addition to their governors.

(b) Machines of the following types shall be provided with speed limiting devices, unless their inherent characteristics, or the load and mechanical connection thereto, are such as to safely limit the speed, or unless the machine is always under the manual control of a qualified operator: (1) Separately excited direct current motors. (2) Series motors. (3) Motor generators and converters that can be driven at excessive speed from the direct-current end, as by a reversal of current or decrease in load.

Low Voltage Protection.—All motors so employed or arranged that an unexpected starting of the motor is a hazard, except those with an emergency use, and where the opening of the circuit may cause a special hazard, such as exciter or condenser pump motors, shall be equipped with low voltage protection which will automatically cause and maintain the interruption of the motor circuit, when the voltage falls below a certain operating value.

Motor-running protective devices consisting of circuit-breakers, controllers with over current units, thermal cutouts or other devices approved for

the purpose shall be required for each motor to protect the motor and motor branch-circuit conductors against operating overloads.



Individual Motor Drive With Approved Starting and Stopping Switch and All Wiring in Conduit.

STORAGE BATTERIES.

Rooms or enclosures containing storage batteries shall be so ventilated as to remove acid spray and prevent dangerous accumulation of inflammable gas. Passage of such gases to other rooms shall be prevented.

Switches and incandescent electric lamps in battery rooms shall be of the vapor proof type.

FUSES, CIRCUIT-BREAKERS, SWITCHES AND CONTROLLERS.

All switches, fuses, automatic circuit breakers, starting rheostat, and other control devices shall be so arranged or marked as to identify the equipment controlled by them.

Circuit breakers should be so located and shielded that persons will not be burned or injured by their operation.

Switches shall be so installed as to minimize the danger of accidental operation. Switches which may tend to close by gravity shall be provided with proper devices to prevent accidental closing.

Where practicable, the blades of knife switches shall be dead when the switches are open.

Fuses shall be so arranged that either: (a) They are disconnected from all sources of electrical energy before they can be touched. (b) They can be disconnected by a switch. (c) They can be conveniently handled by means of suitable insulated tools provided for that purpose.

ELECTRICAL WIRING.

Inside wiring shall be rigidly installed, protected from mechanical injury and have ample current-carrying capacity for its intended use. All wiring shall be effectively insulated and, where practicable, shall be enclosed in a conduit or equivalent construction. Conductors shall be protected against excessive heating by the design of the system, and by the installation of suitable fuses or automatic circuit breakers in all conductors except ground or neutral conductors.

Conduits shall be effectively grounded.

Oil switches and disconnectors should be so arranged that they can be secured in the open position or plainly tagged to prevent inadvertent closing while work is being done on equipment controlled by them.

ELECTRICAL APPLIANCES (PORTABLE TOOLS, EXTENSION LAMPS, ETC.)

Insulation.—Portable devices shall be provided with an adequate dielectric interposed between ungrounded current carrying parts and those external surfaces which persons can touch.

Grounding of Frames.—The grounding of frames of portable devices operating at over 60 volts to ground is recommended as a safety measure.

Voltage Limits.—Portable and pendant conductors shall not be installed or used on circuits operating at more than 300 volts to ground unless they are accessible only to qualified persons.

Hazardous Locations.—Where exposed to dampness or corrosive influences, portable conductors shall be of a type specially suited and where exposed to inflammable gas or dust particles, they shall be so protected or isolated by elevation that they cannot be readily damaged. Portable lamps in locations where explosives or inflammable gases are present shall be incased in vapor-proof globes with suitable mechanical guards.

Portable lamps in damp places shall be equipped with a socket of non-combustible, non-absorbent insulating material, an approved handle of non-absorbent insulating material, a basket guard, and approved cord.

Strain Relief.—Portable and pendent conductors shall be so installed that no strain is placed on the terminal connections and shall have no joints except at suitable fittings.

LINE WORK CLEARANCES.

Clearances on all line work shall comply with National Electrical Safety Code, published by the National Bureau of Standards, hand book H. 32, and sold by the Superintendent of Documents, Washington, D. C.

Illumination.

(From "Industrial Safety Standards" Issued by the National Conservation Bureau.)

The advantages of good illumination, both natural and artificial, and of bright and cheerful interior surroundings, include the reduction of accidents, greater accuracy in workmanship resulting in improved quality of goods, increased production, less eyestrain, greater cleanliness, more order and neatness in the plant, and easier employee supervision.

Minimum Levels of Illumination.

Illumination by daylight or artificial light shall be supplied for traversed spaces, such as hallways, roadways, etc., during working hours, and for work when attended by operators. Minimum levels of illumination, as listed in the following table, are required in all places of employment in Minnesota. Values greater than these minima shall be used when ordered by the Division of Accident Prevention.

ILLUMINATION ON TRAVERSED SPACES.

	Recommended Minimum Foot-Candles
Roadways, yard thoroughfares.....	2-1
Storage spaces, aisles and passageways in workrooms, excepting exits and passageways leading thereto.....	3-2
Spaces such as stairways, hallways, exits and passages leading thereto	5-3
Spaces such as locker rooms, wash rooms, toilet rooms, and passageways where there are exposed moving machines, hot pipes, or live electric parts.....	6-4

ILLUMINATION AT THE WORK.

Where discrimination of detail is not essential:	
Work such as handling material of a coarse nature, grinding clay products, rough sorting, coal and ash handling, foundry charging	5-3
Where slight discrimination of detail is essential:	
Work such as rough machining, rough assembling, rough bench work, rough forging, grain milling.....	10-5
Where moderate discrimination of detail is essential:	
Work such as machining, assembly work, bench work, fine core making in foundaries.....	30
Where close discrimination of detail is essential:	
Work such as fine lathe work, pattern making, tool making, weaving or sewing light-colored silk or woolen textiles, office work, accounting, typewriting.....	50
Where discrimination of minute detail is essential:	
Work such as drafting, weaving or sewing dark colored material, very fine inspection or inspection of very dark goods	100-25

The preceding table gives the range of minimum illumination values that are considered desirable for different classes of work. These values are based upon practice established through years of experience. Elderly persons or

persons with defective eyesight require more light than do those having perfect vision. A range of foot-candle values is given for each group of operations. In modern practice it will usually be found desirable to select values in or even beyond the upper portion of the range.

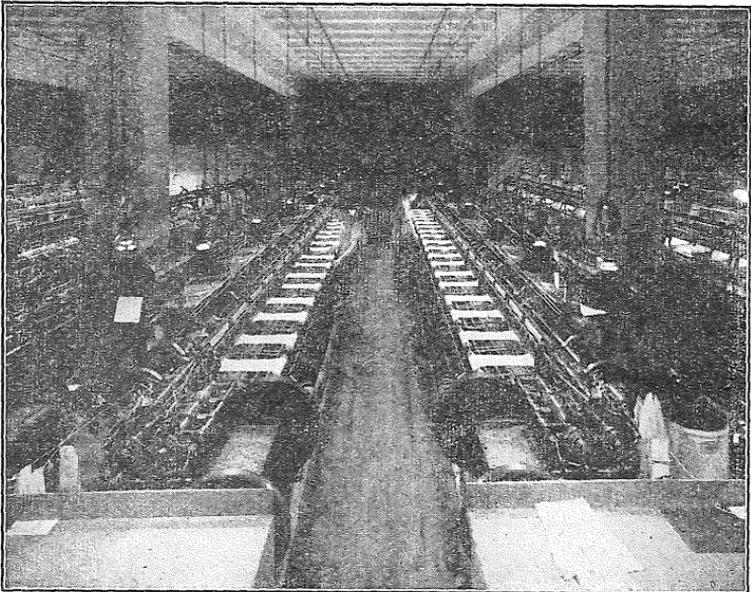
It is recognized that any specific process when carried on in different factories is performed with different degrees of fineness and with other variations, so that one factory may need more illumination than another for the same class of work. In the table, ranges of foot-candle values are given to correspond to the variations actually existing in practice. Attention is called to the fact that the values in the table are operating values, that is, they apply to measurements of the lighting system in ordinary use, not simply when the lamps and reflectors are new and clean.

DIFFUSION AND DISTRIBUTION OF LIGHT.

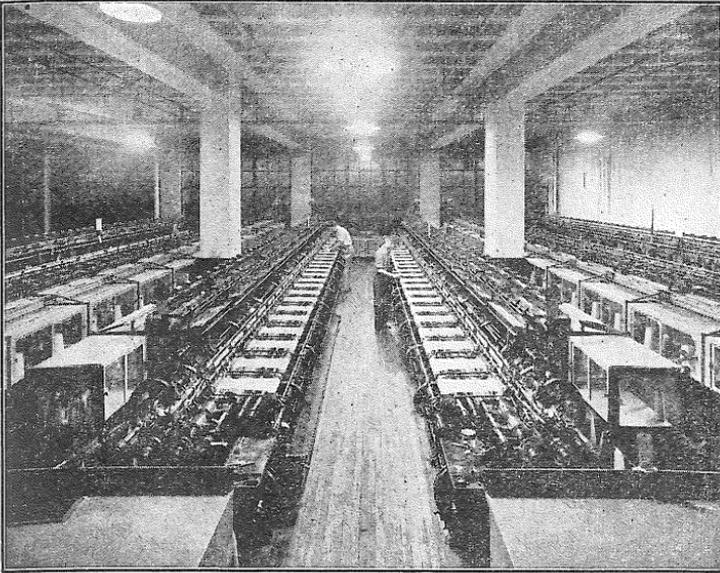
Lighting, whether natural or artificial, shall be such as to provide good distribution of light and to avoid glare and objectionable shadows and extreme contrasts. In artificial lighting, lamps shall be so installed in regard to their height, location and spacing and shall be so equipped with reflectors, shades or other suitable accessories as to accomplish these objects.

Bare light sources, such as exposed lamp filaments, located within the ordinary field of the worker's vision are presumptive evidence of glare.

The principal causes of glare are: (a) The light source may be too bright; that is, it may have too high a candlepower per square inch of area. (b) The light source may be too powerful for comfort; that is, it may have too great a total candlepower in the direction of the eye. (c) A given light source may be located at too short a distance from the eye or it may lie too near the center of the field of vision for comfort; that is, within too small an angle



Poorly Lighted Industrial Plant.



Same Plant Well Lighted.

from the ordinary line of sight. (d) The contrast between the light source and its darker surroundings may be too great. (e) The time of exposure may be too great; that is, the eye may be subjected to the strain caused by a light source of given strength within the field of vision for too long a time.

Glare from natural lighting may frequently be reduced by the use of refracting or diffusing glass in windows and skylights, and by the rearrangement of machines and benches so that operators are not required to face windows.

Exit and Emergency Lighting.

The lighting to be provided in all important stairways and all exits from work places and in the passageways related thereto shall be so supplied that it will not be subject to failure of the room or work-space lighting from internal causes. In artificial illumination, the service for exit and emergency lighting shall preferably be from an independent connection or connections extending back to the main service entrance. In cases of unusual danger which may exist on account of the type of building or nature of the work, crowded conditions, or lack of suitable exit space, an independent service shall be assured by connecting to a separate source of supply without or within the building. During the hours of occupancy when daylight is lacking, this separate source of supply shall be connected so as to function continuously or to come on automatically upon failure of the regular lighting service.

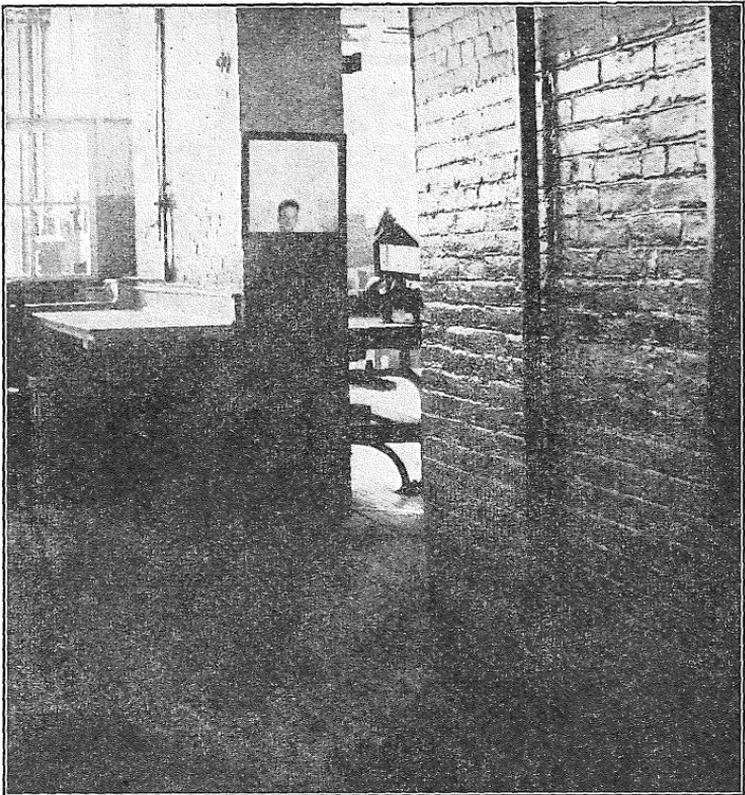
Maintaining the Level of Illumination.

The proper maintenance of equipment for both natural and artificial lighting is essential. Systems which are adequate when first installed will soon deteriorate unless properly maintained. For continued effectiveness and

economy in lighting, the factory owner shall establish a regular definite system of maintenance so that skylights, side windows, lamps and accessories are at all times kept clean, in proper adjustment and in good repair. Means for easy access to all lighting units shall be provided for employees in charge of their maintenance. Walls and ceilings shall be repainted at regular intervals and preferably in light tones. This is especially true where systems of indirect lighting are used.

Especially in connection with the maintenance of lighting systems, attention is called to the desirability of having available in the factory an instrument with which the foot-candles of illumination received at any point can be measured. One instrument, the foot-candle meter, while not designed for precise measurements, has a wide field of usefulness because, with a little practice, determinations are easily made and are accurate enough for most practical purposes. The foot-candle meter is small, light in weight and entirely self-contained. Illumination is read directly from the scale without computation or manipulation.

By measuring light actually delivered to the work, the foot-candle meter automatically reveals the combined effect of all possible causes of deterioration. Ignorance of the magnitude of deterioration has often been the cause of inadequate maintenance.



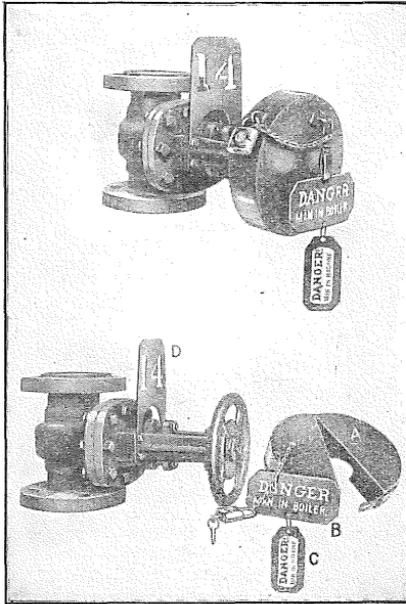
Blind Corner Mirror.

Steam Boilers, High-Pressure

Any steam boiler with a safety valve set to permit a pressure exceeding 15 pounds shall be considered a high-pressure steam boiler.

The requirements of this item shall not apply to: (a) Heating plants in buildings occupied solely for residence purposes, with accommodations therein not to exceed four families. (b) To railroad locomotives, nor to railroad locomotive engineers employed by railroad companies.

Safety Valves.—Safety valves shall not discharge within 7 feet of floor, platform, ground, or boiler top, across a passageway or foot-walk or in such



Boiler Valve Lock.

a way as to endanger persons operating stop valves. The arrangement of piping must not be such as to create a back pressure on the safety valve.

Boiler Blow-Offs.—Open blow-offs shall not discharge within 7 feet of floor, platform, or ground, across a passageway.

Exits from Boiler Room.—Safe exit from all parts of boiler room shall be provided by at least two stairways, ladders permanently fastened in place, or other means of exit.

Boiler Valve Locks.—An effective valve locking device is one which will prevent any motion of the valve stem, and which is so attached to the valve that it cannot be removed.

When two or more boilers are connected to a common steam, feed-water, or blow-off line, at least one controlling valve in the connection from each boiler to each such common steam, feed-water, or blow-off line shall be equipped with an effective valve locking device; and whenever a person is

working in any boiler of a battery, the steam, feed-water, and blow-off valves shall be closed and locked.

Non-Return Valves.—A non-return valve is one which will automatically close and prevent steam from the main line from flowing back into the boiler if the pressure in the latter should fall below that in the steam line.

Where two or more boilers are connected to one steam line, a non-return valve shall be provided in the main steam connection of each boiler, either in addition to or combined with the regular stop valve.

Engines.

The term "engine" shall include steam, gas, oil, air, and pumping engines, steam turbines, and engine-type air and ammonia compressors, excepting such equipment as locomotive cranes, pile drivers, steam shovels, and portable hoisting engines and concrete mixers.

Engine Fly-Wheels.—The term "fly-wheels" shall include fly-wheels, balance-wheels, and pulleys, which are mounted on and revolve with the crankshaft of the engine and which are more than 30 inches in diameter. Gears mounted on the engine crankshaft and driving transmission equipment shall be considered as part of the transmission equipment. Fly-wheels shall be guarded as follows:

(1) If the guard is less than 6" from the rim, or less than 15" from spokes or other dangerous projections, it shall conform to the requirements of Item 3 and shall extend from the floor to a height of 5 feet, except that if the top of the wheel is less than 5 feet above the floor the guard need not extend above the wheel. In no case, however, shall the guard be less than 42" high unless it extends across the top of the wheel.

(2) If the guard is at least 15 inches from spokes or other dangerous projections, and is not less than 6 inches nor more than 20 inches from the side or face of the rim, a standard railing may be used. A standard toe-board shall also be provided if the wheel extends into a pit or is within 2" of the floor.

(3) No door or gate shall be permitted in the guard, except that on gas or oil engines a portion of the guard may be removable, so as to provide room for safely starting the engine. Where the use of a jack bar is necessary, a slot opening in the guard will be permitted.

Engine Governors.—The requirements of this section shall not apply where automatic control of speed is not essential to safety, as in the case of reversing engines without fly-wheels, or an engine connected by a shaft, coupling, or gears to a constant load, such as a blower, a centrifugal machine, or a hydro-extractor.

Each engine shall be equipped with a governor which will automatically and effectively control the speed of the engine when the load changes.

Engine Parts.—The moving parts which shall be considered dangerous are cranks, connecting-rods, cross-heads, tail-rods, governor balls, gears, contact point of governor belt and pulley, and exposed ends of engine shaft, except that gears mounted on the engine crankshaft and driving transmis-

sion equipment shall be considered transmission equipment rather than engine parts.

(1) Cranks, connecting-rods, and cross-heads shall be guarded as follows:

(a) If the engine has an overhanging crank, a standard railing as prescribed by the code relating to "Railings, Toe-boards and Guards" shall be placed not less than 15" nor more than 20" from the moving parts.

Note.—Where the outline of the parts to be guarded is such that the railing cannot be kept at least 15 inches distant from all parts without being more than 20 inches from some of them, it shall be covered with wire mesh work, sheet metal, or other material meeting the requirements of the code relating to guards at all points within 15 inches of moving parts.

(b) If the engine is of the center crank type, a metal guard complying with the requirements shall be provided to protect the sides and path of the crank.

(c) If the crank or cross-head is completely housed, an opening large enough to permit examination of the bearings shall be provided, except in the case of an engine with a splash oiling system.

(2) Tail-rods shall be enclosed with sheet metal, wire mesh work or other suitable material meeting the requirements of the code relating to guards in such a way as to prevent accidental contact with the moving end, or else shall be guarded by a standard railing placed not less than 15" nor more than 20" away from any part of the path of travel.

(3) Governor pulleys so located that any person, in performing his regular duties, may come in contact with them, shall be guarded by means of a solid metal plate, placed not less than 1" nor more than 2" from the pulley and having a diameter at least 4 inches greater than that of the pulley. The plate shall be rigidly supported and shall be so arranged as not to interfere with inspection, oiling, or operation of any part of the equipment.

(4) Fly-ball governors so located that any person, in performing his regular duties, may come in contact with them, shall be surrounded by a substantial guard or basket of sheet metal, wire mesh work, or other suitable material meeting the requirements of the code relating to guards, so arranged as to prevent accidental contact with the rotating balls.

Machine Hazards.

The requirements of this item shall not apply to machines in storage or out of position with reference to driving equipment, nor to machines driven by hand or foot, nor to electric or pneumatic portable tools which are carried from place to place by an employe as needed, such as circular and vertical knife cloth cutters, small grinding wheels or buffers mounted directly on the shaft of the motor, riveters, hammers, and drills. Power driven machines are classified as follows:

Blowers, whether exhaust or pressure.	Agitators.
Elevator machines.	Beaters.
Hoisting engines (type not counted under engines).	Mixers.
Bucket or belt conveyors.	Power or hand operated derricks (type where there are gears).
Pumps driven by belts, gears, chains, or similar devices.	Jib cranes (hand and power; type where there are gears).

Revolving kilns or cookers.	separators, etc.
Generators (not direct connected).	Stationary machines operated by hydraulic power, valve controlled, such as bulldozers, draw benches, presses, etc.
Abrasive wheels.	
Bottling machines (power driven only).	Stationary machines operated by air, valve controlled, including only hammers and riveters.
Dry rooms with power attachments (as in laundries).	
Stationary machines operated by steam, such as hammers, cream	Open hearth charging machines.

Stopping and Starting Devices.—The requirements of this item shall not apply to machines driven by belts which are not more than 1" in width or ½" in diameter and which do not travel faster than 1,200 feet per minute. Neither shall they apply to individual machines in a group which comprise one operating unit and which are so inter-related that the starting or stopping of any one machine would interfere with the operations or process, such as certain equipment in canneries, flour mills, grist mills, paper mills, stone crushing, brick manufacturing, and cement manufacturing.

All machines except grindstones, blowers, dynamos, and continuously running pumps shall be provided with an effective starting and stopping device, such as an individual belt shifter, clutch, switch, or valve, which will serve to completely disconnect the machine from the source of power.

Moving Parts.—When machine parts (other than gears, sprockets, set screws, and similar projections) are so located with reference to other equipment or machines or to parts of buildings that they are guarded just as effectively as they would be by a standard guard, no further guard is required. Guards other than standard railings shall comply with the requirements of the code relating to guards. Balconies or runways on machines are considered working platforms in applying the requirements of this item.

(1) Gears and sprockets which are not completely encased by the housing of the machine shall be completely enclosed or shall be guarded by a band extending around the face, with side flanges extending inward beyond roots of teeth. Friction drives shall be completely enclosed.

(2) Belts and pulleys within 6 feet of floor or platform level shall be guarded unless protected by the housing of the machine. The requirements as to height of guards shall be the same as provided for transmission belts.

(3) Wheels, shafting, spindles, counterweights, revolving and reciprocating parts, and other similar parts which are within 6 feet of floor or platform level (excluding those parts covered under the heading of "Points of Operation"), shall be completely enclosed or effectively guarded.

(a) If guards are within 4" of moving parts they shall be at least 6 feet in height.

(b) If guards are 4" or more from moving parts they shall be at least 5 feet in height.

(4) Clutches, couplings, set screws, bolts, keys, oil cups and similar projections, unless enclosed by the housing of the machine, shall be guarded to comply with the requirements for projections on revolving shafts.

Points of Operation.

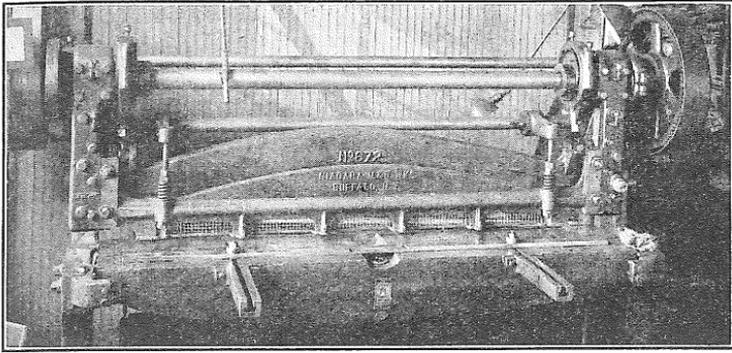
The "point of operation" of a machine shall mean that part of the machine where stock is actually inserted and maintained during any process of forming, shaping, or other necessary operation.

Guards shall be provided at the points of operation of various machines as follows:

TEXTILE.

Body Ironer.—A guard which will stop the rolls when the hands of the operator strike the rod while feeding the rolls shall be placed between the hot rolls and clothed roll.

Cards.—Cylinder door, or cover for licker in roll, shall be provided with an interlocking device so arranged that the cover cannot be opened while the machine is running.



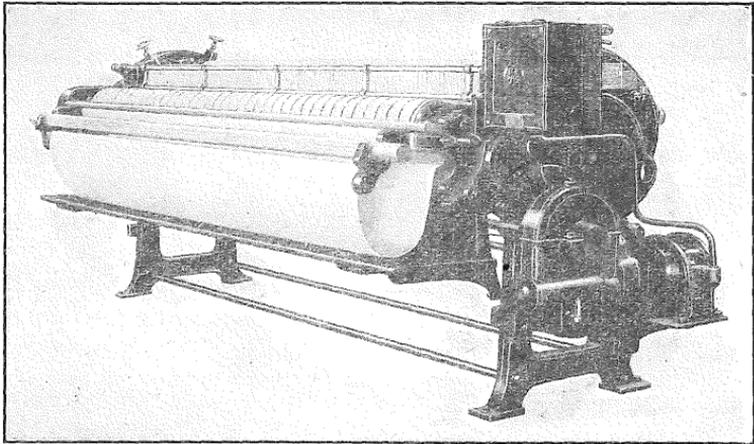
Power Shears Guarded.

Flat Work Ironers (All Types).—The feed rolls shall be provided either with a bar across the front, so arranged that the striking of the bar by the hand of the operator will stop the machine, or with a fixed rod which will prevent the hands from entering the rolls. Feed rolls shall be covered or guarded so that a person cannot reach into them. This can be either a fence on the sides or a complete cover, depending upon the type of ironer.

Moire Machine, Roll Type.—Rolls shall be provided with a cover or guard, so arranged that the material can be fed without permitting the fingers of the operator to be caught by the rolls.

Sewing Machine.—A wire or stamped metal form of such a shape and so placed that the operator's fingers can not pass under the needle shall be attached to the pressure foot of the machine. It shall be of such a form that the operator can see the work at all times, and that needle can be threaded conveniently without removing the guard. It shall be so fastened to the foot that the operator cannot remove it.

Shearing.—Rolls shall be provided with a cover or guard, so arranged that the material can be fed without permitting the fingers of the operator to be caught by the rolls.



Finger Guard on Flat Work Ironer.

File Cutting; Ribbon Finishing; Openers; Pickers; Willowing.—The beater cover shall be provided with an interlocking device, so arranged that the cover cannot be opened while the machine is running. The hopper shall be so located that the attendant cannot come in contact with the picker roll.

FOOD AND BEVERAGE.

Bottling Machine, Pressure.—A barrier, such as wire mesh or screen, shall be so arranged on the machine that broken glass cannot fly and strike the operator.

Dough Brake.—Rolls shall be so enclosed that it will not be possible for the operator's hands to come in contact with them when feeding the machine.

Cake Mixer; Dough Mixer.—The cover shall be provided with an interlocking device, so arranged that power cannot be applied to the blades unless the cover is in place on the mixer.

Meat Chopper; Meat Grinder.—The hopper shall be of such size and arrangement that a hand cannot come in contact with the cutting or feeding knives or worm.

PAPER AND PRINTING.

Corner Stayer.—The machine shall be provided with an automatic device which will instantly stop the downward motion of the plunger if the finger of the operator should come between the plunger and the anvil. This device may be built into the machine or may be a separate attachment.

Corner Cutter; Creaser (Scorer).—The machine shall be provided with a guard which will make it impossible to place a finger underneath the knife while feeding stock, and this guard shall be kept in adjustment while the machine is in operation.

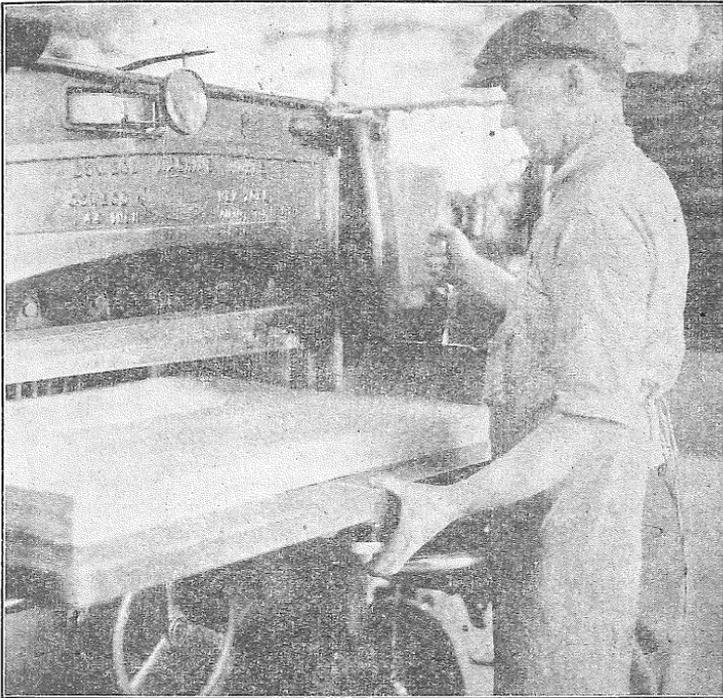
Platen Job Press.—(1) A mechanically operated guard, gate, or sweep motion, which will throw the hands out of the way as the press closes. (2) An automatic feed which does not require the operator's hands to be placed

between platen or bed and type. (3) An automatic stop which will prevent the platen or bed from closing if the hand is caught between it and the type.

Paper Cutter, Hand.—A rod or plate shall be so arranged on the feeding side that the hand feeding the paper cannot reach the cutting edge while holding the paper in place and feeding it.

Paper Cutter, Power (Guillotine).—A starting device which requires the use of both hands shall be combined with a non-repeat device which will prevent a second stroke of the knife. This may be either a latch or a specially constructed clutch.

Drum Winders on Paper Machines.—The machine shall be so arranged that the drums run outward, or else a cover or guard shall be provided for the point of contact of drum and paper roll, where they run in on the operating side.



Two-Hand Trip Device for Guillotine Paper Cutter.

Winding Reels on Paper Machines.—Unless the machine is so constructed that the reels run in opposite directions or that there is at least 8" of space between the rolls of paper when they reach the maximum size, a guard shall be provided for the reels where the rolls of paper run in. A permanent stop, placed below the bottom reel and above the top wheel to limit the space between the reels, shall be considered a sufficient safeguard.

Paper Slitter.—The machine shall be provided with an approved guard which will make it impossible for a finger to come in contact with the cutting edges while the machine is in operation.

WOOD AND CORK WORKING AND SAWS.

Band Knife.—The upper and lower wheels and all portions of the blade except that between the sliding guide and the table shall be enclosed or guarded.

Cork Board Cutter; Cork Slicing Machine.—A guard shall be placed over the cutters in such a way that the hand cannot come in contact with the cutters.

Gang Ripper.—An effective hood, substantially secured, shall be so placed as to guard the saws.

Jointer.—The machine shall have a cylindrical cutting head, and shall also be provided either with an apron guard or with a guarded automatic feed and a permanent hood which covers the cutting parts.

Matcher; Molder; Mortise Machine; Panel Raiser; Planer; Pulley Pocket Machine; Router; Sticker; Tenoning.—Cutting heads shall be protected by an efficient guard, such as an exhaust hood. Cutters projecting from ends of shaft running substantially in vertical position shall be guarded with a cage or adjustable cover, so designed as to keep the hand away from the cutting edges. Rolls shall be provided with a cover or guard, so arranged that material can be fed without permitting the fingers of the operator to be caught.

Roll Feed Drum Sander.—The rolls shall be provided with a guard or cover, so arranged that the operator cannot be caught in the rolls while feeding the machine.

Circular Saws, Circular Resaws.—The machine shall be provided with an effective hood or guard which will cover the saw and permit a view of the saw blade while it is in use. The guard shall be rigidly supported and so attached that it would be difficult to entirely remove it. When roller feed is used, a standard feed roll guard shall be provided. Each circular saw (other than swing or cut-off saws), unless mechanically fed, shall be equipped with a splitter or riving knife back of the blade.

Circular Rip Saws (Manual Feed).—Each circular rip saw shall be guarded by a hood which will cover the saw at all times to at least the depth of the teeth. The hood shall adjust itself automatically to the thickness of, and shall remain in contact with, the material being cut. The hood shall also be so constructed as to protect the operator from flying splinters and broken saw teeth. Each saw shall be equipped with a spreader, splitter or riving knife. It shall also be equipped with a non-kickback device which will prevent material being thrown back on the operator.

Circular Cross-Cut Saw and Circular Knives (Manual Feed).—Each circular cross cut saw or circular knife shall be guarded by a hood which will cover the saw or knife at all times to at least the depth of the teeth or cutting edge. The hood shall adjust itself automatically to the thickness of, and shall remain in contact with, the material being cut. The hood shall also be so constructed as to protect the operator from flying splinters and broken saw teeth.

All circular table saws or any saw exposed under the table shall be guarded to the fullest extent practicable.

Jig Saw (Scroll Saw).—The cross head shall be guarded and the crank shaft shall be enclosed.

Band Saw; Band Resaw.—The upper and lower wheels and all portions of the blade except that between the sliding guide and table shall be enclosed or guarded. Feed rolls shall be guarded to standard.

Swing Saw.—A hood which will cover at least one-half of the saw disc shall be provided. A chain or other effective emergency stop which will prevent the saw from swinging beyond the front edge of the table shall also be provided.

Shoe Last Machine; Spoke Lathe.—A hood or a shield shall be arranged so as to prevent chips from flying in the face of the operator.

Variety Machine (Shaper).—Cutters projecting from ends of shaft running substantially in vertical position shall be guarded with a cage or adjustable cover, so designed as to keep the hand away from the cutting edges.

MISCELLANEOUS MACHINES IN VARIOUS INDUSTRIES.

Abrasive Wheels.—The term “abrasive wheels” shall mean only wheels of mineral composition, not including grindstones or wheels of metal, wood, leather or cloth with abrasive surfaces.

Retaining Hood.—All abrasive wheels which are 6” or more in diameter shall be provided with substantial retaining hoods. Such hoods shall be of sufficient strength to retain fragments if the wheel should burst, and shall be constructed as follows:

- (a) They shall be adjustable to the wear of the wheel.
- (b) The maximum exposure of the wheel periphery or circumference on bench or floor stands shall not exceed 90 degrees.
- (c) The upper point of opening in the retaining hood facing the operator shall not be less than 30 degrees from a vertical line drawn through the spindle center.
- (d) The maximum exposure of the wheel periphery or circumference for retaining hoods on swing frame grinding machines shall not exceed 180 degrees, and the top half of the wheel shall be protected at all times.

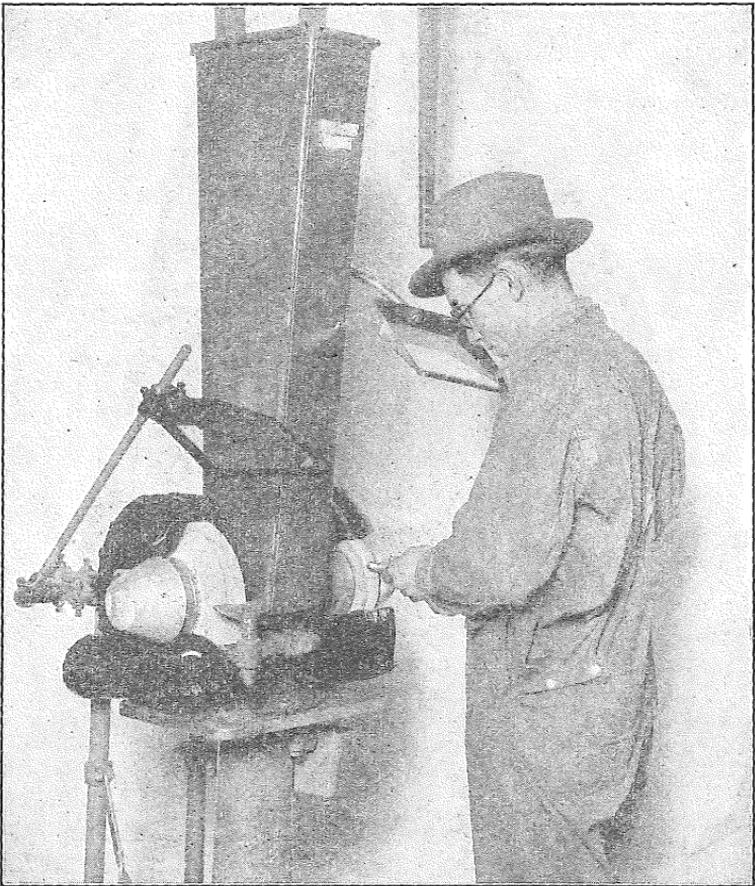
Safety Flanges.—Safety flanges shall be of the following dimensions:

Diameter of Wheel Inches	Minimum Outside Diameter of Flanges Inches	Radial Width of Bearing Surface		Minimum Thickness of Flange at Bore Inches
		Minimum Inches	Maximum Inches	
6.....	3	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{8}$
8.....	4	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{3}{8}$
10.....	5	$\frac{1}{2}$	1	$\frac{1}{2}$
12.....	6	$\frac{1}{2}$	1	$\frac{5}{8}$
14.....	8	$\frac{5}{8}$	$1\frac{1}{4}$	$\frac{5}{8}$
16.....	10	$\frac{3}{4}$	$1\frac{1}{2}$	$\frac{5}{8}$
18.....	12	1	2	$\frac{3}{4}$
20.....	14	$1\frac{1}{4}$	$2\frac{1}{2}$	$\frac{3}{4}$
22.....	16	$1\frac{3}{8}$	$2\frac{3}{4}$	$\frac{3}{4}$
24.....	18	$1\frac{1}{2}$	3	$\frac{3}{4}$
26.....	20	$1\frac{1}{2}$	$3\frac{1}{4}$	$\frac{3}{4}$
28.....	22	$1\frac{3}{4}$	$3\frac{3}{4}$	$\frac{7}{8}$
30.....	24	2	4	$\frac{7}{8}$
36.....	28	2	4	1

Calendar, Mixing, or Other Rolls.—(1) **Paper Industry:** Each calendar shall be provided with a guard or feed device, so arranged that the material can be fed without permitting the fingers of the operator to be caught by the rolls. The device shall be so arranged that operator can immediately stop the rolls at the feed point by the use of a lever, rod, or treadle, or the rolls shall be equipped with an automatic device which will stop them when the fingers approach the intake points. Doctor feed shall be considered as meeting this requirement.

(2) **Sheet Material:** All rolls or calendars shall be provided with a guard or feeding device, so arranged that the material can be fed without permitting the fingers of the operator to be caught by the rolls.

(3) **Plastic Material (such as rubber, celluloid, chocolate, etc.):** Each machine having calendar or mixing rolls shall be provided with a foot treadle, stop-cord or lever by means of which the machine can be instantly stopped. This device shall extend the full width of the rolls and shall be located in front of the machine, in such a position that the operator can readily reach it in case he should be caught while tending the machine.



Well-Guarded Grinding Stand.

Corrugating, Crimping, Embossing, Printing, and Graining Rolls.—Rolls shall be completely covered with a guard provided with a slot, so arranged that the material can be fed to the rolls without permitting the fingers of the operator to come in contact with the roll.

Extractor.—A cover for the revolving drum shall be so arranged that the cover must be closed at all times while the drum is in motion.

Perforating Machine.—The machine shall be provided with a device which will prevent the fingers from coming between the punch and the die.

Rubber Band Chopper.—The machine shall be provided with a device of sheet metal or mesh work which will prevent the fingers from coming between the shearing edges.

Shears, Power (Not Alligator); Shears, Foot (Not Alligator).—The machine shall be provided with a device which will prevent the hand of the operator from being between the knives of the shears while they are in motion. This may be either a fixed barrier, a gate, or a sweep motion rod.

Tumblers (Horizontal Type Only).—A device shall be so arranged in connection with the opening in the tumbling barrel and the driving mechanism as to prevent the barrel from moving while the door is open. The barrel shall be enclosed or guarded to prevent contact with an employee.

Washer.—Requirements same as those for tumbling barrels.

Wire Drawing Machine, Block Guard.—A stopping device shall be so arranged that it will automatically shut down the block in case the operator should be caught on the block and carried around it.

Wire Drawing Machine, Reel Guard.—A stopping device shall be so arranged that it will automatically shut down the block in case the operator should be caught in the wire as it runs from the reel, and in case the reel should be drawn up to the frame.

PUNCHING, STAMPING, DRAWING, AND TRIMMING PRESSES AND DROP HAMMERS ON COLD WORK.

Power Presses.—The term “power presses” shall mean power-driven machines fitted with plungers and dies, for the purpose of cold blanking, trimming, drawing, punching, or stamping material. The requirements of this item shall apply to power-driven drop presses or drop hammers working on cold material, but shall not apply to hydraulic presses, plate shears, plate punches, bulldozers, and hot metal presses and hammers.

Foot and Hand Presses.—The term “foot and hand presses” shall mean machines actuated by foot or hand power only, and fitted with plungers and dies for the purpose of cold blanking, trimming, drawing, punching, or stamping material. The requirements of this item shall also apply to drop hammers, operated by a rope or belt passing over a power-driven shaft or pulley, where the manual effort of the operator in lifting the hammer or weight is supplemented by the power of the shaft.

Fully Guarded.—A press shall be considered “fully guarded” if it meets any one of the following requirements:

(a) **Plunger Enclosure:** A fixed guard or enclosure shall be provided around the bottom position of the plunger, so arranged that a finger cannot go under the plunger while feeding the stock.

(b) Limited Plunger Travel: The machine shall be so arranged that the maximum distance traveled by the plunger is not more than $\frac{3}{8}$ ".

(c) Automatic Feed: The machine shall be provided with a feed of such a character that the services of an operator are not required, except at intervals to restock the feeding device or magazine.

(d) Guarded Semi-Automatic or Mechanical Feed: A guard, enclosure, or barrier shall be provided in front of the plunger, and the machine shall also be provided with an arrangement such as dial feed, slide feed, push feed, rotating feed, or other similar arrangement actuated by, or attached to the machine, by means of which the stock is fed under the plunger, making it unnecessary for the operator to place the parts under the plunger.

Partially Guarded.—A press shall be considered "partially guarded" if it meets any one of the following requirements:

(e) Arm-Operated Device: The machine shall be provided with a device manipulated by the operator's arm in feeding the press, and so arranged as to prevent the operation of the clutch mechanism while the hand is placing or removing the stock.

(f) Gate Guard: A guard or gate which closes automatically before the power stroke can be taken shall be provided in front of the plunger.

(g) Unguarded Semi-Automatic Feed: The machine shall be provided with an arrangement such as dial feed, slide feed, push feed, rotating feed, or other similar arrangement actuated by or attached to the machine by means of which the stock is fed under the plunger, making it unnecessary for the operator to place the parts under the plunger.

(h) Sweep Guard: The machine shall be provided with a positive "sweep motion," mechanically operated, which will throw the hands out of the way as the plunger descends.

(i) Two-Handed Operation: The machine shall be arranged for "two-handed" operation; that is, the hands shall be used instead of the feet to trip the press, and the simultaneous action of both hands shall be required.

Non-Repeat Device.—The term "non-repeat device" shall mean a device which disconnects the treadle or other tripping device from the operating mechanism after each stroke and prevents a second stroke of the press until the treadle or other tripping device is released.

Power Transmission Equipment.

The term "transmission equipment" shall include all mechanical means of transmitting power from a prime mover to one or more machines, except as noted below. Any belt, chain, or similar device which drives only one machine and which runs to a shaft supported by bearings attached to or forming an integral part of a machine shall be considered a part of the machine, except where it passes through floors or rooms other than the one in which the machine is located, in which case the part not in the room with the machine shall be considered transmission equipment. Belts, gears, chains, shafting, or similar devices which transmit power to more than one machine shall be considered as transmission equipment.

Gears which are mounted on an engine crankshaft and which drive transmission equipment shall be considered as part of the transmission equipment.

Any clutch by which transmission shafting is directly connected to a machine with no intervening belts, chains, gears, or similar devices shall be considered as transmission equipment if it has dangerous projections which continue to revolve when the machine is stopped.

Where transmission equipment (other than gears, sprockets, friction drives, set screws, keys, bolts, and similar projections) is so located with reference to other equipment or to parts of buildings that it is guarded just as effectively as it would be by a standard transmission guard, no further guard shall be required.

Transmission equipment which is within 18" horizontally from the vertical plane of the edges of any balcony or working platform (other than oiling runways) shall be subject to the same requirements as if they were directly over such balconies or platforms.

Note.—See requirements as to construction of guards, enclosures, or casings.

Gears, Friction Drives, Sprockets. — (1) All gears and friction drives, wherever located, shall be completely encased or shall be guarded by a band extending around the face, with side flanges extending inward beyond roots of teeth. Where there is a spoke hazard, gears shall be enclosed on the exposed side. No guard shall be required, however, on adjusting gears which do not normally revolve.

(2) All sprockets, wherever located, shall be completely encased.

Clutches.—Dangerous projections within 7 feet of floor on all clutches shall be completely encased.

Vertical and Inclined Belts, Chains and Ropes.—Wherever belts are referred to in the following sub-items, the same requirement shall apply to chains and ropes used for transmitting power.

(1) All vertical or inclined belts within 6 feet of floor or platform level, and all pulleys within 7 feet of floor or platform level, shall be completely enclosed or effectively guarded. Guards other than standard railings shall comply with the requirements of the code relating to guards.

(2) If the guard is within 4" of belt or pulley it shall extend from floor or platform level to a height of at least 6 feet, except as follows:

(a) If the belt comes up through the floor and the top of the pulley is more than 5 feet but less than 6 feet above the floor, the guard need not extend above the top of the pulley. If the top of the pulley is not more than 5 feet above the floor, the guard need not extend above a point midway between the top of the pulley and a height of 5 feet, except that in no case shall it extend less than 42" above the floor unless it covers the top as well as all sides of the belt and pulley, in which case there shall be no requirement as to height.

(b) If any part of a pulley is more than 6 feet and less than 7 feet above the floor, the guard shall extend to a height of 7 feet above the floor or to the top of the pulley. If it is an overhead belt, the guard may be a basket or box, suspended from above and extending across the bottom of the pulley and all around it to its top or to a height of 7 feet.

(3) If the guard is within 15" but not within 4" of belt and pulley, it shall extend from floor or platform level to a height of at least 5 feet, except as follows:

(a) If the belt comes up through the floor and the top of the pulley is not more than 5 feet above the floor, the guard need not extend above a point midway between the top of the pulley and a height of 5 feet, except that in no case shall it extend less than 42" above the floor unless it covers the top as well as all sides of the belt and pulley, in which case there shall be no requirement as to height.

(b) If any part of a pulley is more than 5 feet and less than 7 feet above the floor, the guard shall extend to a height of 7 feet above the floor or to the top of the pulley. If it is an overhead belt, the guard may be a basket or box, suspended from above and extending across the bottom of the pulley and all around it to its top or to a height of 7 feet.

(4) Where no pulley hazard is involved, a standard railing placed not less than 15" nor more than 20" from the belt (measured horizontally from the top of the railing) shall be considered a sufficient guard.

Note.—The railing may be placed more than 20 inches from the lower run of an inclined belt if this is necessary to comply with the requirement of sub-item (5) following.

(5) If the belt is inclined, the height of the guard or the distance of the guard or railing from the belt shall be such that the vertical clearance between the floor and the lower run of the belt at any point outside of the guard or railing shall not be less than 6' 6".

Horizontal Belts, Chains, and Ropes.—Wherever belts are referred to in the following sub-items the same requirements shall apply to chains and ropes used for transmitting power.

(1) All horizontal belts within 7 feet of floor or platform level shall be completely enclosed or effectively guarded. Guards shall comply with the requirements of the code relating to guards.

(2) Where both runs of the belt are within 6 feet of floor or platform level, the guard shall extend at least 15" above the upper run or to a height of at least 6 feet from the floor. In no case shall the guard extend less than 42" above the floor, however, except that if it covers the top as well as all sides of the belt and pulley there shall be no requirement as to height.

(3) Where the upper run of the belt is more than 7 feet above floor or platform level and the lower run is within 6 feet of the floor, the pulleys shall be guarded on sides and outer face to a height of 7 feet, and the belt guard between the two pulleys shall extend at least 15" above the lower run or to a height of at least 6 feet from the floor. Unless the guards extend across the inner face of each pulley to a height of 7 feet, the guard for the lower run of the belt shall be carried to the same height as the pulley guards at all points within 15" horizontally from the rim of either pulley.

(4) If both runs of the belt are 6 feet or more above floor or platform level, the lower run shall be guarded on sides and bottom to a height of 7 feet or at least to the height of the upper run.

(5) Where pulleys are so located and of such dimensions as to permit passage between the upper and lower runs of the belt, the space between the pulleys shall be completely barred or shall be provided with a passageway substantially guarded on sides and top.

Transmission Shafting.—(1) Vertical and inclined shafts shall be encased to a height of at least 6 feet above floor or platform level.

(2) Horizontal shafts within 6 feet of floor or platform shall be completely encased.

(3) Shafting under bench machines shall either be completely encased or shall be provided on exposed sides with a guard which extends from the under side of bench top to the level of the bottom of the shaft, and which is not within 6 inches of the shaft.

(4) Guards shall comply with the requirements of the code relating to guards. Cardboard tubes shall not be considered sufficient protection.

Shaft Ends.—Any exposed shaft end which projects more than 2" beyond bearing or hub and which is within 6 feet of floor or platform shall either be cut off or shall be guarded by a safety sleeve.

Projections on Revolving Shafts.—(1) The following shall be considered dangerous projections, regardless of location:

(a) Set screws, keys, bolts, oil cups, or similar projections, if not within the plane of the rim of a pulley;

(b) Couplings containing protruding bolts or nuts;

(c) Broken pulleys and similar revolving parts;

(d) Gears, pinions, or sprockets on transmission shafting, which are not meshing with other gears or carrying a chain.

(2) Pulleys which are not carrying belts and which have spokes or other projections, even if these are within the plane of the rim of the pulley, shall be considered dangerous projections when within 6 feet of floor or platform level.

(3) All projecting keys in revolving shafts shall either be made flush or shall be guarded by cylindrical safety sleeves or by stationary enclosures.

(4) All revolving objects which project beyond the plane of the rim of a pulley, gear, or wheel shall be guarded by cylindrical safety sleeves, by metal discs, or by stationary enclosures.

(5) All revolving set screws exposed to contact shall either be made flush or shall be counter-sunk beneath the surface of the part into which they are inserted.

Note.—Winding the shaft with tape or a leather band at the side of projecting set screws or keys shall not be considered sufficient protection.

Belt Shifters.—Each set of tight and loose pulleys shall be provided with a permanent mechanical device by means of which the belt may be shifted from one pulley to the other without touching the belt with the hand.

Traveling Cranes.

Foot-Walk.—The requirements of this item shall not apply to cranes having manually operated travel and hoist, nor to I-beam or monorail hoists.

(1) A foot-walk shall be provided along the entire length of the bridge, preferably on the motor side. This walk shall be at least 5 feet, and preferably 6 feet 6 inches, below the bottom of any overhead obstruction under which the crane passes, such as the roof trusses, and shall be at least 18

inches in width, except where it passes the motor, at which point it may be reduced to 15 inches.

(2) Foot-walks shall be of substantial construction and rigidly braced.

(3) Standard railings and toe-boards shall be provided.

Access to Foot-Walk.—The requirements of this item shall not apply to cranes operated by lever or other means from the floor, nor to cranes having manually operated travel and hoist, nor to I-beam or monorail hoists.

Safe and easy access from crane cabs to bridge foot-walks shall be provided by means of stairways or ladders permanently fastened in place. Stairways shall have standard hand-rails.

Access to Crane Cab.—The requirements of this item shall apply only to cranes upon which the operator rides.

Safe and easy access from floor to crane cab shall be provided by means of stairways or ladders permanently fastened in place, and the opening between the stairway or ladder and the cab shall not exceed 18 inches. Stairways shall have standard hand-rails. Ladders shall extend at least 4 feet above the floor of the crane cab.

Warning Signal.—The requirements of this item shall not apply to cranes having manually operated travel and hoist.

A foot or hand operated gong, or some other effective warning signal, shall be provided in a location convenient to the operator.

Crane Cabs.—The requirements of this item shall apply only to cranes on which the operator rides.

Crane cabs shall be provided with railings or enclosures on all sides. These must be at least the equivalent of standard railings with toe-boards.

Crane Bumpers.—Bumpers extending above the rail to a height at least equal to one-third of the diameter of the truck wheel shall be provided at each end of each rail of the crane runway. It is recommended that these bumpers be fastened to the girders rather than to the rails.

Trolley Pan.—The requirements of this item shall apply only to cranes having a trolley truck.

Crane trolleys shall be provided with a solid floor or pan, extending under the entire trolley. The cable opening shall be just large enough not to chafe the cable at either end of its travel.

Fenders.—The requirements of this item shall not apply to cranes having manually operated travel and hoist, nor to I-beam or monorail hoists.

Fenders which will push or raise a hand, arm, or leg out of danger shall be provided in front of all bridge truck wheels. They shall be attached to the bridge frame and shall extend below the top of the rail.

Safety Switches.—The requirements of this item shall not apply to cranes having manually operated travel and hoist, nor to I-beam or monorail hoists.

A switch in the main power circuit, with means for locking it in the open position, shall be provided above the crane cab, where it can be easily reached from the foot-walk, or, if the crane is without cab or foot-walk, where it can be easily reached from the crane girder.

Floors.

The term "floors" shall include platforms, balconies, runways, gratings, etc.

Unsafe Floor Space.—(1) Floors shall be considered unsafe if they are uneven or slippery, or if they are not free from loose boards, splinters, protruding nails, cracks, or unguarded holes.

(2) The members of gratings or of slatted floors of balconies, runways, etc., which are 6 feet or more above any working level shall not be spaced more than $\frac{1}{4}$ " apart if within buildings or 1" apart if outside of buildings, such as fire escapes, etc.

Openings.

Floor Openings.—The term "floor openings" shall include all floor openings having an area of 3 square feet or more and a minimum dimension of 18" or more, except elevator and hoistway openings, soaking pits in tanneries, dyeing establishments, veneer factories, etc.; and openings to permanent magazine feeds. Unguarded openings of smaller size shall be considered as "unsafe floor space."

(1) Floor openings shall be guarded on all sides (except, of course, a side giving access to a stairway) with standard railings and toe-boards, or provided with fixed safety covers with flush hinges. Safety covers shall be so constructed that when opened they will automatically guard the opening as effectively as a standard railing with toe-board.

Note.—If access to the opening is necessary for the purpose of handling material through it, a portion of the railing or guard on not more than two sides may be arranged to swing or slide, but must be so fastened that it cannot be entirely removed.

Wall Openings.—The term "wall openings" shall include all wall openings from which there is a clear drop of 6 feet or more and which are 30" or more in height and 18" or more in width, with the sill or lower edge within 24 inches of the floor, platform, or balcony level. Windows shall not be considered as "wall openings," except when located at the foot of any flight of stairs or at any platform on stairs.

Wall openings shall be guarded by standard railings or else shall be closed to a height of at least 36" and preferably 42" from floor, platform, or balcony level, by a guard meeting the requirements prescribed for guards under the heading, "Railings, Toe-boards and Guards." If the opening extends to the floor and the drop is 6 feet or more and the guard contains openings more than 1" in width, a standard toe-board shall also be provided. Guards may be arranged to slide or to swing inward, but must not swing outward and must be so fastened that they cannot be entirely removed.

Note.—The bottom rail of the guard or gate may be raised $\frac{1}{2}$ inch above the floor, if necessary for convenience in sweeping or to allow clearance for it to swing.

Hoistway Openings.—The term "hoistway openings" shall include all floor openings other than elevator openings which give access to hoisting apparatus.

Hoistway openings shall be guarded on all sides with standard railings and toe-boards, except that on the one or two sides where access to the opening must be provided, sliding or hinged doors or gates may be used.

The clearance between the floor and the bottom rail of any such door or gate shall not exceed $\frac{1}{2}$ " , and no opening more than 1" in width shall be permitted in the door or gate within 3" of the floor.

Elevated Runways and Platforms.

The requirements for railings and toe-boards shall not apply to: (a) Small platforms for motors, fans, and similar equipment, unless there is standing room 18" or more in width and 5 feet or more in height beside the equipment. (b) Shelves which are used only for storage of material and on which there is no occasion for persons to stand. (c) Platforms used for loading railroad cars or wagons.

Railings.—Elevated runways and platforms which are 6 feet or more from floor or ground level shall be provided with standard railings on all open sides, except that on runways which are constructed for the sole purpose of oiling and repairing transmission equipment and which are 18" or more in width, the railing will be required only on one side.

Note.—Railings are required on both sides of oiling runways which are less than 18 inches in width.

The intermediate rail may be omitted from railings on platforms used for storing lumber, or on oiling runways or runways used in filling tank cars.

Toe-Boards.—Elevated runways and platforms which are 6 feet or more above floor or ground level, except platforms used for storing lumber or runways used in filling tank cars or constructed for the sole purpose of giving access to monitor roof windows or of oiling and repairing transmission equipment, shall be provided with standard toe-boards on all open sides.

Railings, Toe-Boards, and Guards.

Railings.—(a) Railings shall be at least 42 inches in height in all cases.

(b) They shall be of substantial construction, permanently fastened in place, and smooth and free from protruding nails, bolts, or splinters. An intermediate rail shall be provided between the top rail and the floor, unless this space is filled with substantial wire meshwork, expanded metal, or other suitable material complying with the requirements of item (b), following, under "Guards."

(c) If constructed of pipe, the inside diameter of the pipe shall not be less than $1\frac{1}{4}$ " .

(d) If constructed of metal shapes or bars, each part shall have a cross section at least equal in strength to that of a $1\frac{1}{2}$ " x $1\frac{1}{2}$ " x $\frac{3}{16}$ " angle.

(e) If constructed of wood, the posts must not be smaller than the sizes commercially known as 2" x 4" or 3" x 3" . The top rail must be at least as large as the size known as 2" x 4" inches. The intermediate rail must not be smaller than the size commercially known as 1" x 4" .

Note.—Intermediate rails and toe-boards, and top rails which are attached to side of posts, should be placed on the side of the posts away from the engine, belt, floor opening, etc., to be guarded, so that any blow or pressure against them will be taken up by the posts instead of tending to push the rails away from the posts.

(f) Posts shall be spaced not more than 8 feet apart.

Toe-Boards.—(a) Toe-boards shall be at least 3" high, and preferably 6", and shall be placed not more than ½" above the floor or platform.

(b) They shall be constructed of wood, sheet metal, wire meshwork, or other material complying with the requirements of item (b), following, relating to guards, and with no openings more than 1" in width.

Note.—The principal purpose of a toe-board is to prevent tools or other objects from rolling off or being pushed off and injuring persons below. It is therefore preferable that it contain no openings whatever and that it be placed close to the floor, but for convenience in sweeping it may be raised not more than ½ inch from the floor.

Guards.—(a) If guards are made of wire meshwork, perforated or expanded metal, cross strips or bars of wood or metal, etc., the width or diameter of the holes shall not exceed 2" (see note below). If parallel strips or bars of wood or metal are used, the space between them shall not exceed 1". There shall be no openings more than ½" in width or diameter within 4" of any gear, belt, pulley, flywheel, or other dangerous moving part. Wood slats shall be smooth and free from splinters, and the holes in perforated or expanded metal shall be free from sharp, cutting edges.

Note.—If the material of which the guard is constructed has openings wider than ½ inch, it shall be covered at all points within 4 inches of belts, etc., with wire meshwork or sheet metal or some other suitable material having no openings wider than ½ inch. If the hole is diamond shape, the width shall be measured along one side of the opening. If the hole is oblong, the greatest dimension shall not exceed that specified above for "width."

(b) The thickness of material used for guards shall not be less than is specified in the following table:

Thickness of Material

Width or Diameter of Opening Inches	Wire Mesh Work	Expanded Metal	Perforated Metal	Solid Sheet Metal	Metal Strips Parallel or Crossed	Wood Strips Parallel or Crossed	Solid Wood
	U. S. Gauge	U. S. Gauge	U. S. Gauge	U. S. Gauge	U. S. Gauge	Inches	Inches
½	No. 20	No. 18	No. 20	No. 22	No. 16	¾	¾
¾	No. 19	No. 17	No. 19	No. 22	No. 16	¾	¾
1	No. 18	No. 16	No. 18	No. 22	No. 16	¾	¾
1¼	No. 17	No. 15	No. 17	No. 22	No. 16	¾	¾
1½	No. 16	No. 14	No. 16	No. 22	No. 16	¾	¾
1¾	No. 14	No. 13	No. 15	No. 22	No. 16	¾	¾
2	No. 12	No. 13	No. 14	No. 22	No. 16	¾	¾

Notes.—(1) If the width or diameter of the opening is less than ½ inch, the thickness of the material shall be at least as great as is specified above for a ½ inch opening.

(2) The material commonly known as "chicken wire" is not suitable for guards and does not meet the requirements of this section.

(c) The supporting frames shall be of substantial construction, such as angles varying from 1" x 1" x ⅛" to 1½" x 1½" x ⅜", or iron pipe with inside diameter varying from ¾" to 1½", according to the weight of the filling material, the size of the panels, and the exposure of the guard to collision with trucks, etc. Any panel which measures more than 42" in both width and length shall be substantially supported across its narrowest dimension at intervals of not more than 42".

(d) The filling material shall be bolted, riveted, or otherwise securely attached to the frame in such a manner that no sharp points or edges will be exposed. Bolts should be at least ⅜" in diameter and should be spaced not more than 10 inches apart. Flat bars or strips used for clamps should not be smaller than ¾" x ⅛" if of iron, or 1" x 1" if of wood. Perforated or sheet metal may be spot-welded to angle iron frames.

(e) Guards shall be securely and permanently fastened in place, except as hereinafter provided.

Stairs.

By "flight of stairs" is meant any series of steps, or of steps and landings, containing more than four risers and not exceeding one story in height.

Defective Treads.—Treads shall be considered defective:

- (1) Unless in good repair, firmly secured, and free from protruding bolts, screws, nails, etc.
- (2) When in an unnecessarily dirty or slippery condition.
- (3) When the surface or the nosing shows wear to the extent of more than $\frac{1}{2}$ ".
- (4) When the width tapers toward one side, as in winding or circular stairways.
- (5) When the treads are not all of the same width or when the risers are not all of the same height in any one flight.

Hand Rails.—(1) Hand rails shall not be less than 36" nor more than 42" in height, measured vertically above nose of treads. On platforms they shall be at least 36" and preferably 42" in height.

- (2) Hand rails shall be provided as follows on each flight of stairs:
(a) On all open sides. (b) On one side of an enclosed stairway 4 feet or less in width. (c) On both sides of an enclosed stairway more than 4 feet in width. (d) On both sides and in the center of a stairway over 8 feet in width.

Notes.—When hand rail is provided only on one side, it shall be on the side which is to the right of a person descending the stairs.

If the stairway is enclosed, the width shall be measured between walls in applying sub-items (b), (c), and (d) above.

LADDERS.

The too general use of ladders should be discouraged. If passage is to be continued for any length of time, safety and economy will be obtained by the use of temporary stairways, substantially built, with railing and wide enough for at least two men to pass.

Building.—Where ladders are used they shall be substantially built, set level, and well secured.

If ladders are used as common passageway, one shall be provided for ascending and one for descending.

Rails.—Rails of ladders shall always project at least 3 feet above floor level and must be of sound material.

Painting.—Ladders shall not be painted, as painting covers up defects. Linseed oil or oil stain shall be used instead.

Bases.—Portable ladders shall have non-slipping bases, or be so fastened at the bottom that there is no danger of slipping.

Defective ladders shall be destroyed.

Stepladders.—All stepladders shall be provided with an automatic locking device or spreader to hold the front and back sections in open position and shall be an integral part of each ladder and with a spread of no more than 40 degrees.

FIXED LADDERS.

Rest Platform.—If fixed ladders are used to ascend to heights exceeding 30 feet a landing or rest platform shall be provided for each 30 feet or major fraction thereof unless provided with safety cages.

Rails.—Rails of fixed ladders to landings shall extend a distance of at least 3 feet above the landing.

Rungs.—The rungs may be omitted above the landing. Where an employee must step a greater distance than 14 inches from ladder to roof, tank, hoist, etc., a landing shall be provided.

Guard Rails.—All fixed ladder landings shall be equipped with standard guard rails and toe boards, so arranged as to give safest possible access to ladder. Such platform shall not be less than 24 inches in width.

Material.—Wood side rails and rungs shall be thoroughly seasoned material free from shakes, cross grain, checks and decay. Side rails shall be red, white or Sitka spruce or species equivalent in strength. Rungs shall be oak, ash or material of equivalent strength.

Explosive Vapors and Gases.

STORAGE.

Where five gallons or more of liquids which give off flammable vapors at ordinary temperatures are kept, the main supply shall be stored in a buried tank located outside the building and the working supply should be pumped into the building as needed. When this pump is stopped, all the liquids in the pipe should flow back into the supply tank. Where a buried tank and pump cannot be used, the main supply shall be stored outside and well away from other buildings and shall be kept covered and under lock and key.

Inert gas systems, which prevent mixture of air with the gases of flammable liquids in storage, are recommended.

Note.—Among the common liquids giving off flammable vapors which are explosive when mixed in the proper proportions with air are: gasoline, naphtha, benzine, benzol, toluol, xylol, amyl acetate (banana oil), carbon disulphide, alcohols, ethers and acetones. The majority of so-called "volatile solvents" fall in this class, also light fuels and illuminants, and many mixtures used for cleaning and for thinning lacquers, enamels, paints and varnishes. All liquids subject to rapid evaporation shall be regarded with suspicion unless their constituents are definitely known and understood. It should be kept in mind that most solvent vapors are heavier than air and so have a tendency to flow toward lower levels and pocket in sumps, basements and other depressions.

Safety cans of five gallons capacity or smaller shall be used for distributing the liquid to working places where small amounts are used. Systems and appliances approved by the Underwriters' Laboratories offer specifications for these and greater requirements.

IGNITION HAZARDS.

Smoking and the possession of matches or other flame producing articles shall be prohibited in areas where explosive materials are used, stored or generated.

Open lights or flames, switches, motors or other electrical equipment (except those provided with approved vapor-proof enclosures) shall not be permitted where hazards are present through: Artificial leather manufacturing; degreasing of skins (with gasoline or benzine); dipping or cleaning (with liquids listed above); japan mixing; lacquer manufacturing; nitro-cellulose film storage; rubber cement mixing; spray painting; dip coating and oven drying; or wherever explosive vapors, gases or dusts are present.

Incandescent lights of the double globe keyless type shall be used to provide illumination.

STATIC ELECTRICITY.

Effective means of diffusing charges of static electricity shall be provided, such as: Maintaining the moisture content of the air at not less than 60 per cent relative humidity; bonding and grounding of all metallic parts; provision of brush collectors or other effective means of removing static electricity from moving belts.

Use of non-conducting materials, if possible, is recommended where conditions are such that static electricity charges may accumulate.

Fire Hazards.

Fire Exits.—A floor which is more than 3 feet below ground level on three or more sides shall be considered a basement. The floor next above the basement, or the lowest floor if there is no basement, shall be considered the first floor.

Each floor and each basement shall be provided with at least two standard fire exits, except such floors or basements as are used only for storage purposes or are not used at all.

The following types of exits shall be considered standard: (a) Horizontal exits; (b) fireproof stair-towers; (c) enclosed inside stairways; (d) open inside stairways in buildings having not more than two stories above the basement; (e) outside fire escapes.

Note.—Inside stairways shall not be considered standard exits from upper floors unless each floor beneath has at least two standard exits.

Exit doors shall not be locked, barred, or bolted in such a manner that they cannot be readily opened by employes at any time during working hours, and if hinged they shall swing in the direction of exit travel.

Horizontal exits are: (a) Door openings (preferably protected by fire doors). (b) Openings or bridges (preferably protected) leading to other buildings or to ground level.

A **smoke-proof stair tower** is one constructed on all sides of brick or other fire resistive material, and entered only from an exterior balcony or from an interior vestibule which is open to the outside air.

An **enclosed inside stairway** is one protected throughout its entire length by an enclosure, which shall be of slow-burning construction. Door openings in the enclosure shall be provided with self-closing solid doors which slide or swing in the direction of exit travel.

Outside fire escapes on buildings which have more than two stories above the basement shall not be considered standard unless all wall openings on

or directly beneath them are provided with self-closing solid doors or with wire glass windows.

Ladder fire escapes shall not be considered standard except under the following conditions: (a) On buildings having not more than two stories above the basement, in which no women or minors and not more than ten men are regularly employed above the first floor. (b) As a means of passing to the ground from the end of a stairway type of fire escape, where the ladder is not more than 15 feet long and is rigidly fixed or of the counter-balanced type.

WELFARE AND HEALTH.

Ventilation.

On each machine, group of machines, or equipment of the types listed below, there shall be a hood or ventilator, connected by means of a pipe to an exhaust fan or other suction device which will remove all fumes, gases, or dusts arising from any of the operations of the work to such an extent that the health or well being of the exposed workers is not affected. All explosive, noxious, or poisonous gases, dusts, or fumes produced in workrooms from other than the listed items of equipment, shall be removed by means of exhaust fans, suction systems, blower systems, or other positive devices as required by the Industrial Commission general code for industrial environmental sanitation:

Listed Equipment.

Acid dipping and cleaning tanks	Gasoline, benzine, or alcohol dipping or cleaning tanks
Aniline dye machines	Japan or lacquer dipping tanks
Brass cupola	Lampblack grinding
Brass crucibles	Lead melting or treating furnaces, crucibles, or pots
Bronze powdering machines	Nitrating vats
Buffing wheels	Rag picking machines
Cement grinders	Sand blasts
Crude alcohol manufacturing vats	Solvent tanks in the rubber industry
Dry grinding wheels	Willowing machines
Emery wheels	Woodworking machines
Galvanizing tanks	

Eye Protection.

PLANO AND RX SAFETY LENSES must meet the following specifications:

Thickness at thinnest point of lens not less than 3.0 m/m. Lenses must be free from visible and optical defects and meet all optical specifications as outlined in U. S. Bureau of Standards specifications. All lenses should under polarized light show a definite pattern to indicate lens has been hardened. Lens should meet drop ball standards for strength and be trademarked with manufacturer's code for identification.

Respirators.

All employees engaged in work where safety demands the use of respirators shall be provided with a type approved by the U. S. Bureau of Mines and shall be required to use them.

Foot and Leg Protection.

All employees pouring molten metal, acids, or other liquids having a corrosive or harmful effect upon the human body shall be furnished with standard protection for feet or legs or both, and shall be required to use them.

(1) Leggings shall be made of material which will prevent the molten metal or corrosive substances that are being handled from coming into contact with the leg of the wearer; shall be constructed in such a manner that when adjusted on the wearer a tight enclosure is made; shall be so fastened that they can be put on or taken off quickly; and shall be kept in good repair.

(2) Foot Protection shall be made of material which will not be easily affected by the substances being handled; shall closely fit the contour of the foot and ankle; shall be so designed that liquid or molten material cannot enter the shoe; shall be of such design that they can be easily and quickly removed from the foot; and shall be kept in good repair.

Welfare Facilities.

Toilets—See Sec. 182.35 to 182.40, Minnesota Statutes 1949. (Page 13, this book.)

Washing Facilities.—Every place of employment shall be provided with adequate washing facilities in the ratio of one lavatory (or equivalent wash place) for each 10 employees up to 100 persons, and one lavatory (wash place) for each additional 15 persons. Each lavatory (wash place) shall be provided with soap and hot and cold running potable water.

Lockers.—Individual lockers shall be provided in places of employment where the nature of the work requires that clothing be changed.

Towels.—Individual clean towels of cloth or paper shall be provided. Other apparatus for drying the hands may be substituted only upon the approval of the Industrial Commission.

Clothing Lockers.

For the information of employers who may be required by law or who may desire to provide clothing lockers for their employees, minimum specifications are:

A locker is a compartment 72" high, 18" wide and 12" deep, made of steel, where a change of clothing may be stored. Equipped with a shelf and not fewer than one clothes hook on each side or equivalent hanger bar, and sufficient openings in the door for the purpose or ventilation.

First Aid.

In every place of employment the employer shall provide some means of first aid for the treatment of accidents and illnesses. All first aid treatment shall be administered by some person who has been instructed by a physician or an organization such as the Red Cross and is qualified for such duties.

The first aid kit shall be so constructed as to exclude dust and shall be kept clean. The highest possible degree of sanitation shall be maintained.

The contents of the first aid kit shall be of such materials as approved by the organization's own doctor or the Red Cross and contain only articles which may be required for the industry.

At the discretion of the Industrial Commission a first aid room shall be set aside for the administration of first aid and be equipped with hot and cold running water, soap and towels and sanitary drinking water facilities.

First aid stations shall be plainly marked. Full information as to locations of doctors, hospitals, ambulances or trained first aid workers shall be plainly posted.

Window Cleaners.

All buildings, in which the sills of windows are located more than ten (10) feet above grade or adjoining flat roof, shall be provided with safety devices for the protection of window cleaners, when windows are cleaned from the outside. The term "outside" shall mean the exterior of front, sides and rear of buildings.

When windows are cleaned from the sill, a safety belt of heavy leather, canvas, rope or other substantial material shall be provided.

Bolts, rings or other fittings for holding the belt, shall be of bronze, brass or other approved durable rolled or pressed metal, and shall be firmly and permanently fastened to both sides of all windows of buildings, at a point not less than 45 to 51 inches above the sill. Use of expansion bolts installed in masonry of buildings will not be permitted. Cast metal in fittings is prohibited.

The ends of the belts shall be fitted with approved rolled or pressed metal safety terminals.

When windows are cleaned from a scaffold, the scaffold shall be of substantial construction and fitted at exposed side and ends with guard rail not less than forty-two (42) inches high, and toe boards not less than six (6) inches high.

Proper and adequate tackle and other necessary fittings shall be provided when swinging scaffolds are used.

Portable ladders, when used, shall be fitted with safety feet or other suitable protection to prevent slipping.

Window cleaners shall use the safety devices provided for their protection.

Window cleaners shall not pass from window to window on the outside, unless both safety hooks are securely fastened, or when standard runways have been provided.

The use of safety devices and methods of cleaning windows, other than those specified above, may be permitted after having been duly approved by the Industrial Commission of Minnesota.

Inspectors must instruct foremen that in every case where owing to the lack of material or lack of authority to change a condition that in the opinion of the inspector is unsafe, the job must be stopped until persons in authority are notified and conditions made safe.

CONSTRUCTION SAFETY CODE

LIGHTING AND POWER.

Sec. 1. On all construction and engineering projects where necessary there shall be proper and sufficient lighting. All lighting to be arranged so that employees may observe their work and work place with safety. All wiring for lights and power must conform to the National Electric Code and to the electric codes of Duluth, Minneapolis and St. Paul in those cities.

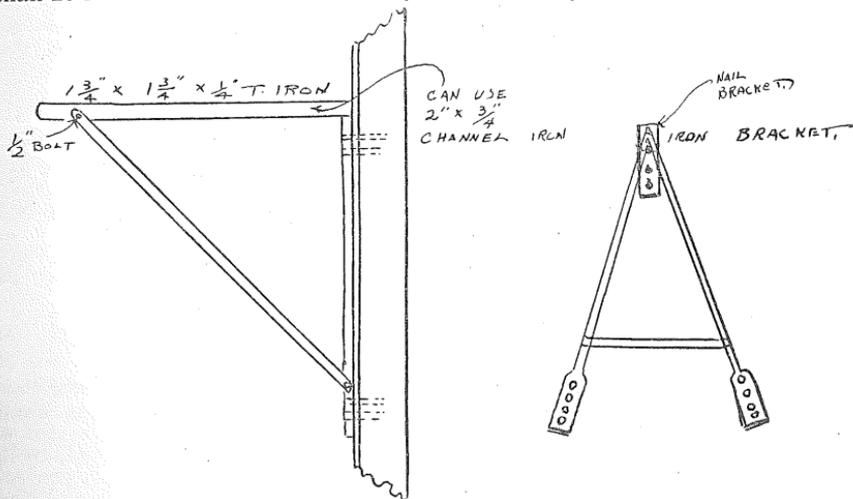
Sec. 2. On all construction jobs where night shifts are working, contractors shall provide emergency lighting equipment to be used in case of light failure at the job. This is to apply when it is necessary to have employees work continuously because of conditions of the work.

METAL BRACKETS.

Sec. 3. Fastening.—The use of metal scaffold brackets hung on nails or secured to sheeting boards only is prohibited. Brackets hung on nails shall not be less than 16 penny in size, and not less than four in each bracket driven into the studs, spaced at intervals not greater than six feet and shall be provided with space for guard rails and toe boards.

Sec. 4. Loads.—The allowable loads shall be the same as specified for carpenters' wood brackets specified in Sec. 7.

Sec. 5. Platform.—The platform on metal brackets shall not be less than 20 inches wide and of 2" x 10" planks, securely fastened together.



Metal Brackets.

CARPENTERS' WOOD BRACKETS.

Sec. 6. All carpenter brackets shall be built to securely carry all loads on the outermost edge.

Sec. 7. **Load.**—A load twice the total weight placed on it, not less than 400 pounds, and the allowable load not over 600 pounds.

Sec. 8. **Platform.**—The platform on wood brackets shall not be less than 20 inches wide and of 2" x 10" planks, securely fastened together.

Sec. 9. **Brackets.**—The brackets shall have their supporting bolts near the top, and such bolts shall be securely anchored and fastened. The practice of merely passing the bolt through the sheeting is prohibited, and some additional means of anchorage shall be provided, dependent upon the type of the building.

Sec. 10. **Bolt.**—The bolt shall not be less than $\frac{3}{8}$ " in diameter, with washers, and shall be long enough to project at least one inch beyond the nut when in place.

Sec. 11. **Spacing.**—The brackets shall be spaced at intervals not greater than six feet. In the erection of bracket scaffolds, provision shall be made for the placement of guard rails and toe boards.

Sec. 11-a. Wood brackets shall be constructed with a 2" x 6" upright securely bolted to stud with $\frac{3}{8}$ " bolts, with a 2" x 6" bearer braced with 1" x 4" diagonal braces on each side of bearer. Brackets to be spaced no greater than 6 feet apart.

SPOUTING OF CONCRETE.

Sec. 12. **Tower Supports.**—Where spouting equipment, of whatever kind, is supported by the tower, the tower shall be built in such manner as to carry safely any and all stresses caused by such loads.

Sec. 13. **Boom Anchor.**—Whenever a boom is supported by the tower, the boom anchor shall be located at a level where guy lines are attached, and the upper fastening of the falls which raise and lower the boom shall be placed at a distance not less than one-half the length of the boom above the boom anchor and at a level supported by the guys. The guys supporting these two points shall be designed to carry the extra load caused by the boom.

Sec. 14. **Bracket Construction.**—The hopper brackets on all towers shall be designed and constructed with a safety factor of at least six.

Sec. 15. **Guard Rails, Hopper Platform.**—Whenever employees are required to work on the platform of the hopper bracket, a two-rail railing three and one-half feet high and toe boards shall be provided around the platform.

Sec. 16. **Safety Hooks.**—No open hook shall be used with a bucket, cage or skip when operated inside of shafts or towers. Some efficient form of safety hook or shackle shall be used or the hook properly moused.

BOATSWAINS' CHAIRS.

Sec. 17. **Chairs.**—Boatswains' chairs, attached by means of a sling to a suspended rope used for painting, cleaning or other small operations, shall be constructed and supported in such manner that they have the factor of 4. Such chairs shall have a seat not less than 2 feet long, 1 foot wide, by 2 inches thick. Cleats shall be provided at each end of seat and shall project not less than 9 inches in front and substantially secured to the seat. The chair shall be swung by ropes or cables securely fastened to the seat. Manufacturers' standard chairs may be used, provided they comply with the requirements.

Sec. 18. **Blocks and Tackle.**—Boatswains' chairs may be supported by means of blocks and tackle securely fastened overhead or by means of suspension from a fixed overhead object. Where either of these methods is

impractical, as in case of a flagpole, the rope may be secured to the pole by means of a suitable and safe hitch.

Where the chair is secured by means of an overhead block, the free fall line shall pass through the chair and be securely fastened thereto or to the bottom block or supporting tackle.

Sec. 19. **Stirrups.**—When the suspension rope is attached to a fixed overhead object or secured to a pole by means of a substantial hitch, stirrups or supports shall be provided, upon which a workman may rest while shifting the position of the chair. The stirrups or supports shall be fastened independently of the chair and shall be as substantially constructed and securely fastened as the chair itself.

Sec. 20. **Safety Belts.**—Safety belts must be provided for employees using boatswains' chairs and shall be securely fastened to the supporting tackle.

Block and tackle usually attached permanently to the top of stacks, etc., shall never be used to support a workman, except after being tested by placing four times the actual weight upon it.

CARPENTERS' SCAFFOLD.

Lighter scaffolds, such as for carpenters or where no material is on the scaffold, can be constructed of lighter material when not more than 10 feet high.

Sec. 21. **Uprights** shall rest on solid footing and be not less than 2" x 4", free from knots, and be continuous and of clear, long grained lumber, spaced not more than 7 feet apart.

Sec. 22. **Bracing.**—All uprights shall be braced with cross and diagonal braces of not less than 1" x 8".

Sec. 23. **Bearers.**—Bearers no less than 1" x 8" shall be attached to a frame building by notching a piece of lumber, not less than 2" x 4" by 12" long, to the size of the bearer, so it will bear evenly on the 2" surface. This plate or piece so prepared shall be nailed securely to the side of the building and the bearer nailed to the plate.

Sec. 24. **Platform.**—The minimum width of carpenters', painters', decorators' and miscellaneous platforms shall be two 2" x 10" planks. Where the platform planks overlap on a single bearer, the lap of both the lower and upper plank shall not be less than 6" over the center of the bearer.

FACTORY CHIMNEYS.

Sec. 25. **Protective Roof.**—At the hoist opening and at the entrance to the chimney a protective roof shall be erected of 2" planking. The remainder of the work-place shall be covered or fenced off and provided with warning notices.

In the case of internal hoisting, in addition a protective scaffold shall be erected immediately over the men working below.

Sec. 26. **Iron Brackets.**—The inside working scaffolds shall be erected on wooden bearers or iron brackets resting in the masonry. Iron brackets shall not be inserted less than 12 inches below the last course of bricks.

Under each working scaffold the next lower scaffold shall be left as a protective scaffold. In the case of work from hanging truss scaffolds (bracket scaffolds) this provision shall not apply.

HORSE OR SQUARE SCAFFOLD.

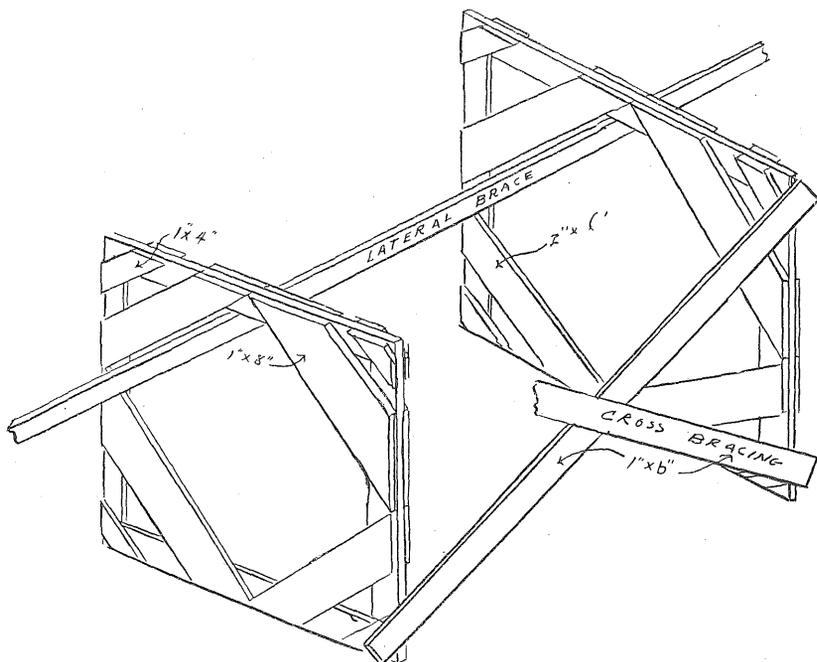
Sec. 27. **Metal Scaffold.**—Metal scaffolds are constructed of various types, but the one most commonly used is a metal scaffold made of $1\frac{3}{4}$ " x $1\frac{3}{4}$ " x $\frac{1}{4}$ " T iron or 2" x $\frac{3}{4}$ " channel iron, with iron legs and braces bolted with $\frac{1}{2}$ " bolts. In folding, transporting and storing, these bolts and those of the carpenter bracket scaffolds wear and corrode and should be examined before being used each time as to their wear.

Sec. 28. **Horse Scaffold.**—A horse scaffold shall be constructed of sound lumber and braced externally and internally with 2" x 6" or 8" bearers, 2" x 6" legs, with 1" x 4" cross or diagonal braces. The distance between the legs shall not be less than two-fifths or three-fifths the height of the horse.

Sec. 29. **Scaffold Squares.**—The squares shall be made of not less than 2" x 6" lumber and shall be securely fastened on both sides at the corners with not less than 1" x 6" and shall have braces on both sides, running diagonally from the center to the adjacent sides. Horses and squares shall always be kept in good repair.

Sec. 30. **Platforms.**—All horse or frame scaffolds shall be set level on substantial foundations. When built more than one (1) tier high, the horses shall be set in vertical lines, separated at each tier with a continuous 2" plank placed under the vertical members thereof, with cleats nailed to planks to prevent the end horse slipping off supports and with all parts of the scaffold securely braced to give rigidity to and to prevent excessive swaying of such scaffolds. All horse or frame scaffolds shall not be used more than three tiers high nor more than 15 feet in height.

Sec. 31. Square and horse scaffolds illustrated.



SQUARE SCAFFOLDS.

Squares should not be more than 5 feet square of 2" x 6" lumber and shall be securely fastened on both sides at the corners with not less than 1" x 6" and shall have braces on both sides running diagonal from the center to the adjacent sides.

IRON WORKERS' NEEDLE BEAM.

For riveting, drilling or other work on structural steel where flooring has not been completed the scaffold shall be constructed to carry the imposed load with a safety factor of 4.

Sec. 32. **Needle Beam.**—Needle beams not more than 10 feet in length shall be of sound wood, not less than 4" x 6" in cross-section, or other material of equal or greater strength, 2 feet longer than the distance between supports, shall be one solid piece without splicing and provided with means to prevent supports slipping over the ends. When conditions require beams, the cross-section shall be increased in accordance with the length of the beams and the weight to be supported, or a center support or hanger for needle beams provided every 8 feet. Suspending members shall be securely fastened by 1¼" manila rope to the beams or girders to prevent slipping. Proper precaution to prevent the cutting of rope on beams shall be taken.

Sec. 33. **Platforms.**—Platforms shall be not less than three 10" planks inside and outside of the building, unless space will not permit. Planks used for platforms shall meet the requirements for allowable loads and stresses.

STRUCTURAL STEEL WORKER PLANKING.

Sec. 34. A solid 3" plank floor shall be maintained over the entire building within two stories of the riveters and four stories of the erector. Such floors shall be shifted at two-story heights.

Sec. 35. ¾" drop bolts 4" or more from end of planks or other approved method, but in no case shall the safe factor be less than 4 times the load held, according to table herein.

IRON WORKERS' NEEDLE-BEAM SCAFFOLD.

Needle beams shall be no less than 4" x 6", sound material, hung on no less than 1¼" manila rope. Platforms not less than three 10" planks.

LADDER JACK SCAFFOLD.

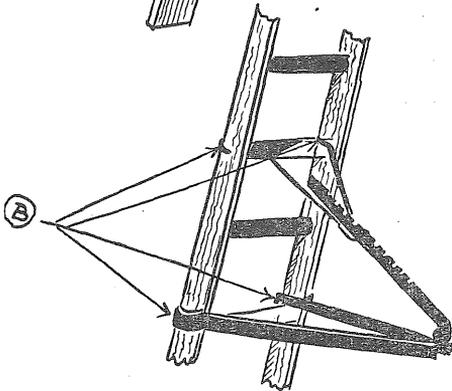
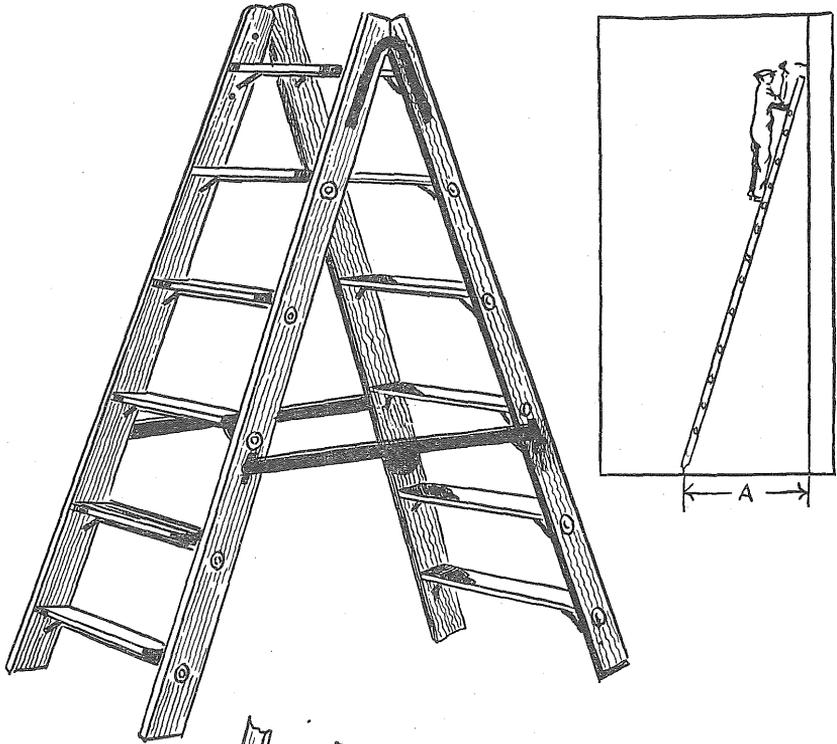
Sec. 36. **Platform.**—The platform of this scaffold shall be at least 2" x 10" and shall extend over bearing surface at least 12 inches. The platform shall not have a span of more than 10 feet, unless it is trussed, and then not more than 15 feet.

Sec. 37. **Height.**—In no case shall ladder jacks be used to exceed 25 feet from the ground.

Sec. 38. **Ladder Jack.**—The ladder jack shall be clamped or otherwise securely fastened to the ladder and shall bear on the side walls. All ladders to be of first class material and be secured against slipping. All ladder jacks shall be of an approved type. Ladder jacks shall not be used to support more than one section of plank and not more than two employees shall be permitted to work on such section of planking at the same time. When ladder jacks are placed on outside of ladder, the base of the ladder shall be placed at a distance greater than specified.

Sec. 39. **Ladder Angle.**—The best angle at which to place a ladder is that in which the distance between the base and wall is approximately one-fourth of the length of the ladder. In other words, a 12-foot ladder shall be placed so that the bottom of it is 3 feet away from the wall or object it is leaning against. The base of a ladder shall be placed at an angle of no less than 25% or more than 40% of each 12-foot height from the wall or object it is leaning against. (See illustration opposite page.)

Sec. 40. **Extension Ladders.**—Where extension ladders are used with ladder jacks the sections of the extension ladders shall lap not less than 6 feet. This applies to all extension ladders.



Safe Angle for Ladder.

The best angle at which to place a ladder is that in which the distance A is approximately $\frac{1}{4}$ of the length of the ladder. In other words, a 12 foot ladder should be placed so that the bottom of it is 3 feet away from the wall or object it is leaning against.

OUTRIGGER SCAFFOLDS.

Sec. 41. **Outrigger.**—The outrigger or thrustout shall be no less than 2" x 10" or heavier or of any material equal in strength and shall not project more than 5 feet in front of the wall; they shall be securely braced to prevent tipping and turning. Outriggers shall be securely supported by U bolts, or spiked or lashed to secure uprights, propped tight to ceilings and well braced. Outrigger or thrustouts shall be not more than 7 feet apart. Thrustouts shall not be built into a wall and left with no other support, but shall project entirely through the wall or through windows and be solidly supported and substantially braced.

Sec. 42. **Vertical Members.**—Vertical members shall be of 2" x 6", extending 8 inches above the outrigger and fastened by 2" x 8" shoulder blocks. This same applies below the bearer on which platforms are.

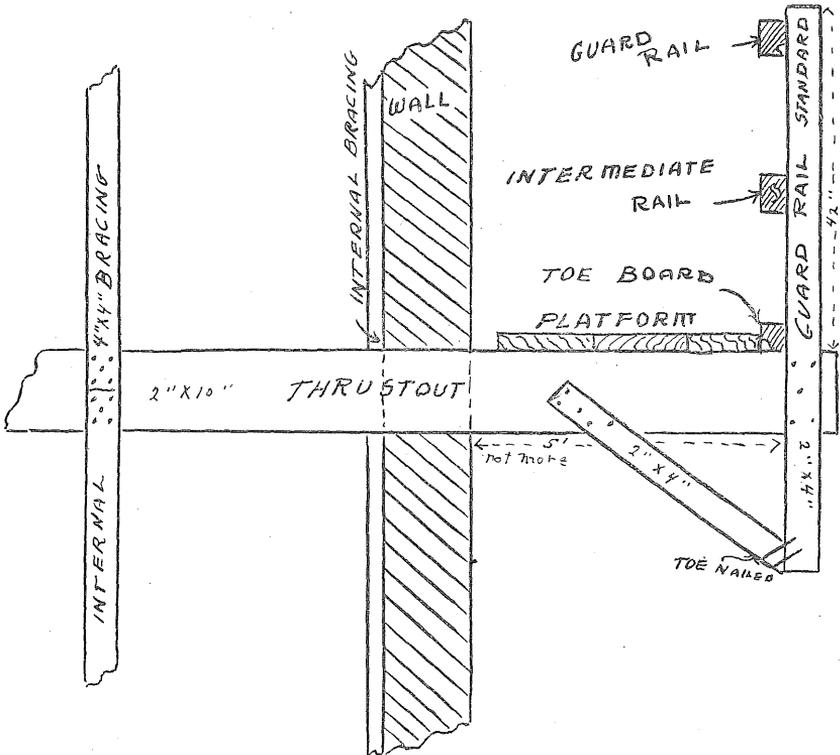
LADDER JACK SCAFFOLD.

Platform shall be at least 2" x 10" plank and shall extend over bearing surface at least 12".

The platform shall not have a span of more than 10 feet, unless it is trussed, and then not more than 15 feet.

Ladder jack shall be securely fastened to ladder and bear on side walls.

Not more than 2 men will be allowed on ladder jack at one time.



A—Outrigger or Thrustout.

All stepladders shall be provided with an automatic locking device or spreader to hold the front and back sections in the open position, and shall be an integral part of each ladder, with a spread of no more than 40 degrees.

Sec. 43. **Platforms.**—Planks shall not be less than 2" x 10".

Sec. 44. **Guardrail.**—All scaffolds must be railed and have toe boards.

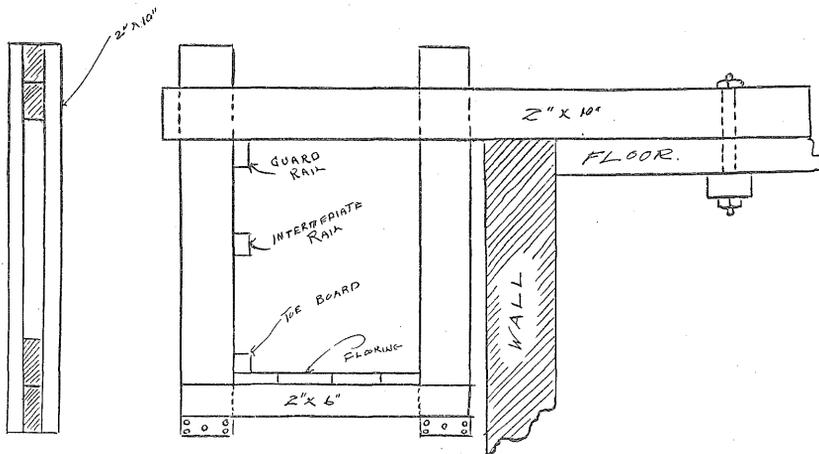
OUTRIGGER OR THRUSTOUT.

Sec. 45. Thrustouts scaffold shall consist of 2" x 10" outriggers securely supported by U-bolts spiked or lashed to secure uprights propped tight to ceilings and well braced.

Loads shall be in accordance with table herein.

Thrustouts shall be not less than 2" x 10" or 4" x 6", internal braces 4" x 4". Platform planks shall be 2" x 10".

Thrustouts shall not be more than 7 feet apart and shall not project more than 5 feet in front of wall unless approved by Division of Accident Prevention of the Department of Labor and Industry, in accordance with the table herein.



B—Outrigger or Thrustout.

FOOT SCAFFOLDS.

Sec. 46. **Platform.**—When placed upon other scaffolds or platforms whose elevation is above the surrounding area, such scaffolds shall have a minimum width of one 10" plank, and a maximum height of 24" measured from the supporting platform or scaffold, and one tier only shall be permitted.

Sec. 47. **Height.**—Foot scaffolds in excess of 24 inches in height shall have a minimum width of four 10-inch planks and shall be supported on horses.

PAINTERS' OR TUCK POINTERS' SCAFFOLD.

Sec. 48. **Hooks.**—The hooks used to support this scaffold shall be of a strength at least equal to wrought iron or steel of a cross section

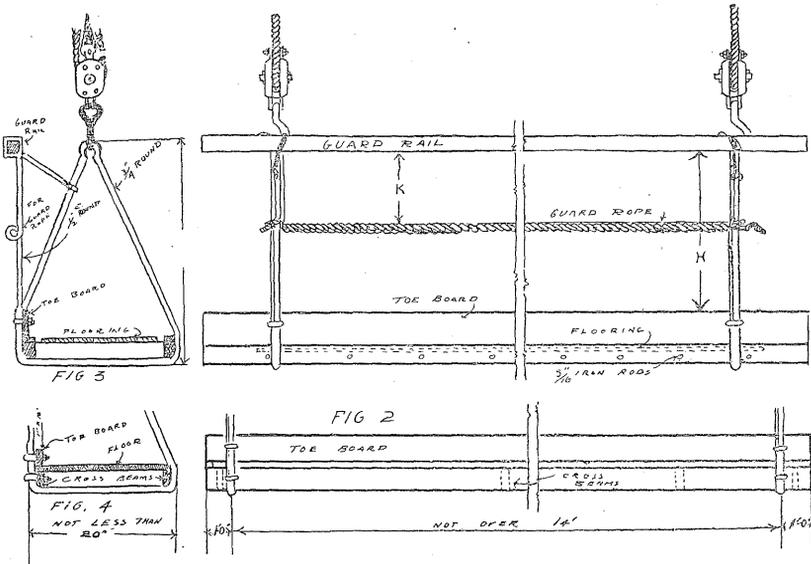
$\frac{5}{8}$ " x 2" bent edgewise, securely anchored and supported and the hooks tied back with rope. Care should be taken that eaves or cornices are in good condition.

Sec. 49. **Load.**—Scaffold shall be constructed to bear at least four times the maximum load, and every time it is erected it shall be tested by raising the platform one foot from the ground and loading with the weight mentioned above. Such tests shall be made with the permission or in the presence of the inspector.

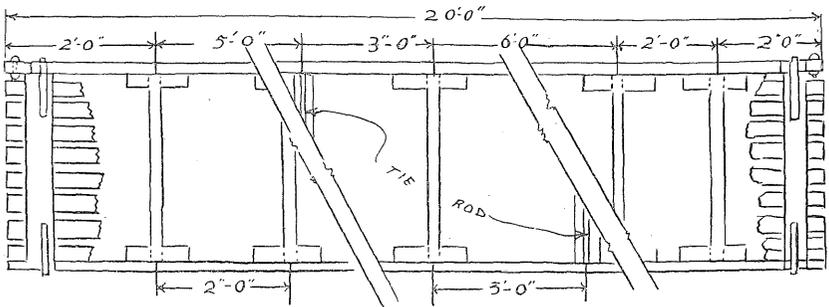
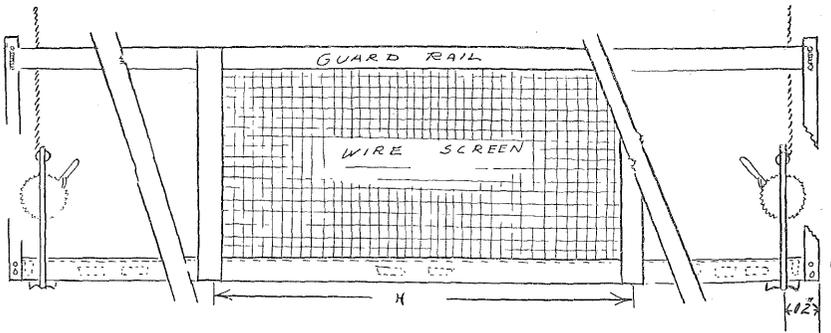
Sec. 50. **Blocks and Rope.**—Blocks and ropes shall be in good condition and be free from acid burns and flaws. When acid is used, the free end of the rope shall be placed in a barrel and moved away from scaffold. Ropes no less than $\frac{3}{4}$ inch in diameter shall be used to support scaffold.

Sec. 51. **Number Men.**—No more than two men shall be permitted on this type of scaffold at one time except when more than two stirrups with corresponding hooks, blocks and ropes are used.

Sec. 52. **Stirrups.**—The iron stirrups or hangers shall be of a strength at least equal to wrought iron or steel three-quarters of an inch in diameter and shall be so formed that guard rails and toe boards made may be easily secured to them. The distance between hangers shall not exceed 14 feet, unless consent of the Division of Accident Prevention is obtained.



A—Painters' or Tuck Pointers' Scaffolds.



B—Painters' or Tuck Pointers' Scaffolds.

Sec. 53. Platform.—The platform planks shall be laid together and shall overlap the stirrup 12 inches. A bar strip or other device shall be permanently attached to the platform outside the stirrup to prevent slipping.

Sec. 54. Ladder.—When the platform consists of a ladder, material for construction of same shall comply with table shown.

Sec. 55. Minimum standards for swing staging ladders. (See accompanying table.)

Sec. 56. Safety Lines.—Safety lines of $\frac{5}{8}$ " diameter long fibre manila rope, hanging from the roof, securely tied thereto, shall be provided between each pair of hangers or falls.

Sec. 57. See illustrations, A, B.

SWING STAGING LADDERS

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Length of Ladder	Minimum Inside Width	Rail Cross Section Ends	Rail Cross Section Ends	RUNGS		IRON RODS		Flooring
				No.	Diameter	No.	Diameter	
16'	20"	1 $\frac{7}{8}$ "x2 $\frac{3}{4}$ ".....	1 $\frac{7}{8}$ "x3 $\frac{3}{4}$ ".....	11	1 $\frac{1}{8}$ "	4	$\frac{5}{16}$ "	1 $\frac{1}{2}$ "x3"
18'	20"	1 $\frac{7}{8}$ "x3".....	1 $\frac{7}{8}$ "x4".....	12	1 $\frac{1}{8}$ "	4	$\frac{5}{16}$ "	1 $\frac{1}{2}$ "x3"
20'	20"	1 $\frac{7}{8}$ "x3".....	1 $\frac{7}{8}$ "x4 $\frac{1}{2}$ ".....	13	1 $\frac{1}{8}$ "	4	$\frac{5}{16}$ "	1 $\frac{1}{2}$ "x3"
24'	20"	1 $\frac{7}{8}$ "x3".....	1 $\frac{7}{8}$ "x4 $\frac{3}{4}$ ".....	16	1 $\frac{1}{8}$ "	5	$\frac{5}{16}$ "	1 $\frac{1}{2}$ "x3"

SWING STAGE LOADS.

Table for loads of swing scaffold when outrigger beams are used on top of roofs over building wall can be obtained from the Commission.

ROOFING DEVICES.

Sec. 58. **Devices.**—Devices used in the construction of pitched roofs or construction on pitched roofs shall be securely fastened in place. Shingling footlocks shall not be less in size than 2" x 4" timber, secured in place by properly spaced tin strips or shingles, not less than 4 inches wide or material of equivalent strength.

Sec. 59. **Crawling Boards.**—Crawling boards, ladders or chicken ladders shall be used wherever necessary to provide protection against slipping or falling of employees. Cleats shall be provided on crawling boards, securely fastened thereto, not less than 3" x 1" and shall project approximately 2½ inches on each side of board.

Sec. 60. **Double Crawling Boards.**—When crawling boards are double they shall be securely bolted together by a hinge bolt or otherwise substantially secured. When single they shall be provided with hooks, bolts or solidly fastened cleats on the under side at the upper end to catch over the ridge pole or otherwise substantially secured.

Sec. 61. **Brackets.**—Where brackets are used for shingling or roofing, they shall be supported by ropes passing over the ridge pole of the building or by means of pointed projections with points secure and thrust deeply into the woodwork of the building.

Sec. 62. **Life Lines.**—Roofers working on steep pitched roofs shall be furnished with a safety belt and have a ¾ inch number one grade untreated manila rope for a life line securely fastened to building and safety belt.

HEAVY-DUTY SINGLE-POLE SCAFFOLDS.

A single pole scaffold is one row of uprights on outside edge of scaffold, the putlog which carries the platform bears on the wall at least 4 inches and rests on the ledger, secured to the uprights, the top of the ledger being level with wall.

Sec. 63. **Putlogs.**—Putlogs shall extend at least 6 inches beyond the upright and all putlogs should be spaced so as to carry the load. Putlogs should be not less than 4" x 4" or material of equal strength.

Sec. 64. **Corner Putlog.**—Where a scaffold is built around a corner, at least one putlog shall be laid and securely fastened diagonally across the corner so that one end may rest upon each of the two ledgers that meet at the corner. Care shall be taken in laying platform planks, so that no tipping hazard exists.

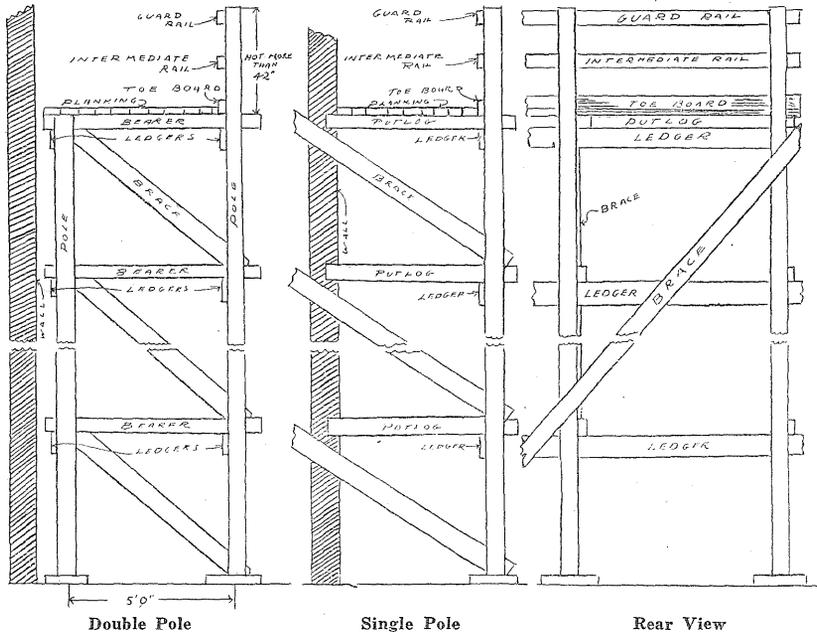
Where material is placed on scaffold from inside, wire mesh shall be placed on outside of scaffold on inside of guard rail.

Sec. 65. **Uprights.**—All uprights shall rest on solid footing and be of 2" x 6", 4" x 4" or heavier, according to the height and for the purpose used, spaced 7 feet apart.

Sec. 66. **Braces.**—All uprights shall be so braced as to prevent swaying and collapsing, using cross and diagonal braces not less than 1" x 8".

Sec. 67. Splicing.—All spliced uprights shall be square at the butts and be securely nailed or bolted with cleats. These cleats shall not be less than 4 feet long and the width of the upright.

The cleats shall be secured on two adjacent sides and shall be 2 feet on each side of the butts.



Sec. 68. Diagonal braces of 1" x 8" shall be securely fastened to uprights and extend from bottom to top of uprights.

A Ledger is a 2" x 6" or 2" x 8" securely fastened to uprights and extends lengthwise of scaffold.

The scaffold plank shall be at least 2" x 10", laid close together, fastened on bearer or putlog. Two successive planks shall not butt on one putlog, but shall rest two putlogs, one on each side of upright. Where planks lap they shall be 6" over center of putlog or bearer.

A guard rail no more than 42" high with an intermediate rail, and a 1" x 6" toe board, shall be placed on all scaffolds 6 feet or more above ground or working floor.

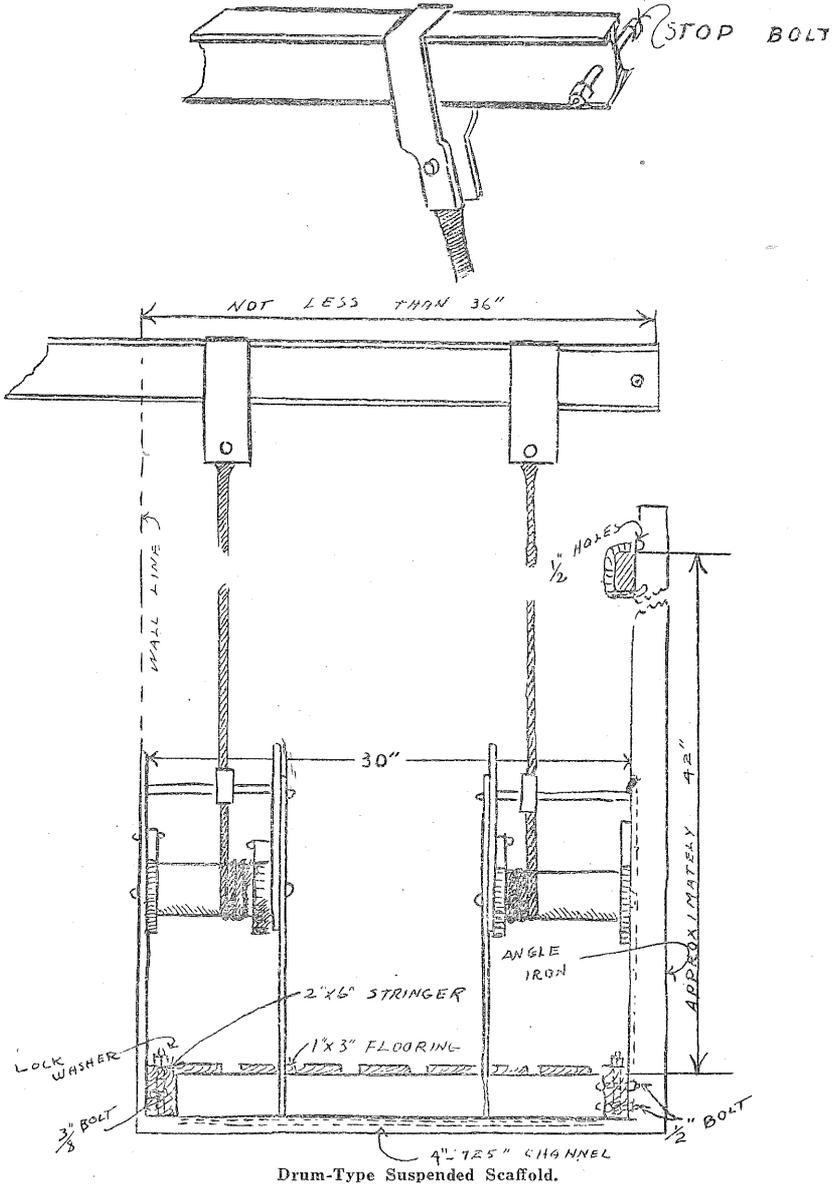
SUSPENDED SCAFFOLDS.

Suspended scaffolds are used either inside or outside of building. The parts of the building or structure to which the scaffold is to be secured shall be carefully inspected by the employer to determine whether such parts are of sufficient construction and strength to secure and support the load.

Sec. 69. Thrustouts.—The thrustouts shall be of equal strength to 6-inch I-beams and shall project not less than one foot beyond the outer edge of the

scaffold and shall be securely fastened to the frame work by U-bolts and anchor plates, tightened by use of jam or lock nuts. I-beams shall be equipped with stop bolts, rigidly fastened and of proper size to prevent the shackle from slipping off.

Sec. 70. Bearers.—Bearers shall be securely fastened to the scaffold fixtures and spaced according to load, but shall not be spaced more than 8 feet apart.



Sec. 71. Platform.—The platform, consisting of 2" x 10" planks, shall be securely tight and consist of toe board and railings, inclosed with a mesh wire, canvas or other suitable material to prevent material from falling down.

Sec. 72. Fixtures.—There are two types of fixtures—the pumpjack and drum type. Of these, the latter is the best. The scaffold shall be in charge of a competent person and shall be kept as near level as possible at all times. When men are working above, the scaffold must have overhead protection.

Sec. 73. Cables.—The supporting cables for suspended scaffolds shall be at least ½ inch in diameter, securely fastened to I-beam thrustout and scaffold fixtures and be periodically inspected as to their safety.

Sec. 74. Illustration of drum-type suspended scaffold.

HEAVY-DUTY TWO-POLE SCAFFOLDS.

For Bricklayers, Stonemasons, Concrete Workers, Stonecutters and Steel Workers.

Sec. 75. Uprights.—There are two types—single and double pole. The two-pole is made of uprights, one at the wall and the other on the outside, at the width of the scaffold. All uprights to be of 2" x 6", 4" x 4" or heavier, according to the height and for the purpose used, spaced 7 feet apart and so braced as to prevent swaying and collapsing, using cross and diagonal braces not less than 1" x 8". All uprights shall rest on solid footing.

Sec. 76. Cleats.—All spliced uprights shall be square at the butts and be securely nailed or bolted with cleats. These cleats shall not be less than 4 feet long and the width of the upright. The cleats shall be secured on two adjacent sides and should be 2 feet on each side of the butts.

Sec. 77. Ledger.—The ledger shall be kept level. All ledgers, uprights, putlogs and planks shall be of a good material, free from knots. Ledgers 2" x 6" or 8" shall be securely fastened to the uprights. The ledger board shall be secured on the inside of the upright, and uprights shall be braced diagonally with no less than 1" x 8".

Sec. 78. Bearers.—Bearers 2" x 6" or 4" x 4" shall rest on ledger boards. This scaffold shall have a guard rail and toe boards when 8 feet or more above ground.

Sec. 79. Platform.—Scaffold platform shall be at least 5 feet wide and of 2-inch material, laid closely together and secured to prevent slipping and tipping. Two successive planks shall not butt on one bearer, but shall have two bearers not more than 4 inches apart. Where planks lap they shall not be less than 6 inches over the center of the bearer.

Sec. 80. Corner Bearer.—Where a scaffold is built around a corner, at least one bearer shall be laid and securely fastened diagonally across the corner so that one end may rest upon each of the two ledgers that meet at the corner. Care shall be taken in laying platform planks, so that no tipping hazard exists.

A guard rail no more than 42" high with an intermediate rail and a 1" x 6" toe board shall be placed on all scaffolds 5 feet or more above ground or working floor.

WINDOW JACK SCAFFOLD.

Sec. 86. Use.—Window jack scaffolds shall be used only for the purpose of working at the window through which the jack is placed.

Sec. 87. Planks.—The placing of planks between one window jack and a jack in an adjacent window is prohibited. Window jacks shall not act as the supporting elements for other scaffolding.

Sec. 88. Load.—Not more than one person shall be permitted to be on a window jack scaffold at any one time.

Sec. 89. Guard Rails.—Window jacks shall be provided with 42-inch guard rails of approved type.

Sec. 90. This type of scaffold to be used by window washers, painters, glaziers and caulkers.

Sec. 91. For scaffolds in between windows, see specifications for outrigger and thrustout scaffolds, sections 41 to 42 and 45 to 47.

CRANES AND POWER SHOVELS.

Sec. 92. Guard Plates.—The installation of skirt boards and guard plates which greatly reduce the hazard from swinging cranes, clam shell drag line or shovel is recommended.

Sec. 93. Inspection.—All cranes and power shovels shall be inspected for loose parts, bent boom members, defective cables and other defects each day on which they are in use.

Sec. 94. Brakes.—Brakes shall be frequently examined and tested, and lining kept in good condition at all times.

Sec. 95. Booms.—If booms or cranes are lengthened the load shall be decreased 200 lbs. for each 5 feet, and if boom is shortened add 200 lbs. for each 5 feet.

Sec. 96. Boom Safety Bar.—On all cranes or derricks a safety bar of angle or channel iron shall be provided to prevent boom from being raised more than 80 degrees from the horizontal position. This will prevent boom from tipping over backwards.

Sec. 97. Cable Fastening.—Cables shall be securely fastened to drums and shaft conveyances either by zinc plugs or other suitable clamps and at least four full turns of the cable shall remain on the drum at all times. The cable fastening shall be secure against the maximum emergency strain.

DERRICKS.

Sec. 98. Guy Lines.—Gin poles, frame derricks and similar hoisting apparatus shall be designed and constructed and have sufficient guy lines to securely support and maintain the maximum working loads to be imposed upon them. Such lines shall be so placed as to prevent excessive swaying and shall be securely fastened to permanent parts of the building where possible, and when fastened to a temporary construction care shall be taken to see that such temporary construction and fastening is of the proper strength to hold the load. Guy lines shall not be fastened to rolling stock (railroad cars, tracks, etc.) except where the hoisting equipment is mounted as a complete portable unit.

Sec. 99. **Stiff-Leg Derricks.**—The sills of stiff-leg derricks shall be substantially secured in such a manner that the derricks will not tip under the maximum working load in any position. Not less than four guy lines shall be used to hold the mast of a guy derrick. Guy lines shall be securely fastened to the permanent construction where possible.

Sec. 100. **Hold-Down Guy.**—Where the boom of a stiff-leg or guy derrick is longer than the mast, a holding-down guy or other device shall be used to prevent pulling off the top fittings.

Sec. 101. **Mast Fastening.**—The foot of the mast shall be set on a substantial foundation and shall be securely fastened in place.

GASOLINE EQUIPMENT.

Sec. 102. **Refueling.**—No gasoline operated machinery or equipment shall be refueled when in operation.

Sec. 103. **Exhaust.**—The exhaust of a gasoline engine operating on air compressor for jack hammers in closed area shall be so located that there will not be any chance for exhaust gases being drawn into air intake of compressor.

Sec. 104. **Exhaust Extension.**—All gasoline engines must exhaust to the outside air. All exhaust pipes from tractors shall extend above the operator's head.

Sec. 105. **Storage.**—All gasoline shall be stored in closed drums located at a safe distance from all inflammable material.

PROTECTION FOR HOISTING ENGINEERS.

Sec. 106. **Enclosure.**—A proper enclosure shall be provided for the protection of operators of all hoisting equipment. The roof of the enclosure shall be of sufficient strength to protect the operator from falling material.

Sec. 107. **Windows.**—Windows shall be installed in the enclosure of ample size to afford the operator clear vision of all external parts of hoisting equipment.

Sec. 108. **Frost Shields.**—Frost shields shall be provided to prevent frosting of windows.

Sec. 109. **Heat.**—Adequate heat shall be provided and maintained in all hoist operators' enclosures.

Sec. 110. **Floor.**—The floors in all hoisting sheds shall be made of planks or other suitable material and be free from all tripping hazards.

HOIST MACHINERY.

Hoist winches used in connection with building construction.

Sec. 111. **Winch Gears.**—The gears, pinions and all revolving or reciprocating parts of hoist winches shall have a minimum factor of safety of six, and this factor of safety shall be obtained by dividing the lowest ultimate strength of the material by the computed stresses from all causes produced under conditions of maximum load.

Sec. 112. **Winch Frame.**—Every winch frame shall be of rugged construction and positively secured in position by holding down bolts of adequate diameter, which shall be kept drawn up tight when the winch is in use.

Sec. 113. **Winch Control.**—All winch control levers, and the controls of the engine or electric motor driving the winch shall be so grouped that every such control lever and control is within workable reach of the person acting as driver in charge of the hoist from the position which such person takes up when driving. The maximum throw of the control lever of a friction hoist winch shall not exceed 60 degrees.

Sec. 114. **Cable Drum.**—Every hoist rope barrel cable drum shall be provided with continuous flanges at each end.

Sec. 115. **Brakes.**—An efficient brake shall be fitted on the winch, and such brake shall be capable of exerting a restraining torque 50 per cent greater than the torque transmitted to the brake drum from the suspended maximum load, exclusive of the friction in the transmission parts between the load and the brake. To stop a hoist with full load at maximum speed in either up or down direction a brake applied by hand shall not require a greater force than 40 lbs. at the end of the hand lever and a brake applied by foot shall similarly not require more than 80 lbs. on the pedal.

Sec. 116. **Brake Blocks.**—Brake blocks and linings shall be protected from the action of water. Brakes shall be provided with a device to compensate for the wear of the linings or wear of the brake block. Brake weights shall be bolted or otherwise securely attached to their levers. Brake linings shall be effectively and permanently secure even after they have become worn. All steel brake bands shall be securely riveted or bolted with reamed holes and fit bolts to pin jaw which is pinned to cam or tumbling shaft arm.

Sec. 117. **Clutches.**—If the winding member is driven through a friction clutch, such clutch shall be of a type which can be instantly disconnected.

Friction clutches shall be protected from the action of water.

The faces of jaw clutches shall be kept square.

Jaw clutches with chipped or broken jaws shall not be used.

All hoisting machines shall be provided with automatic brakes of sufficient holding power to prevent rotation of drum in either direction when power is cut off from machine.

Sec. 118. **Limit Switch.**—All hoisting machines shall be provided with an efficient device limiting the travel of cage at top and bottom of shaftway, or should be equipped with an automatic signal.

HOIST TOWER — METAL.

(Steel Towers — Masts)

Sec. 119. **Loads.**—All steel construction towers, masts, hoists, etc., shall be built to conform to the 1928 specifications for steel construction adopted by the American Institute of Steel Construction, except that single bolted connections may be used, provided they are properly designed to carry the maximum working loads and stresses to be imposed upon them, with a safety factor of not less than 6.

Sec. 120. **Foundation.**—All steel construction towers, masts, hoists, etc., shall be placed upon firm and substantial foundations and securely guyed against swaying or tipping.

Sec. 121. **Guying.**—Particular care shall be given to securely anchoring and guying the top of the towers or masts and also at the bucket dumping position where such equipment is used. Towers, masts or hoists on which

booms are to be supported and used shall be designed or strengthened at the points where the boom may be attached as to safely sustain the maximum working load and the action of such equipment.

Sec. 122. **Anchor Spacing.**—Where steel construction towers, masts, hoists, etc., are secured or anchored to the building or structure, they shall be substantially secured at intervals of not more than 40 feet and also at the top. Where such towers or masts are erected independent of the building or structure the towers or masts shall have substantial guy anchorage at each corner-post or to cross-arm brackets, at intervals not exceeding 35 feet. The interval of spacing anchors may be increased and the number of guys reduced to permit the use of apparatus having long booms, when the material used and the method of construction employed provide a factor of safety not less than the requirement of this code.

Sec. 123. **Guy Lines.**—All guy lines used in anchoring and securing steel towers and mast hoists shall be not less than ½-inch steel cable or of sufficient strength to provide the proper factor of safety. Guy lines of used material must be inspected and approved by the State Industrial Commission before they can be used.

When it is necessary to remove diagonal bracing at the bottom or other levels of steel towers for loading or unloading, or any other purpose, some other bracing or reinforcement of equivalent strength shall be provided.

See Wood Towers for Sheave Beams, Ladders, Guarding Blocks and Cables, Gates and Platforms, sections 124 to 138.

HOIST TOWERS — WOOD.

Sec. 124. **Foundation.**—All towers used on construction work shall rest upon solid foundation and all wooden members shall be securely nailed or bolted.

Sec. 125. **Material.**—All materials, except the cage or bucket guides, shall be select common Oregon pine or equal.

Sec. 126. **Guide.**—The cage or bucket guide shall be clear, straight grained Oregon pine or equal, free from knots and other defects.

Sec. 127. **Size Uprights.**—The sizes of uprights for towers shall consist of lumber as specified in the following table:

Load	Tower Height Uprights
½ cubic yard or 2,000 lbs.....	50 ft. in height, 4" x 4"
½ cubic yard or 2,000 lbs.....	50 ft. to 100 ft., 4" x 6"
½ cubic yard or 2,000 lbs.....	100 ft. or more, 6" x 6"
1 cubic yard or 4,000 lbs.....	50 ft. in height, 6" x 6"
1 cubic yard or 4,000 lbs.....	50 ft. to 100 ft., 6" x 6"
1 cubic yard or 4,000 lbs.....	100 ft. or more, Industrial

See illustrations on Page 79.

Commission may require uprights of larger dimensions.

Sec. 128. **Removing Panel Ties.**—Not more than two ties shall be removed from any panel point in the tower at any one time and never from two consecutive panels.

Sec. 129. **Bracing.**—The diagonal cross bracing shall be at least 2" x 6" for all towers and shall occur on each of the four sides of the tower and

between each tier of horizontal cross-ties 6 to 7 feet apart, except at a loading and unloading platform, in which case some other bracing of equivalent strength shall be provided.

Sec. 130. **Splicing Corner Posts.**—The splices of corner posts shall be made with square butt joints and with at least two pads or scabs on the adjacent sides. The pads or scabs shall be the same width as the corner posts and not less than two inches in thickness, and must extend at least two feet on each side of the joint and be securely nailed or bolted.

Sec. 131. **Anchors.**—All towers shall be securely tied to the building or anchored every 35 feet in height by at least $\frac{1}{2}$ -inch cable with complete slings or timber ties bolted together and around tower.

Sec. 132. **Platforms.**—All material platforms used for hoisting material on buildings shall be enclosed on both sides to the height of at least five feet. This applies exclusively to material hoists. Where passengers are carried, regulations to passenger elevator must prevail.

Sec. 133. **Gates.**—Gates shall be provided at all landings, and platforms from tower to building shall be railed and have toe boards.

Sec. 134. **Towers Stairs.**—On towers where stair wells are used for employees to go to and from their work, there shall be a properly constructed stair with hand rail, toe boards and railings on landing. Tower shall be enclosed by close-fitting board not less than $\frac{3}{4}$ inch thick or 18-gauge wire netting having a mesh not greater than two inches fixed to the outside tower frame to a height not less than 6 feet above every floor level, scaffolding, platform or stairway adjacent to the hoist tower.

Sec. 135. **Guarding Blocks and Cables.**—All sheaves, blocks and wire cables accessible to workmen shall be guarded in such a manner to prevent workmen's clothing or limbs being drawn into sheaves or blocks.

Sec. 136. **Sheave Beams.**—Overhead sheave beams shall be of sufficient size and strength to carry safely the maximum working load and increased stresses of stopping and starting. The sheave beams shall be bolted or lag screwed, not nailed, and the sheave bearing shall be mounted in all cases on the top of beams, securely bolted to them and abut against the sheave hub.

Sec. 137. **Sheave Safety.**—A double safety cable shall be placed around lower part of tower frame and in front of hoist cable to prevent material hoist from falling in case lower sheave pin or jaw should break. All cables running from engine to hoist across stairs or passageway shall be guarded.

Sec. 138. **Guy Line Anchors.**—Where dead man is used to fasten guy lines it shall consist of 12" x 12" timber free from rot, and buried at least six feet into the ground. Cables shall be wrapped around dead man at least twice and secured with two or more cable clips.

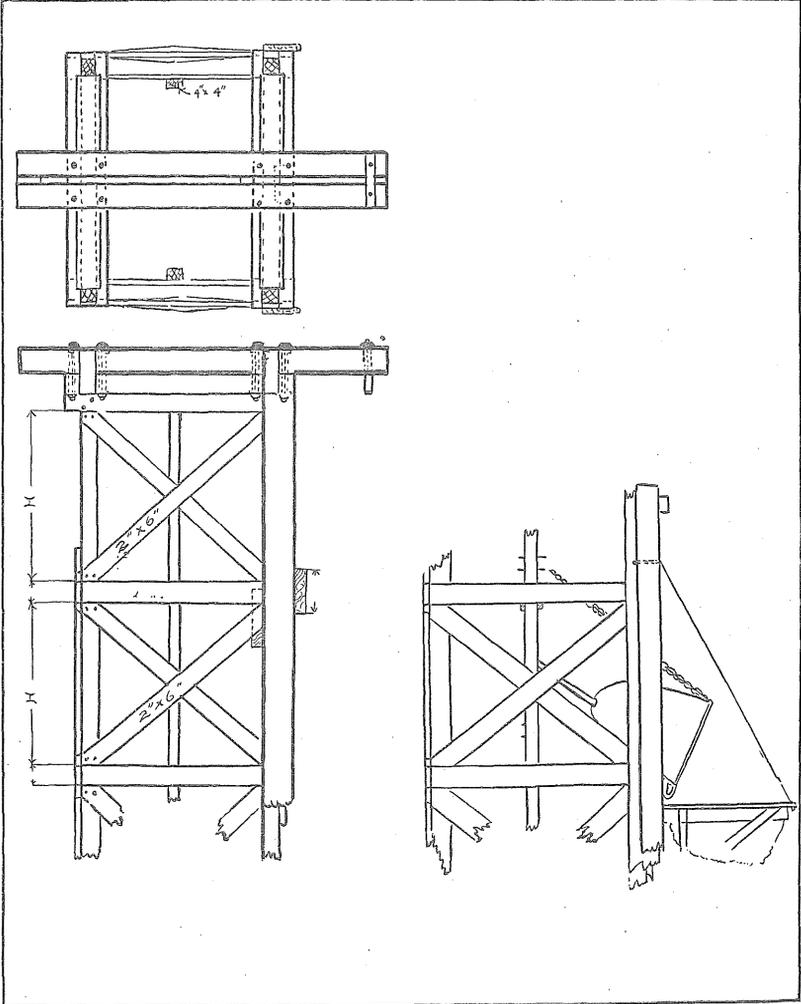
Where boxes are used for anchoring guy lines for hoist towers and derricks they must be of sufficient size and construction to hold the material necessary for such anchorage. Cables or slings must be securely wrapped around the box and clipped by at least two cable clips. Where a separate sling is used around dead man or box or where cables are spliced the loop shall be lined with properly formed metal thimbles to withstand wear.

SLINGS (HOISTING).

Sec. 139. **Slings.**—Slings shall be provided as part of hoist equipment and shall be in charge of an experienced man, who shall see they are kept in good condition.

Sec. 140. Cable Thimbles.—Ends of rope or cable sling shall be properly spliced to form the loops, and loop shall be lined with properly formed sheet metal thimble to withstand wear and must have two cable clips on each end.

Sec. 141. Equal Stress.—When using multiple rope sling or a sling with both ends engaged in the hoisting hook, the sling shall be adjusted so as to equalize the stress as much as possible.



Three Views of Towers.

SAFETY BELT, LIFE LINES AND NETS.

Sec. 142. Safety Belt.—Where workmen are employed 20 feet or more above the ground, floor or similar elevation, in theaters, auditoriums, lobbies, light courts, open shafts and similar places, and it is impracticable to pro-

vide temporary floors, stagings, ladders, or scaffolds therein, life nets or safety belts shall be provided by the employer for the protection of employees.

Sec. 143. **Life Nets.**—In cases where life nets or safety belts cannot be used, life lines shall be provided for use of employees engaged on such work.

Sec. 144. **Life Lines.**—Life lines shall be of no less than ¾-inch long fiber manila rope, securely fastened to worker with a belt.

Sec. 145. **Safety Belts.**—Belts to be at least three inches wide, and be fastened to some secure support above.

Sec. 146. Approved type safety belt, with shoulder-straps, must be provided.

MATERIAL HOIST TOWERS MADE OF WOOD.

Sizes of uprights for towers shall consist of as specified in the following table:

Load to Be Lifted	Tower Height	Uprights
½ cubic yard or 2,000 lbs.....	50 feet.....	4" x 4"
	50 to 100 feet.....	4" x 6"
	100 feet or more.....	6" x 6"
1 cubic yard or 4,000 lbs.....	50 feet.....	6" x 6"
	50 to 100 feet.....	6" x 6"
	100 feet or more.....	*See note

Note.—Industrial Commission may request uprights of larger dimensions.

For diagonal cross bracing and horizontal ties, see section 129. For splices of corner posts see section 130, page 79.

RUNWAYS AND RAMPS.

Sec. 147. **Platform.**—The runway shall be composed of planks each at least 10 inches in width, and the minimum width of the runway shall be 30 inches. They may be laid so that their edges abut. In that case a wide solid bearing shall be provided.

When the planks overlap, the plank that runs from below shall be placed so that it laps over the one running from above. The planks of runway and ramps shall be securely nailed and the supports shall be well braced.

Sec. 148. **Incline.**—Runways and ramps constructed at a greater incline than 1 foot rise to 6 feet shall be provided with cleats running crosswise and flush with the edges of the inclined platform.

Sec. 149. **Cleats.**—The cleats shall be of ample size, spaced not more than 8 inches apart and securely fastened. They may be laid in sections across the platform so as to form a barrow track.

Sec. 150. **Slipping.**—Runways and ramps shall be kept free from any slipping hazard.

Sec. 151. **Guard Rails.**—All runways or ramps shall be provided with guard rails and toe boards. Where such runways pass near deep holes, railroad tracks, high tension wires, mortar beds or similar dangerous places, guard rail and toe board shall be provided on open sides of the runways or dangerous places.

FLOOR OPENINGS, SHAFTS AND PITS

Sec. 152. **Guard Rails.**—All floor openings, elevator shafts and stairways shall be provided with substantial guard rails at least 42 inches high and with toe boards 6 inches high.

Sec. 153. **Ground Covers.**—All shafts or pits below the surface of the ground shall be covered with substantial plank covers, securely fastened or locked in such a manner that all unauthorized persons cannot remove the same.

DRINKING WATER.

Sec. 154. An adequate supply of pure drinking water shall be provided at all construction jobs in enclosed containers, which shall be kept in a sanitary condition at all times and so arranged that the employees must pour or draw the water from the container.

Sec. 155. A bubble fountain with pressure may be provided. Individual drinking cups shall be provided and employees shall use same. The use of drinking cups and dippers in common is prohibited.

Sec. 156. Ice used for cooling drinking water shall be applied in such a manner that the ice itself will not come in contact with the drinking water. The water from the melting ice shall not become mixed with the drinking water.

EYE PROTECTION.

Sec. 157. All employees engaged in cutting or chipping concrete, rock, steel or brick shall be provided with and use substantial safety goggles, properly fitted for the protection of eyes, without cost to the employee. (See illustrations on page 20 and specifications for lenses on page 55.

HELMETS.

Sec. 158. All employees engaged in the process of oxy-acetylene or electric welding or cutting shall be provided with approved welding goggles or helmets in compliance with sections 182.24 to 182.28, Minn. St. 1941 (Mason's 4166 to 4170), without cost to the employee.

Sec. 159. **Sterilizing.**—No employee shall be required nor shall he use goggles, helmets or respirator furnished to another until the same have been properly sterilized to prevent transmission of diseases. This sterilizing formula can be made up from one part of formaldehyde and ten parts of water. Other commercial products are available which can be used providing they result in proper sterilization of equipment specified.

HANDLING AND STORING OF EXPLOSIVES.

Sec. 160. — (1) No blasting caps or dynamite shall be kept on a job unless they are stored in separate approved magazines.

(2) Magazines must be locked at all times, properly ventilated, and the warning signs, "MAGAZINES — EXPLOSIVES — DANGEROUS," printed thereon or upon the barricade.

(3) Blasting caps shall not be stored in the same magazine with dynamite or other explosives.

- (4) No primed cartridges shall be stored in a magazine.
- (5) Dynamite cases or powder canisters shall not be opened within 50 feet of a magazine.
- (6) All explosives shall be kept in the original containers in the magazine.
- (7) The law also prohibits any smoking on a vehicle containing explosives.
- (8) Blasting caps or detonators shall not be transported with other explosives.
- (9) At the time of firing a blast no unloaded explosives shall be on hand except such as may be stored in magazines which have been inspected and approved by this department.
- (10) Responsibility. The person, town, village, city or county purchasing and storing explosives is responsible for the safe handling and storage of explosives.
- (11) An explosive magazine shall not be placed inside a wooden building.
- (12) Blasting cap magazines and all dynamite magazines, whether portable or stationary, shall at all times be located a safe distance from inhabited buildings, railways and highways.
- (13) Packages of explosives shall not be stored where men are working.
- (14) Workmen shall not be permitted to carry dynamite or blasting caps in their pockets.

Sec. 161. The principle of construction is simply that of placing one substantial box inside of another with a 5-inch space filled with dry, coarse sand.

Build outer box of type of ordinary contractor's tool box with sloping hinged lid.

Box should be of $\frac{7}{8}$ -inch tongue and groove boards.

The outer box will be 1 foot longer and 1 foot wider and 1 inch deeper than dimensions given for inner box, so that when inner box is set in the outer box the tops will be level with each other and there will be a 5-inch space on all sides for sand filling. Inner box is to be set inside larger box and fastened in place.

At top of each box on sides and ends cut $\frac{1}{4}$ -inch by 2-inch notches spaced about 1 foot apart and not directly opposite.

Level up box and support on wooden sills, bricks or rocks to keep bottom about 6 inches off the ground.

Fill space between boxes with dry, coarse sand (not gravel or crushed rock) to within $\frac{1}{4}$ inch of top of boxes. To prevent sand from falling into storage space or shifting position, a cover may be placed over the sand space.

Cover box with not less than No. 24 gauge iron.

FIRE PROTECTION.

Sec. 162.—All reasonable precaution against fire shall be taken and emergency fire protection shall be provided. Fire extinguishers shall be of the approved type for fire hazard involved.

FOOT PROTECTION.

Sec. 163. **Shoes.**—All persons employed on construction and engineering projects shall wear substantial work shoes with good soles.

Where there is a danger of crushing toes a hard toe safety shoe is recommended.

Sec. 164. **Boots.**—Where employees are compelled to work in water they shall be provided with rubber boots. No employee shall be required nor shall he use the boots furnished to another employee until the same have been thoroughly sterilized to prevent the transmission of foot diseases. All floors shall be kept free from waste material to prevent tripping.

Sec. 165. **Nails.**—Boards with nails shall be properly piled, and all passageways kept clear.

Sec. 166. **Rods.**—All protruding reinforcing rods, nails and wire in stairways and places where employees may be scratched or cut or fall on same shall be cut or covered.

HAND PROTECTION.

Sec. 167. **Acid Handling.**—All employees using acids for cleaning purposes on construction or engineering projects shall be provided with acid resisting gloves.

Sec. 168. **Sand Blasting.**—Employees engaged in sand blasting shall be provided with gauntlets when necessary for the protection of employees in such work.

HEAD PROTECTION.

Sec. 169. **Hard Hats.**—On all building construction, building wrecking, construction of locks, dams, bridges, men employed in shaftways, ditches and underground construction, the employees shall be furnished protective hard hats where necessary which will afford proper protection to the head from falling objects. All hard hats shall be approved by the Industrial Commission of Minnesota. The hats shall be furnished without cost to the employee.

Sec. 170. **Sand Blast Helmets.**—All employees engaged in the process of sand blasting shall be provided with an approved type of sand blast helmet. The helmet shall be so constructed as to fit tight on the head and shoulders so as to eliminate any fine particles of dust. The fresh air attachment shall supply clean, fresh air inside of helmet at a pressure that will eliminate any dust from entering inside helmet. This is to be done without cost to the employee.

PROTECTION FROM FALLING MATERIAL.

Sec. 171. **Enclosure.**—The ground actually occupied by the building construction operations or engineering project shall be shut off by an enclosure from places accessible to the public. The enclosure shall be such as to avoid any risk that might arise from the fall of any objects whatsoever. Places on the building site that are accessible to the workers shall be protected in a similar manner.

Sec. 172. **Warning Signs.**—Warning signs and red lights shall be conspicuously placed and maintained at all dangerous places on the job.

Sec. 173. **Sidewalk Shed.**—Whenever a building shall be erected or increased over two stories in height, or whenever a building of more than 25

feet in height is to be demolished upon any street of a municipality on which municipal regulations will not allow sidewalks to be blockaded, the owner, builder, or contractor constructing, repairing or demolishing such building shall erect and maintain, during the period of such construction and repair, a shed which shall extend over not less than one-half the width of the sidewalk and shall have a minimum width of three feet. The side wall toward the building shall be sealed with boards. The roof over the shed shall be constructed to support the approximate load carried, but in no case shall the planks on the roof be less than 2 inches in thickness. The street side of the sidewalk shed shall have a hand and an intermediate rail.

Sec. 174. **Light.**—Every sidewalk shed shall be kept in good repair, free from unnecessary obstruction and properly lighted at night. The ends of the sidewalk shed walk shall be marked with red lights on the street side.

PROTECTION FROM DUST.

Sec. 175. **Dust Respirators.**—Where persons are engaged in handling of cement in cars, working in rock-crushing plants or dry grinding of terrazzo, the employees shall be provided with and required to use dust respirators of an approved type, without cost to the employee.

Sec. 176. **Dust Collectors.**—On all dust creating operations the contractor shall provide adequate means of arresting or collecting dust to prevent a dust nuisance at the point where the dust is created.

PROTECTION FROM WATER.

Sec. 177. **Raincoats.**—On all construction or engineering projects where employees are exposed to dripping water, there shall be provided without cost a suitable waterproof hat and coat which will prevent their clothes from becoming wet.

SAFETY AND WELFARE OF EMPLOYEES.

Sec. 178. **Riding.**—No person shall be allowed to ride any material hoist.

Sec. 179. **Condition of Operator.**—No person shall be permitted to operate any cranes, power shovels or hoisting equipment of any kind, whose hearing or eyesight is defective, or who is suffering from heart disease or other ailments that might suddenly incapacitate him.

Sec. 180. **Truck Drivers.**—No truck driver shall remain in his cab when truck is being loaded by power shovels, unless cab is equipped with a substantial guard to protect the driver from being injured by material or swinging dipper.

SALAMANDERS.

Sec. 181. **Gas and Smoke.**—No means or agency of heat or heating shall be used which releases smoke or gas within an enclosure where workers are employed.

Sec. 182. **Vents.**—All salamanders or heaters using fuel shall be properly covered and piped to the outside air.

Sec. 183. **Steam Driers.**—The use of steam unit heaters or radiators, fans or blowers is recommended for the drying of concrete and plaster.

TRANSPORTATION OF EMPLOYEES OF ENGINEERING JOBS.

Sec. 184. **Riding.**—No employees will be allowed to ride trucks with feet or legs hanging over sides or ends of truck bodies.

Sec. 185. **Dump Trucks.**—If dump trucks are used, truck body must be chained to chassis.

Sec. 186. **Seats.**—Each truck shall be equipped with plank seats, adequately fastened to fit top of sides of body to prevent slipping.

Sec. 187. Last two seats shall be so arranged that men ride in trucks back to back. Men on last rear seat shall be able to brace feet on end gate.

TOILETS.

Sec. 188. Sanitary toilet facilities shall be provided and maintained on all construction work, in accordance with section 182.35, Minn. St. 1949.

Sec. 189. **Inside Toilets.**—On all construction and engineering projects the toilet rooms and every part thereof, including the floor, walls and ceilings, and all fixtures therein, must be kept in a clean condition. All toilet rooms shall be properly illuminated by natural or artificial light. All toilet rooms not lighted by windows that open easily shall be adequately ventilated to the outside air by artificial means.

Sec. 190. **Outside Toilets.**—All toilet facilities shall be constructed to prevent the entrance of and breeding of flies; properly ventilated and lighted. All seats shall be equipped with hinged covers. A liberal supply of lime or other disinfectant shall be used in the privy vault.

WARMING AND DRY HOUSES.

Sec. 191. **Dressing Room.**—From September 15th to May 1st, inclusive, all construction jobs shall be provided with a warming house or suitable place for employees to change their clothes and eat their lunch.

Sec. 192. **Size.**—Warming house to be of such size as to accommodate all employees on one shift, properly lighted, heated and ventilated.

CAMPS.

Sec. 193. Where the construction work requires employees to be housed, the Minnesota Industrial Camp Regulation of the State Board of Health shall apply.

Sec. 194. **Weather Protection.**—Where workers are exposed a suitable means to protect employees from excessive heat or cold shall be provided.

Sec. 195. **Lockers.**—Necessity for individual lockers shall be determined by the Industrial Commission of Minnesota.

Sec. 196. On all construction projects where it is considered necessary, shower baths shall be provided with an adequate supply of warm water. Showers located outdoors shall be enclosed to insure privacy and the floors shall be raised above the ground and well drained.

GUARDING MACHINERY.

Sec. 197. All dangerous parts of construction machinery or equipment shall be securely and effectively guarded while in operation. Guards removed

for alterations or repairs shall be replaced before machinery is placed in operation.

Sec. 198. **Guards for Gears and Friction Drives.**—All gears and friction drives, wherever located, shall be completely incased or shall be guarded by a band extending around the face, with side flanges extending inward beyond the roots of the teeth.

Sec. 199. **Spokes.**—Where there is a spoke hazard the spoke shall be enclosed on the exposed side.

Sec. 200. **Sprockets.**—All sprockets, wherever located, shall be completely incased.

Sec. 201. **Chain.**—Chains shall be guarded at the intake side of the sprocket.

Sec. 202. **Clutches.**—Dangerous projections on all clutches shall be completely incased.

Sec. 203. **Projections on Moving Parts.**—All keys, set screws, shaft ends and other projections protruding beyond the surface of revolving parts of construction machinery or equipment, when exposed to contact, shall be covered.

Sec. 204. **Belts and Pulleys.**—All belts and pulleys on construction machinery or equipment, when in reach of workmen, shall be completely enclosed on all exposed sides, or protected with standard railing located within 15 inches of such belt or pulley. All guards within 4 inches of belt or pulley shall have no openings in the guard more than $\frac{1}{2}$ inch.

Sec. 205. **Saws.**—All power driven cross-cut and rip saws shall be provided with a substantial guard over the blade which will follow the material. Rip saws shall be equipped with spreader blade to prevent material from binding or pinching. Guards shall automatically rise by pressure of material or otherwise to receive the material to be cut and shall be so constructed or equipped as to prevent material being thrown back at operator.

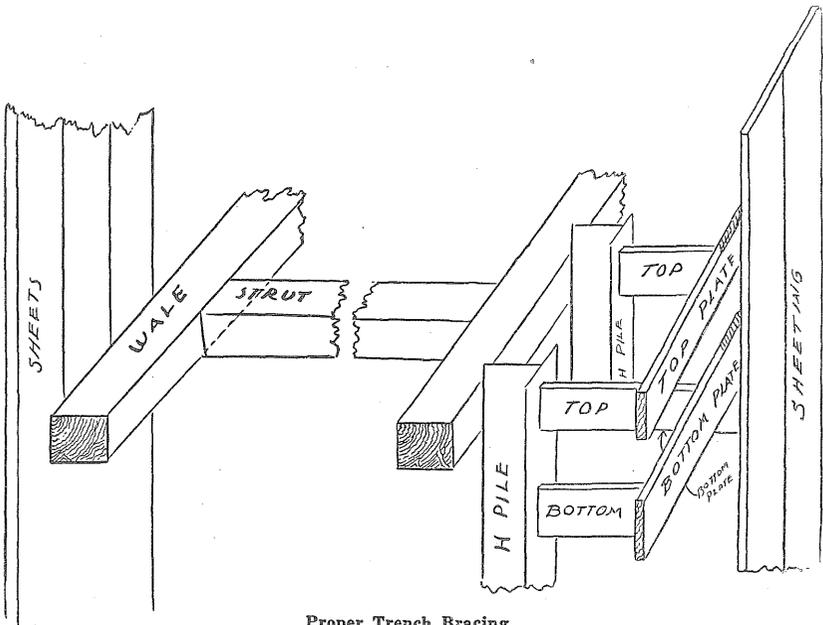
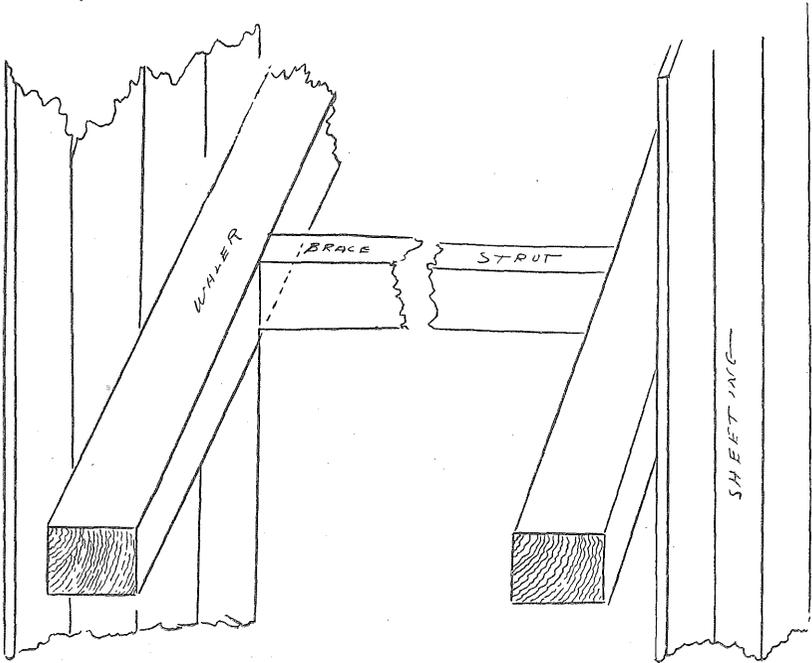
Sec. 206. **Shaft Couplings.**—All shaft couplings on centrifugal machines must be completely enclosed.

TRENCH BRACING.

Sec. 207. **Trenches Not Over 7 Feet Deep.**—If the trench is not over 7 feet in depth, wooden sheet-piling shall not be less than 2 inches in thickness. If the trench is over 7 feet in depth, the wooden sheet-piling shall not be less than $2\frac{5}{8}$ inches in thickness.

Sec. 208. **Vertical Braces in Hard Material.**—Trenches over 8 feet in length and 5 feet or more in depth in hard, compact material shall be braced at intervals not exceeding 8 feet, with $1\frac{5}{8}$ " x $5\frac{5}{8}$ " planks, or heavier, placed vertically in the trench opposite each other against the walls. These braces shall, if possible, extend to the bottom of the trench; otherwise as low as possible to clear the top of pile or other material to be placed in the bottom of the trench.

Sec. 209. **Strut Braces and Screw Jacks.**—The strut braces in trenches shall be supported by screw jacks or by timbers placed at right angles to



Proper Trench Bracing.

both stringers, cleated and rigidly screwed or wedged. The timber shall not be less than the following:

Width of Trench	Size of Timber
1 ft. to 3 ft.....	4 x 4 in.
3 ft. to 6 ft.....	4 x 6 in.
6 ft. to 8 ft.....	6 x 6 in.

One horizontal strut brace shall be required for each pair of vertical braces, for each 4 feet of depth or major fraction. Horizontal stringers shall not be less in strength than 1 $\frac{5}{8}$ " x 5 $\frac{5}{8}$ " clear timber.

Sec. 210. **Trenches in Loose Material.**—When the excavation of trenches for pipes or other purposes in connection with building operations exceeds four feet in depth in loose or running soil, or five feet in depth and eight feet in length in stiff soil, other than rock or hardpan, the sides of such trenches shall be sheet-piled and braced to prevent the soil from caving in on those engaged in work in such trenches.

Sec. 211. **Inspection of Sheeting.**—Inspectors and foremen shall inspect thoroughly every day the possibility of the backing or filling running out from behind the sheeting. This is necessary where the trenches are being dug in sand, especially quicksand.

When in the judgment of the inspector additional shoring or bracing is necessary to make the job safe, they shall insist upon the orders being carried out at once, and the men removed from the trench or pit while being complied with.

Sec. 212. **Material at Edge.**—All materials shall be kept at least two feet away from edge of trench to prevent loose material from falling on employees in ditch.

Sec. 213. **Ladders.**—Substantial ladders shall be provided in all trenches to afford proper passage in and out of trench.

Sec. 214. **Mechanical Digger.**—When mechanical trench diggers are used, the sides of the trenches shall be braced in the manner previously described as rapidly as the work progresses.

Sec. 215. **Unshored Space.**—The unshored space between the end of the fully installed sheeting or shoring and the end of the trench, where the excavation is actively proceeding, shall never exceed 10 feet.

Sec. 216. **Blasting.**—If blasting is done in trenches, a suitable blasting mat or heavy plank and timber shall be placed over top of trench to prevent any loose material being thrown above ditch.

When blasting near highway or street, traffic must be properly flagged.

All blasting shall be performed by an experienced man.

TUNNELS.

Sec. 217. **Combustible Material.**—All combustible material shall, as far as possible, be kept out of structures or near the shaft entrance to tunnels. Oils and other dangerous flammable materials shall be stored in a covered building kept solely for such storage and located at least 100 feet from the shaft. No combustible rubbish shall be permitted to remain in the tunnel.

Sec. 218. **Waste Containers.**—Metal containers shall be installed in tunnel engine rooms for the deposit of greasy waste.

Sec. 219. **Dry House.**—Adequate and sanitary washing, bathing, latrine facilities, shall be provided. Change houses shall be cleaned daily.

Sec. 220. **Housekeeping.**—All waste material must be removed from tunnel walks and surface buildings on each shift.

Sec. 221. **Hoisting Engine.**—The hoist shall not be housed in the same room with the air compressors, as the noise may cause confusion in the reception of signals.

Equipment shall be housed in a warm, substantial building with adequate illumination.

Sec. 222. **Signal System.**—Every shaft shall be provided with an efficient means of interchanging distinct and definite signals between the top of the shaft and the lowest level and the intermediate levels from which hoisting is being done. The push and pull electric system is necessary for depths greater than 150 feet, and desirable for all shafts. However, a signal system consisting of a cord or wire actuating a bell or whistle is satisfactory for shafts of shallow depths if the line is protected against accidental signaling. Special care shall be taken to keep electrical apparatus in good order and from coming in contact with other electric conductors.

Sec. 223. **Signals.**—Standard signals shall be used, an explanation of which shall be posted in the hoist room, collar of the shaft and at each underground station. The following signals are required in several states and may be considered as standard for all shallow shafts:

1 bell—Stop if in motion or hoist if not in motion;

2 bells—Lower;

3 bells—Run slowly and carefully.

Additional signals to meet local conditions may be adopted.

Sec. 224. **Riding Buckets.**—The use of buckets for handling men is extremely dangerous. The maximum number of men permitted to ride on one cage or bucket shall be determined and the rule strictly enforced.

Riding with tools or material shall be prohibited.

Sec. 225. **Cages.**—Cages shall be equipped with effective safety catches, and these shall be inspected frequently.

Sec. 226. **Tie Material in Bucket.**—When tools, timber or other materials project above the cage or bail of the bucket, they shall be securely fastened to the hoisting rope or to the cage in a manner that will prevent contact with the side of the shaft.

Sec. 227. **Gates.**—The gate or entrance shall afford safe clearance for the shaft opening and permit easy entrance for persons and the loading of material.

Sec. 228. **Landing.**—Shafts shall have proper platforms for landing of buckets or elevator. Elevating apparatus shall be frequently inspected.

Tunnel shafts shall be fenced in and platforms guarded with railings. Red lights shall be placed at night.

Sec. 229. **Head Frame.**—The material and construction of the head frame shall be sufficiently strong and durable to assure its withstanding any

strain likely to be put upon it. The head frame shall be so constructed as to secure the maximum protection for men working on or around it.

Sec. 230. **Sheaves.** — Sheaves shall be sufficiently strong, properly mounted, and frequently inspected.

Sec. 231. **Clearance.**—Safe clearance shall be provided between the top landing and sheave timbers.

Sec. 232. **Access to Sheave.**—A stairway or fixed ladder, with runway equipped with hand rails, is desirable for easy access when oiling the cable sheave.

Sec. 233. **Guardrails.**—All runways and platforms shall be equipped with toe-boards and handrails.

Sec. 234. **Walks.** — Car tracks shall be provided with good runways, free from openings.

Sec. 235. **Timbering.**—Timbering requirements for shafts are governed by the nature of the soil and surrounding conditions.

A large factor of safety must be used when selecting the kind of supports to be used and in the installation of same.

Timber sets shall be properly spaced, joints securely fitted and the whole structure securely blocked and wedged in place.

Sec. 236. **Voids.**—Open spaces or voids behind the timbering shall be filled with suitable material.

Sec. 237. **Ladderway.**—Shafts shall be provided with safe ladders from the bottom to the surface. They shall be kept always in good condition.

The rungs shall be securely fastened, equally spaced, not over fourteen inches apart, and the length of the rungs not less than twelve inches.

Sec. 238. **Landings.**—Ladders shall be provided with landings every thirty feet.

Sec. 239. **Rungs.**—The rungs of a ladder shall in no case be less than four inches from the wall or other obstruction in the shaft to give enough toe room.

Under no circumstances shall any ladder, inclining backward from the vertical, be installed.

Sec. 240. **Ladder Tops.**—The tops of the ladders shall extend at least three feet above the collar of the shaft or landings.

Sec. 241. **Cleaning Shaft Timbers.**—Timbers and projections in ladderways or stairways shall be kept clean of all loose rock and other debris.

Sec. 242. **Passageway.**—At all landings where it is necessary for men to cross from one side of the shaft to the other and there is no tunnel work provided, adequate provisions must be made to prevent exposure to falling material or descending buckets or cages. No tunnel shall be driven to exceed 2,500 feet between portal or portals or between shafts or exits unless approved by the Industrial Commission of Minnesota.

Sec. 243. **Ventilation.**—Tunnel workings shall be thoroughly ventilated to expel poisonous gases resulting from blasting. Men shall not be permitted to return until this has been accomplished.

Sec. 244. **Fans.**—For quick removal of gases in headings not under pressure, a fan with suitable tubing shall be used after each shot.

Precautions shall be taken at the beginning of each shift for the detection of explosive gases and insufficiency of oxygen in the air. Further precautions shall be taken from time to time to see that noxious gases are exhausted from the working face.

Portable blowers, with lines of flexible tubing or other suitable conduit to clear fumes from headings, shall be installed.

Ventilation shall be adequate to carry off all carbon monoxide gas exhausted by trucks or tractors.

Sec. 245. **Fans and Blowers.**—Blowers that are capable of delivering a sufficient volume of good air to the ventilation line, with enough pressure to give the desired results, shall be selected.

Sec. 246. **Minimum Air Requirements.**—A minimum of 100 cubic feet of air per minute per man, or, where horses and mules are used, at least 200 cubic feet per horse or mule per minute, shall be supplied.

In tunnels and subway construction, where other gases are likely to be encountered, 400 cubic feet of air per minute per man is recommended.

No person shall be permitted to work in tunnels under air pressure until approved through physical examination.

Sec. 247. **Loose Materials.**—Daily inspection of the roof and sides of tunnel shall be made by a competent inspector, and loose pieces of rock scaled and removed.

After a blast is fired and the blasting is completed, the affected locality shall be thoroughly scaled and all loose materials removed.

Sec. 248. **Safety Hats.**—Wearing of safety hats when tunneling in loose or scaly material is recommended.

Sec. 249. **Lighting.**—Tunnels, stairways, ladderways, passageways and all dark places on the surface shall be properly lighted.

Shafts more than 100 feet deep shall be well lighted.

Places housing hoisting, pumping or other machinery shall be so lighted that moving parts of machinery can be clearly distinguished.

Sec. 250. **Emergency Light.**—Spare or emergency lighting equipment shall be kept ready and conveniently located in all underground stations where a failure of electric light might cause danger.

Care shall be taken that electrical equipment and appliances are properly guarded and protected.

Sec. 251. **Communication.**—Where tunnels are driven from shafts a telephone system shall be established and maintained, communicating with the surface at each shaft, and with a station or stations readily accessible at the working levels.

Sec. 252. **Windlass.**—The base of the windlass shall be constructed of four 2" x 4" oak, laid flat to form a square, and shall be about 40 inches across.

Sec. 253. **Uprights.**—The uprights supporting the load shall be of 2" x 4" oak and shall be braced with two 5/8" iron braces securely fastened to base and extend to a height of three-fourths of the uprights.

Sec. 254. **Winding Shaft.**—The winding shaft shall be of steel, continue through the wood drum and extend far enough beyond the uprights to secure the handles. The shaft shall be secured with a locking device at top ends of uprights.

Sec. 255. **Drums.**—The wood drum shall be of maple wood about 5 inches in diameter and securely fastened to the winding shaft by staggered bolts.

The drum must be equipped with a brake at one end, and be of sufficient size and leverage to hold the load. Gears or sprocket teeth with a dog must be placed on the other end capable of holding the load.

Sec. 256. **Ropes.**—Ropes shall not be less than $\frac{3}{4}$ inch of good manila rope unless otherwise specified by the Division of Accident Prevention of the Department of Labor and Industry.

Sec. 257. **Handles.**—The windlass must be equipped with two properly fitted and constructed handles, securely fastened to shaft.

The windlass shall be operated by two men when employees are being raised or lowered in shaft also when bucket is raised or lowered while men are at work in shaft.

Sec. 258. **Safety Hooks.**—Safety hooks must be provided on all operations.

WRECKING OF BUILDINGS.

Sec. 259. (1) **Roof.**—When wrecking any building, the floors and walls shall not be disturbed until the roof has been removed.

(2) **Side Walls.**—Side walls shall not be removed more than one story at a time, after which the floor of that particular story shall be removed.

(3) **Chutes.**—Chutes shall be provided to lower plaster, bricks, and other loose material. Materials shall not be allowed to accumulate on floors.

(4) **Stairways.**—Stairways and passageways shall be kept clear of materials at all times.

(5) **Floor Openings.**—All floor openings shall be provided with substantial railings, or shall be kept securely covered.

(6) **Scaffold.**—Adequate scaffolding shall be provided and maintained for use of employees removing walls and partitions.

(7) **Protruding Nails.**—All boards and other loose material shall be kept free of protruding nails.

(8) **Employees on Top of Walls.**—Employees shall not be allowed to stand or work on the top of walls being removed.

(9) **Crushing Protection.**—Employees shall not be allowed to stand or work underneath steam shovel dippers or other mechanical devices used for carrying or hoisting materials.

(10) **Goggles.**—The employers must furnish proper goggles for all men employed to protect their eyes against chips or dust; and where glasses are used, their goggles shall be properly fitted over the glasses; if acetylene gas or electric welders are used for any purpose, proper goggles and eye protection must be furnished.

(11) **Ladders.**—Good substantial ladders shall be furnished by the employer and shall be fitted with shoes or other safety devices to keep them from slipping.

(12) **Water Hose.**—A water hose of sufficient size shall be furnished and used to wet down all walls and dust to keep them from injuring the eyes of the people at work and pedestrians or people living or having offices in the vicinity.

(13) **Guard Rails.**—If windows are taken out and men are employed where there is a danger of falling out, railings or protection must be put at these openings, as well as at elevators and stairways and other holes made through floors.

(14) **Lights.**—Wherever owing to the condition of the building the regular lights are discontinued, and if there is need of extra illumination to protect people from stepping on nails or being injured in any way, special lights shall be run into the building while being razed.

(15) **Toilets.**—Toilet facilities shall be provided.

(16) **Eating Place.**—A safe place shall be provided for the workmen to eat their lunches.

(17) **Drinking Water.**—The employer shall always furnish pure drinking water for the employees on the job.

(18) **Inspection—Ropes, Cables, Beams.**—All ropes, cables, beams, hoisting or other apparatus shall be regularly inspected.

(19) **First Aid Kits.**—Regular first aid kits shall be provided and the men shall be instructed to immediately take care of all cuts and scratches.

(20) **Shoes.**—The shoes on the workmen shall be regularly inspected, so as to protect the workers against nails and other sharp objects. Boards with nails shall be properly piled and all passageways kept clear.

(21) **Removing Materials.**—Men shall be instructed to be very careful not to pull any object off up above where any other men might be working or allow it to fall through to floors or ground below.

(22) **Pulling down Walls.**—Whenever walls are being pulled down the place must be roped off or fenced off and a watchman put to notify the public of the danger of flying objects.

(23) **Catch Scaffold.**—Catch scaffolds shall be constructed on the outside walls of all buildings being wrecked no less than three stories from the top floor. Catch scaffold shall be at least 10 feet wide with 36-inch flare board, and shall be constructed of good, sound, heavy material.

WARNING SIGNS AND FLAGS, FLARES AND LANTERNS.

Sec. 260. **Warning Sign.**—On all construction and engineering projects it shall be the duty of the employer to designate all dangerous places with warning or danger signs with letters no less than 5 inches in height and so placed that they will be visible night or day and clearly indicate the hazard at a safe distance.

Sec. 261. **Red Lanterns.**—Where red lanterns are called for, it will be essential for the contractor to see that they are kept cleaned, trimmed, and

filled properly at all times, and the light be kept at such a height so that the maximum amount of radiation will be available.

Sec. 262. Space Between Lanterns and Flares.—All dangerous places of every kind and description shall be marked at all extremities with red lanterns. The space in between the extremities of the project, if not over 20 feet in length, may be filled in with flares.

Flares may also be used on road construction projects as auxiliary safeguards to red lanterns to designate the length of the projects, as, for instance, if patch or shoulder work on roads is in progress, red lanterns should be used to designate the entire width of the project on the side toward the travel, in which case no less than two red lanterns shall be used on either end; or, if the distance is greater than 20 feet, red lanterns shall be placed every 20 feet with the flares in between and the entire length of the operation shall be marked with flares placed not more than 40 feet apart.

Sec. 263. Fastening Lanterns.—If the project is to last a greater period of time than 15 days, arrangement shall be made by which lanterns can be securely fastened to the barricade or to a post in line with the barricade, so that the lanterns cannot be stolen.

Sec. 264. Red Lights on Hills.—On hills an advance red light shall be placed at least 50 feet in advance of the place where the work is being done, so that car drivers will be able under all conditions to have their cars under control by the time they get to the point where actual operations are taking place. The same advance signals shall be used in the daytime when flags are used in place of red lanterns, and flags shall be placed in accordance with these instructions.

Sec. 265. Detours.—In all places where detours are made where traffic is reasonably heavy, signs, arrows, flares or lights shall be placed at turns to clearly indicate the detour. Where narrow bridges or culverts are crossed, or the detour is too narrow to permit two cars to pass, safety flares or lights shall be used.

CONSTRUCTION IN, ON, OR OVER WATER.

Sec. 266. On wharves, docks, bridges, or trestles wherein crib, caisson, coffer dam, pile driving, pier, abutment, breakwater, subaqueous or any other building or construction, alteration, repair, painting or removal work in or over water is carried on, and where employees are exposed to drowning or other hazards, a sufficient number of life belts or life buoys with lines attached and in good condition shall be kept easily accessible and in close proximity. Where any of the work above described is on water a boat, dory, punt or skiff shall be kept near, easily accessible and equipped with life belts or life buoys, oars and oar locks for use of employees. In crib enclosures or work of similar nature where employees are exposed to danger of falling inside of the enclosure a life raft shall be provided.

Where employees are engaged in construction of dams, harnessing water power, water accumulation or storage, suction or bucket dredging, etc., life buoys, boats, punts, skiffs or other effective means of safety shall be provided, kept in good condition, and located in close proximity for their use.

PILING.

Sec. 267. Pile Leads.—Pile leads shall be kept well greased to provide for perfectly smooth travel of the hammer. When piling is being hoisted into

the leads all men shall be kept in the clear, so that in the event hooks or cables should break they will not be injured.

Sec. 268. **Pit Shoring.**—All excavation in the pits where piling is being driven shall be properly sloped or sheeted and braced so that no cave-in will occur which might affect the sill or cribbing under the pile driver.

Sec. 269. **Pile Driver Sills.**—The pile driver shall be kept on good, wide sills and good, substantial cribbing. If radius pile drivers are used, operated by two separate units of power, the sills and cribbing where machinery is placed shall be solid.

Sec. 270. **Vibration.**—If the pile driver is operating in the cellar, the surrounding banks, buildings and public utility lines shall be carefully watched for any effects which the vibration of the pile driver may cause, such as cave-ins, break of water or gas mains, cracking of building walls or falling of loose materials from buildings.

Sec. 271. **Approach.**—Proper and safe means of approach to pile driving operations must be maintained at all times, guarded and well lighted.

Sec. 272. **Crow's Nests.**—All crow's nests on pile drivers must be built to stand at least three times the load placed upon them. They shall be properly railed, well lighted and all ladders must be properly constructed and braced.

Sec. 273. **Lighting.**—All pile driving operations must be well lighted at night.

Sec. 274. **Steam Hose.**—All steam hose must be equipped with safety couplings and all leaks made tight to prevent escaping of steam. All hose used for air or steam shall be of high pressure material.

Sec. 275. **Clear Vision.** — All exhaust steam must be piped so that the engineer and the man in the crow's nest will have a clear view of all operations.

Sec. 276. **Saddle.** — Workmen guiding steel sheeting into the groove shall use a saddle made by bending angle iron over the top edge of the sheeting with foot rest bent on either side. Men shall by all means stay back the distance of one sheet from the one being guided into place to avoid being pinched.

Sec. 277. **Steam Hammer.**—When discontinuing the use of the hammer, pipe lines shall be cleared by opening the cocks on the hammer and blowing steam through. After this has been done, the flexible hose shall be disconnected either at point where it is joined to the hammer or at the end of pipe line. This is for the purpose of eliminating any possibility of damaging the hammer, the flexible hose, or the pipe line by freezing during cold weather, and also for preventing possible scalding accidents caused by the shooting of plugs of hot water from the hammer when it is started up again.

Sec. 278. **Hammers.**—Hammers shall be blocked at the base of the leads when not in use, or shall be secured against falling by some other safe means.

Sec. 279. **Chop Block.**—On all pile driving leads a chop block or stopping block shall be placed about $\frac{1}{2}$ the distance from the top of the leads. The purpose of this block is to hold the hammer in place while a pile is being set. The block shall be so constructed that it will safely hold the hammer in place.

Sec. 280. **Hammer Cables.**—All hammers shall be securely fastened to the cable by using a thimble in the loop with no less than two cable clips

SAFE LOAD FOR ROPES, CHAINS AND SHEAVES.

(In Pounds)

Sec. 281. Caution.—When handling molten metal, wire ropes and chains shall be 25% stronger than indicated in table. Manila rope shall not be used for this purpose.

WIRE ROPE.

Standard Crucible Cast Steel Hoisting Ropes and Slings, 6 Strands, 19 Wires to the Strand and one Hemp Core.

Safe loads in pounds for single rope. Load in table to be decreased one-half if single rope is used for hoisting an elevator.

Factor of safety of 8 is used. Figures based on American Steel and Wire Company Rope Engineering Handbook, 1940.

Diam. Rope Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
3/8".....	1,125	975	795	560
1/2".....	1,925	1,670	1,360	960
5/8".....	2,950	2,500	2,085	1,475
3/4".....	4,200	3,640	2,970	2,100
7/8".....	5,700	4,940	4,030	2,850
1 ".....	7,375	6,375	5,215	3,690
1 1/8".....	9,250	8,000	6,540	4,625
1 1/4".....	11,500	9,940	8,130	5,750
1 3/8".....	13,750	11,875	9,720	6,875
1 1/2".....	16,250	14,060	11,500	8,125

Special Flexible Crucible Cast Steel Hoisting Ropes and Slings, 6 Strands, 37 Wires to the Strand and one Hemp Core.

Diam. Rope Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
3/8".....	1,100	950	775	550
1/2".....	1,925	1,670	1,360	960
5/8".....	2,900	2,510	2,050	1,450
3/4".....	4,100	3,550	2,900	2,050
7/8".....	5,500	4,760	3,890	2,750
1 ".....	7,125	6,170	5,040	3,560
1 1/8".....	9,000	7,810	6,375	4,500
1 1/4".....	11,075	9,560	8,060	5,500
1 3/8".....	13,375	11,560	9,440	6,690
1 1/2".....	15,875	13,750	11,250	7,940

Special Flexible Plow Steel Hoisting Ropes and Slings, 6 Strands, 37 Wires to the Strand and one Hemp Core.

Diam. Rope Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
3/8".....	1,325	1,145	940	660
1/2".....	2,300	1,990	1,625	1,150
5/8".....	3,500	3,030	2,475	1,750
3/4".....	4,950	4,290	3,500	2,475
7/8".....	6,625	5,740	4,690	3,310
1 ".....	8,625	7,440	6,100	4,310
1 1/8".....	10,875	9,440	7,690	5,440

1¼".....	13,375	11,560	9,440	6,690
1⅜".....	16,125	13,940	11,375	8,060
1½".....	19,190	16,625	13,560	9,560

Standard Plow Steel Hoisting Ropes and Slings, 6 Strands, 19 Wires to the Strand and one Hemp Core.

Diam. Rope Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
⅜".....	1,375	1,190	970	690
½".....	2,350	2,030	1,660	1,175
⅝".....	3,600	3,120	2,540	1,800
¾".....	5,150	4,460	3,640	2,575
⅞".....	7,000	6,060	4,950	3,500
1 ".....	9,125	7,875	6,440	4,560
1⅛".....	11,150	9,940	8,125	5,750
1¼".....	14,125	12,250	11,000	7,062
1⅜".....	17,000	14,690	12,000	8,500
1½".....	20,125	17,440	14,250	10,060

MANILA ROPE.

Safe loads in pounds for three strand single rope.

Diam. Rope Inches	Circ. Rope Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
⅜".....	1⅛"	115	100	81	60
½".....	1½"	265	230	189	133
⅝".....	1⅞"	440	380	310	220
¾".....	2¼"	540	470	380	270
⅞".....	2⅝"	770	665	545	385
1 ".....	3 "	900	780	635	450
1¼".....	3¾"	1,350	1,160	955	675
1½".....	4½"	1,850	1,890	1,310	925
1¾".....	5¼"	2,650	2,300	1,880	1,325
2 ".....	6 "	3,100	2,680	3,185	1,550

Factor of safety of 10 is used. Figures are based on the following: Kent's Hand Book, Volume 3, Eleventh Edition, Section 6, Page 26.

Due to war emergency, Sisal Rope was purchased. Safe loads for this kind of Rope are to be 70% of above loads for same sized rope.

CHAINS.

Safe loads in pounds for single chains.

Diam. Link Inches	When Used Straight	When Used at 60°	When Used at 45°	When Used at 30°
¼".....	720	623	509	360
⅜".....	1,620	1,403	1,145	810
½".....	2,880	2,494	2,036	1,440
⅝".....	4,500	3,897	3,182	2,250
¾".....	6,480	5,612	4,582	3,240
⅞".....	8,820	7,638	6,236	4,410
1 ".....	11,520	9,977	8,146	5,760
1⅛".....	14,580	12,627	10,310	7,290
1¼".....	18,000	15,588	12,728	9,000
1⅜".....	21,780	18,862	15,401	10,890

Factor of safety of 5 is used. Figures are based on U. S. Testing Board's figures on best grade of wrought iron, hand made, tested short link chain.

SAFE LOADS FOR SCAFFOLD PLANKS

Safe loads in pounds uniformly distributed over wide surface of plank supported at both ends.
For loads concentrated in center use one-half of load given.

Span in Feet	— Size of Plank, in Inches —							
	2x6	2x8	2x10	2x12	3x6	3x8	3x10	3x12
	Dressed to 1½ x 5½	Dressed to 1½ x 7½	Dressed to 1½ x 9½	Dressed to 1½ x 11½	Dressed to 2¼ x 5½	Dressed to 2¼ x 7½	Dressed to 2¼ x 9½	Dressed to 2¼ x 11½
6	216	288	364	441	621	848	1,073	1,299
8	153	204	258	312	451	615	779	944
10	113	150	191	231	346	472	587	723
12	.....	113	144	174	273	372	471	571
14	.....	.....	107	129	218	298	376	456
16	.....	.....	.....	94	175	238	302	367
18	.....	.....	.....	.....	139	191	241	292
20	.....	.....	.....	.....	110	149	190	229

Loads are computed for spruce or Norway pine and may be used for Douglas fir or long-leaf yellow pine if tabulated load is multiplied by the following corresponding constants:

Douglas fir, 1.14; long-leaf yellow pine, 1.55.

Table shows safe loads uniformly distributed over the plank supported at both ends. Loads given are net and do not include the weight of the plank.

To arrive at combined weight of load and plank add weight of plank (based on weight of long-leaf yellow pine—40 lbs. per cu. ft.) to load given in table.

Stone masons	Load	75 pounds to square foot
Stone setters	No load	40 pounds to square foot
Bricklayers	Load	50 pounds to square foot
Carpenters	No load	20 pounds to square foot
Painters	No load	20 pounds to square foot
Stucco	Hod load	30 pounds to square foot
Plasterers and lathers	Hod load	30 pounds to square foot

Lathers pre-cast—Designed to carry weight by bay of casts and men.

BUILDING MATERIAL WEIGHTS PER CUBIC YARD
BULK MATERIALS

	Lbs. Per Cubic Yard	Tons Per Cubic Yard
Andesite stone.....	4,887	2.44
Ashes	1,080	.52
Asphalt	2,700	1.35
Asphaltum	2,349	1.17
Basalt rock	4,887	2.44
Brick, soft clay.....	2,718	1.35
Brick, hard clay.....	3,397	1.69
Brick, pressed	3,806	1.90
Brick, paving.....	4,246	2.12
Block, paving.....	3,694	1.84
Bluestone	2,970	1.48
Cement, natural	1,512	.75
Cement, Portland	2,430	1.21
Cement, Portland, set	4,941	2.47
Cement, Rosendale	1,863	.93
Cement, Western	1,747	.87
Cinders	1,080	.54
Clay, dry	1,701	.85
Clay, wet	2,970	1.48
Concrete, cinders	2,970	1.48
Concrete, grave.....	4,104	2.05
Concrete, limestone	4,050	2.02
Concrete, sandstone.....	3,915	1.95
Crushed stone	2,700	1.35
Earth, dry, loose	1,890	.94
Earth, dry, rammed	2,430	1.21
Earth, dry, shaken	2,214	1.10
Earth, damp, loose	2,106	1.05
Earth, damp, packed	2,592	1.29
Earth, damp, rammed	2,700	1.35
Earth and gravel, dry, loose.....	2,700	1.35
Earth and gravel, dry, rammed.....	3,240	1.62
Earth and sand, dry, loose	2,700	1.35
Earth and gravel, wet	3,240	1.62
Earth and sand, wet.....	3,240	1.62
Earth and sand, dry, rammed	3,240	1.62
Fire brick.....	3,915	1.95
Fire clay.....	3,510	1.75
Garbage	1,150	.57
Gravel, dry	2,970	1.48
Gravel out of water.....	1,620	.81
Granite	4,536	2.26
Lime, quick, loose.....	1,431	.71
Lime, quick, shaken.....	1,485	.70
Limestone, solid	4,536	2.26

	Lbs. Per Cubic Yard	Tons Per Cubic Yard
Limestone, loose	2,592	1.29
Marble, solid.....	4,445	2.22
Marble, loose	2,592	1.29
Mortar, set	2,781	1.39
Mud, dry	2,340	1.21
Mud, packed	3,105	1.55
Mud, river	2,430	1.21
Mud, wet	2,916	1.45
Pitch	1,863	.93
Plaster of Paris.....	2,646	1.32
Quartz	4,374	2.18
Rip-rap, limestone	2,160	1.08
Rip-rap, sandstone	2,430	1.21
Rip-rap, slate	2,835	1.41
Rip-rap, rubble	1,753	.87
Rubbish	200	.10
Sand, dry, loose.....	2,619	1.30
Sand, shaken	2,700	1.35
Sand, wet	3,186	1.59
Sand, well shaken.....	2,970	1.48
Sandstone	4,023	2.01
Slag, bank	1,890	.94
Slag, screenings	2,700	1.35
Slag, machine.....	2,502	1.29
Slag, sand	1,485	.74
Slate, shale	4,374	2.18
Snow, wet	405-1,350	.....
Snow, fresh	135- 324	.....
Street sweepings	850	.42
Tar	1,674	.83
Tile	2,970	1.48
Trap stone	5,049	2.52

ALLOWABLE LOADS FOR BEAMS

Allowable uniformly distributed loads for timber beams supported at both ends. The concentrated load, unless separately shown in the table, shall be one-half ($\frac{1}{2}$) the distributed load.

Span in Feet	BEAMS								
	2x4	2x6	2x8	2x10	2x12	2x14	4x4	4x6	6x6
4.....	890	D*1,460 C 1,070	*1,950 1,900	*2,470 *2,470	*2,990 *2,990	*3,510 *3,510	1,980	D*3,260 C 2,390	*4,840 3,460
5.....	710	D*1,460 C 850	*1,950 1,530	*2,470 2,440	*2,990 2,990	*3,510 *3,510	1,590	D*3,260 C 1,910	*4,840 2,780
6.....	590	1,430	D*1,950 C 1,270	*2,470 2,030	*2,990 2,980	*3,510 3,510	1,320	3,190	4,620
7.....	510	1,220	D*1,950 C 1,090	*2,470 1,740	*2,990 2,560	*3,510 *3,510	1,130	2,740	3,970
8.....	440	1,070	1,900	D*2,470 C 1,530	*2,990 2,240	*3,510 3,090	990	2,400	3,470
9.....		950	1,690	D*2,470 1,360	*2,990 1,990	*3,510 2,740	880	2,130	3,080
10.....		860	1,520	2,440	D*2,990 C 1,790	*3,510 2,470	790	1,910	2,770
11.....		780	1,390	2,220	D*2,990 C 1,640	*3,510 2,240	.....	1,740	2,520
12.....		710	1,270	2,440	2,990	D*3,510 C 2,050	1,590	2,310

*Load limited by shear.

D—Distributed load.

C—Concentrated load.

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ELEVATORS, DUMB-WAITERS, ESCALATORS

Sec. 1. The matters covered in this code shall include regulations for passenger elevators, freight elevators, hoists, lifts, dumbwaiters, moving stairways or any mechanical device or apparatus, permanently installed and fixed in position in any building or structure except private residences, for the purpose of conveying people, animals, vehicles, merchandise, building materials or any other load regardless of whether said load is to be conveyed above or below the grade line.

The regulations given herein shall apply to the construction, installation, alteration and operation of all such installations listed in subsection 1-a of this section, which are hereafter constructed, installed or altered within the limits of the State of Minnesota.

An existing elevator installation or moving stairway shall be taken to mean one on which construction was begun prior to the effective date of this code.

A new elevator or moving stairway installation shall be taken to mean one on which construction was begun subsequent to the effective date of this code. The regulations regarding alterations and repairs and their compliance with this code shall be as stated in Section I-2 of this article.

All existing elevators and moving stairways as herein defined may be maintained in their present condition except as herein otherwise provided or when, in the opinion of the Commission, they are constructed or installed in such a manner as to create an unsafe condition or when such installation has become deteriorated so as to endanger life, limb or property. The Commission shall have the power to order the correction or removal of such unsafe conditions.

Temporary elevators, hoists or other devices used solely by builders or mechanics in the construction or alteration of any building or structure shall not be required to conform to the provisions of this article, but this shall not be interpreted as suspending the requirements of safety to life and limb. The Commission shall have the power to order that proper protection be provided around the hoistways of such temporary elevators or other hoisting apparatus.

Manlifts may be installed in industrial establishments which are not readily accessible to the public for the use of employes only, upon approval by the Commission of the plans for such installations. Such manlifts shall comply with the regulations of Sec. 1406.

Sec. 2. Alterations and Repairs.—Alterations or repairs to elevators and moving stairways as herein defined which involve the type of elevator or its motive power, location, safety devices or operating mechanism or the increase in capacity or speed shall not be made without the approval of the Commission.

Any existing elevator or moving stairway installation which is materially changed subsequent to the date of enactment of this code shall comply with

all the provisions of this code governing new installations. A material change shall be defined as any change which moves the location, increases or decreases the length of travel, changes the type of operation, increases the speed of carrying capacity or changes the type of power supply of any existing elevator or moving stairway installation.

Any elevator or moving stairway whether installed before or after the enactment of this code, which may become damaged by fire or other causes, including ordinary wear, to such an extent, that, in the opinion of the Commission, it becomes dangerous to life, limb or property, such elevator or moving stairway shall be repaired or rebuilt in conformity with the provisions of this code.

Sec. 3. Definitions.—The items listed below shall have the following meanings:

Buffer: A buffer is an oil or spring device designed to absorb the impact of the car or counterweight at the extreme limits of travel.

Car (Elevator): An elevator car is the load-containing unit including its platform, car frame and enclosure.

Car Door or Gate: A car door or gate is the door or gate in or on the elevator car which closes the opening ordinarily used for entrance or exit.

Car Door or Gate Electric Contact: A car door or gate electric contact is a device, the purpose of which is to open the control circuit unless the car door or gate is in the closed position, and thus prevent the operation of the elevator by the normal operation device.

Car Enclosure: The car enclosure or cab of an elevator is the enclosure consisting of the walls and top built upon the platform.

Car Frame: The car frame is the supporting frame to which the car platforms upper and lower sets of guide shoes and the hoisting cables are usually attached.

Car Platform: The car platform is the structure which forms the floor of the car and which directly supports the imposed load.

Clearance (Overhead): The overhead clearance of an elevator car is the distance the car floor can travel above the level of the upper terminal landing without any part of the car or devices attached thereto coming in contact with the overhead structure.

Contract Load: The contract load is the safely imposed load on an elevator which is specified in the contract for the purchase of the elevator.

Contract Speed: The contract speed of an elevator is the speed, specified in the purchase contract, to be attained by the elevator in the up direction with contract load in the car.

Door Closer: A door closer is a device, operated by gravity or other means, which will automatically close a door when released by the operator or by some suitable automatic means.

Dumbwaiter: A dumbwaiter is a hoisting and lowering mechanism with a car whose platform does not exceed nine square feet in area, whose over all inside height does not exceed four feet and whose carrying capacity does not exceed 500 pounds. This type of apparatus shall be used only for the conveyance of freight, and shall not be considered as an elevator within the intent of this code.

Elevator: An elevator is a hoisting and lowering mechanism equipped with a car and is used to move persons or things in a substantially vertical direction. Elevators are divided into two general classes of uses as follows:

Passenger elevator: A passenger elevator is an elevator that is designed and used to carry persons other than the operator and persons necessary for loading and unloading.

Freight elevator: A freight elevator is an elevator that is designed and used for carrying freight and on which only the operator and the persons necessary for loading and unloading are permitted to ride.

Elevators are also classified as to the means by which they obtain their motive power. In general the methods are as follows:

Electric: An electric elevator is one in which the lifting of the car is obtained by means of an electric motor directly applied to the elevator machinery.

Electro-hydraulic: An electro-hydraulic elevator is one in which the lifting of the car is obtained by means of an electric motor driving a pump, which pumps liquid directly into the cylinder without an accumulator or pressure tank.

Hand power: A hand power elevator is one in which the motion of the car is obtained through a manually operated pull rope.

Hydraulic elevator: A hydraulic elevator is one in which the motion of the car is obtained from liquid under pressure.

Power elevator: A power elevator is one in which the motion of the car is obtained through the application of energy other than by hand or gravity.

Elevators are also classed as to the type of machine which transmits the power into motion of the elevator car. The following types shall be considered:

Traction type: A traction type elevator machine is one in which the motion of the car is obtained by means of the friction which exists between the hoisting ropes and the traction sheave.

Hydraulic type: A hydraulic type elevator machine is one in which the power is transmitted by means of a fluid under pressure.

Drum type: A drum type elevator machine is one in which the cables are fastened to, and wind on, a drum. The drum type machine shall not be permitted on new elevator installations.

Emergency Release: An emergency release is a device the purpose of which is to make inoperative the door or gate contacts or door interlocks in case of emergency.

Emergency Stop Switch: An emergency stop switch (safety switch) is a device in the car used to cut off the power from the elevator machine independently of the operating device.

Hoistway: A hoistway, for the purpose and intent of this code, shall mean any shaftway, hatchway, well hole or other opening or space in which an elevator or moving stairway is designed to operate.

Hoistway Door or Gate: A hoistway door or gate is the hinged or sliding portion of the hoistway enclosure which closes the opening giving access to the elevator car at any landing.

Full automatic door or gate: A full automatic door or gate is a vertically moving door or gate which is opened directly by the motion of the elevator car approaching any landing and which is closed by gravity as the car leaves the landing.

Semi-automatic door or gate: A semi-automatic door or gate is a vertically moving door or gate which is opened manually and closed by gravity as the car leaves the landing.

Manually operated door or gate: A manually operated door or gate is a door or gate which is opened and closed by hand.

Self-closing door or gate: A self-closing door or gate is a door or gate which is opened manually and closes when released.

Power operated door or gate: A power operated door or gate is a door or gate which is opened and closed by power other than by hand, gravity or the movement of the car.

Hoistway Enclosure: A hoistway enclosure is a structure which separates the hoistway from the floors or landings through which the hoistway extends.

Interlock: An interlock is a mechanism consisting of an electric contact and a mechanical lock so arranged that upon opening, the electric contact is broken before the mechanical lock is unlocked, and upon closing, the mechanical lock is locked before the electric contact is made. The purpose of an interlock is to prevent the operation of the elevator car by the normal operating device unless the hoistway door or gate is closed and locked and all other hoistway doors or gates are closed and locked, and to prevent the opening of any hoistway door or gate from the landing side, except by special key, unless the elevator car is at rest within the landing zone or entering the landing zone with its operating device in the stop position. Stationary cam operated locks shall not be considered as interlocks within the intent of this code.

Electro-mechanical lock: An electro-mechanical lock is a device consisting of an electric contact and a mechanical lock so arranged that the electric contact is operated by the opening and closing of the hoistway door or gate and the mechanical lock is operated by the elevator car entering or leaving the landing zone. The purpose of the electro-mechanical lock is to prevent the operation of the elevator car by the normal operating device unless the hoistway door or gate is closed, and to prevent the opening of the hoistway door or gate unless the elevator car is within the landing zone.

Landing Zone: The landing zone is the distance above and below the floor landing sill required to stop and level the car under normal operating conditions. Where manually operated doors and gates are used the landing zone shall not exceed nine inches above or below the floor landing sill. Where power operated doors and gates are used the landing zone shall not exceed eighteen inches above or below the floor landing sill.

Man Lift: A man lift is any mechanically or manually operated device used to elevate or lower persons by means of a continuous belt, chain, rope or other means of connection, equipped with a platform, the area of which does not exceed six square feet.

Moving Stairway: A moving stairway is a power driven inclined continuous stairway or runway used for raising or lowering passengers.

Operating Device: The operating device is the car switch push button or other device used to actuate the controller.

Operation: Operation is the method of actuating the controller through the normal operating device. The various methods of operation are defined as follows:

Automatic operation: Automatic operation is defined as operation by means of buttons or switches at the landings, with or without buttons or switches inside the elevator car, the momentary pressing of which will cause the car to start and automatically stop at the landing at which the button was pressed.

Car switch operation: Car switch operation is defined as the operation wherein the starting, direction of motion and the stopping of the car are directly and solely under the control of the operator in the car by means of a self-centering switch.

Continuous pressure operation: Continuous pressure operation is operation by means of push buttons or switches in the car or at the landings, any of which may be used to control movement of the car so long as the button or switch is manually held in the operating position.

Safety-Car or Counterweight: A car or counterweight safety is a mechanical device attached to the car or counterweight frame to stop and hold the car or counterweight in case of overspeed, free fall, or through slackening of cables.

Sidewalk Elevator: A sidewalk elevator is a freight elevator, the hoistway opening of which is located either partially or wholly outside the building and which has no opening into the building at its upper terminal landing.

Slack Cable Switch: A slack cable switch is a device for automatically cutting off the power in case the hoisting cables become slack.

Terminal Stopping Device: A terminal stopping device is an automatic device for stopping the elevator car within the overtravel independent of the operating device.

Sec. 4. Approvals Required.—Any person, firm or corporation desiring to install, relocate, alter materially, or extend any elevator or moving stairway, as defined herein, shall be required to obtain an approval for so doing from the Commission.

No approvals shall be required for ordinary repairs and replacement of damaged, worn and broken parts necessary for normal maintenance and such work may be done with parts of equivalent material, strength and design to those originally installed.

Approvals shall be required for the installation, relocation or alteration of employe manlifts in industrial establishments. The plans and details of construction shall be approved by the Commission prior to the installation of such manlifts.

The commission shall have authority to order safeguarding to protect life and limb on temporary elevators, hoists or other devices used solely by builders or mechanics in the construction or alteration of buildings or structures.

Sec. 5. Inspection and Approval Required.—It shall be unlawful for any person, firm or corporation to put into service any elevator or moving stairway, whether the same has been newly installed, relocated or altered materially without first being inspected and approved by the Commission. A letter of approval shall be issued by the Commission for each such installation when the entire unit is completed in conformity with this code. The entire unit shall include all enclosures or shafts, gates, machinery, safety and control devices and all other appurtenances hereinafter provided.

The party who installs, relocates or alters materially any elevator, escalator, manlift, or dumbwaiter shall notify the Commission a week before completion of the work, for inspection.

The Commission shall have the power to require any test deemed necessary to prove the safe operating condition of any elevator or moving stairway or any of its equipment.

Sec. 6. Accidents.—To be Reported: The owner or person in control of an elevator or moving stairway shall immediately notify the Commission of any accident to a person or apparatus on, about or in connection with such elevator or moving stairway, and shall afford him every facility for investigating such accident and the damage resulting therefrom.

Investigation: The Commission shall make or cause to be made an investigation and shall place on file in his office a full report of such investigation. Such report shall give in detail all material facts and information available and the cause or causes so far as they can be determined and shall be open to public inspection.

Operation Discontinued: When an accident involves the failure or destruction of a part of the construction or of the operating mechanism, the elevator or moving stairway shall not be used again until it has been made safe. The Commission may, if deemed necessary, order the discontinuance of operation of the elevator or moving stairway until a new certificate of approval has been issued.

Removal of Parts Restricted: No part of the damaged construction or operating mechanism shall be removed from the premises until permission has been granted by the commission.

Sec. 7. Operational Regulations.—No person under sixteen years of age shall be permitted to operate an elevator in the State of Minnesota.

The minimum contract load of a power passenger elevator shall be not less than 75 lb. per square foot of car platform area inside the car enclosure for cars having a net inside area of 13.3 square feet or less, and for car platforms having a net area exceeding 13.3 square feet the minimum contract load (lbs. per square foot) shall increase according to the following table:

Effective Platform Area (Square Feet)	Loading of Car (Lbs. per sq. ft.)	Minimum Contract Load (Total Lbs.)
13.3.....	75.....	1,000
19.0.....	79.....	1,500
24.1.....	83.....	2,000
28.7.....	87.....	2,500
33.4.....	90.....	3,000
37.6.....	93.....	3,500
41.6.....	96.....	4,000

Effective Platform Area (Square Feet)	Loading of Car (Lbs. per sq. ft.)	Minimum Contract Load (Total Lbs.)
50.0.....	100.....	5,000
57.7.....	104.....	6,000
72.7.....	110.....	8,000
87.7.....	114.....	10,000
125.1.....	120.....	15,000
161.2.....	124.....	20,000
196.5.....	127.....	25,000

The Contract Load requirements for effective platform areas between those shown in the above table may be determined by interpolation.

No allowance shall be made for handrails in determining this area.

It shall be permissible to carry passengers on a freight elevator under emergency conditions, equal in number to the contract load in pounds divided by 150, provided the elevator conforms in all respects to the requirements of this code for passenger elevators except for platform area.

All power-driven freight elevators shall be designed to carry a minimum load of 50 pounds per square foot of car platform area.

A metal plate clearly designating the manufacturer's rated lifting capacity of the elevator in pounds shall be placed in a conspicuous place in each elevator car. A load test shall be made of every new elevator to prove that its capacity is sufficient to comply with the provisions of this section. All load tests shall be made at normal voltage and pressure and under normal conditions of counterbalancing.

The maximum carrying capacity used for lifting safes or other heavy materials shall be considered the capacity which can be safely sustained by the mechanism by means of a special arrangement.

No elevator shall be used for carrying safes or other material of greater weight than the rated lifting capacity of the elevator. No elevator designed to carry safes or other heavy material of greater weight than the normal rated carrying capacity shall be used unless the car is equipped with a locking device which will hold the car fixed at a landing independent of the hoisting ropes while the safe or other material is being loaded or unloaded.

Sec. 8. Car Speed.—The contract speed of any elevator shall in no case exceed 1,000 feet per minute, but the lower limiting speeds given in this subsection shall be used in the specific cases stated.

The contract speed of electric freight elevators with continuous pressure operation, shall not exceed 75 feet per minute.

The speed of freight elevators, not operated by a regular operator, shall not exceed 50 feet per minute, except:

Automatic and semi-automatic push button elevators.

Those elevators which are controlled from the outside of the hatchway by means of switches or push buttons, in which case a means must be provided to cut off the current while any door or gate is open. The operating device in the car and that on the landing must be non-interfering.

MACHINERY AND DESIGN.

Sec. 9. **Machines—General.**—All electric driven elevators suspended by cables shall be of the traction type. Sidewalk elevators shall be excepted from this rule.

All electric elevator machines shall be grounded.

Belt or chain-driven machines shall not be used on installations of power elevators.

Worm gears having cast iron teeth shall not be used to drive power elevators, drums or sheaves.

A friction gearing or clutch mechanism shall not be used for connecting the winding drum or traction sheave of any elevator to the main driving gear.

Electrically released spring applied brakes shall be required on all new and existing power elevators.

The action of electric brakes shall not be retarded by any motor field discharge, counter voltage or by ground or short circuit.

All machinery must be guarded in accordance with the General Safety Rules of the State Department of Labor of Minnesota.

Machine housing of worm gear machines shall be provided with an inspection opening and removable cover plate to permit examination of gear rim bolts.

Safe and convenient access shall be provided to all elevator machinery. Elevator machine rooms shall be of such a size as to permit ready inspection of and access to all portions of machinery located therein. This access shall be exterior to and independent of the hatchway or car. If the parts are located on or over a platform at the top of the hoistway, access shall be above the level of the platform if practicable.

All elevator machine rooms shall be provided with ample illuminating facilities arranged so as to afford safe access and inspection of machinery.

Sec. 10. **Structural Support.**—The design load to be supported by the elevator machine beams shall be calculated as not less than the weight of the stationary load resting on the beams plus twice the sum of the tensions in all cables suspended from the beams with contract load in the car.

No elevator machinery except the idler or deflecting sheaves with their guards and frames, and devices for limiting or retarding the car travel and their accessories shall be fastened to the underside of the supporting beams at the top of the hoistway. Dumbwaiters, however, are exempted from this rule.

Sec. 11. **Hydraulic.**—Hydraulic elevator machines hereafter installed shall be equipped with piston travel-limit bumpers or stops, or with some means to relieve the pressure on piston or plunger at the upper limit of car travel, and the elevator shall also be so roped as to prevent the car from being drawn into the overhead work before these devices come into action.

The piston rods of tension type hydraulic elevators of the sheave type shall have a minimum factor of safety of eight (8), figured on the cross-sectional area at the bottom of the thread.

All tension type hydraulic elevators shall have at least two (2) piston rods.

Guides shall be provided for the traveling sheave yoke of vertical type hydraulic elevators, except dumbwaiters.

The valve chambers and cylinders of hydraulic elevator machines shall be provided with means for removing air.

An air syphon relief valve shall be installed on the discharge pipes of all hydraulic elevators.

The traveling sheaves of vertical cylinder hydraulic elevators shall be attached with two-part structural steel hangers and not U straps.

Pressure tanks shall be so designed as to capacity, and shall be so operated as to the proportion of air to water therein, to prevent the entrance of air into any elevator cylinder attached thereto.

All automatic stop valves of hydraulic elevators operating from street mains, or air pressure tanks, must be packed with cup leather, or other means must be used to prevent choking of valve stems.

Pressure tanks shall be made and tested in accordance with the A. S. M. E. Boiler Code requirements for hydraulic pressure vessels.

Hydraulic elevators shall be provided with an independent automatic means for gradually stopping the car at the upper and lower terminal landings independent of the operator.

Every pressure tank shall be provided with a water gauge glass having brass valves and fittings attached directly to the tank and so located as to show the level of the water when the tank is half filled.

Every pressure tank shall have a pressure gauge which correctly indicates pressure to at least one and one-half ($1\frac{1}{2}$) times the normal working pressure allowed on the tank.

Sec. 12. Reciprocating Pumps.—Every reciprocating pump connected with the pressure tank of a hydraulic elevator shall be equipped with a water safety valve of approved make installed with no intervening valve between it and the pump, so that the pressure cannot rise more than twenty-five per cent (25%) above the normal working pressure, with the pump working at full speed. The safety valve shall be piped to discharge into the discharge tank above the water line. In existing installations, the discharge from the safety valve may be into the pump suction.

All steam elevator pumps connected to air pressure tanks shall be provided and operated with pressure regulating valves controlling the steam to the pumps, and all electrically driven elevator pumps connected to air pressure tanks shall be equipped with automatic pressure regulating devices controlling the motor with automatic by-passes.

All elevator pumps connected to accumulators other than the regulating type, not containing air shall be equipped with automatic pressure regulating devices controlling the motor or with automatic by-passes.

Sec. 13. Hand Power.—No hand power elevator hereafter installed shall exceed 1,000 pounds capacity.

The travel of any hand power elevator hereafter installed shall not exceed twenty (20) feet.

Gates for hand power elevators must be semi-automatic and not less than three feet six inches (3' 6") high.

Sufficient clearance must be provided so that the car cannot be run into the machinery above.

Power driving mechanism shall not be attached to nor made part of any hand power elevator.

All hand power elevators shall be equipped with a broken rope safety device.

ELEVATOR CONSTRUCTION AND INSTALLATION.

Sec. 14. **Hoistway Construction.**—All unused sides of elevator hoistways shall be enclosed from floor to ceiling, or otherwise made to comply with existing fire regulations in the district.

Projections extending inward from the general surface of the hoistway enclosure opposite a car entrance of a power driven elevator shall be beveled on the underside or shall be provided with beveled metal plates. The angle of bevels shall be not less than 60 degrees with the horizontal, or it may have a straight vertical face extending from the hoistway edge of the landing sill to the soffit of the hoistway landing door next below.

(This provision applies to future installation and existing installations of freight elevators and passenger elevators, where, in the opinion of the Commission, an unsafe condition warrants the providing of bevels or flush plates.)

Elevator hoistways are required to be of fireproof construction. The walls of such hoistways shall be constructed of brick, tile, concrete or continuous metal studding, wire lath and plastered on both sides. If constructed of brick, the thickness of such enclosure walls shall be not less than twelve (12) inches for not more than 50 feet of their uppermost height, and increasing in thickness four (4) inches for every twenty-five (25) feet of the remaining lower portion or part thereof. Concrete may be used under the same conditions as brick work, and shall be reinforced if required by the commissioners.

If constructed of tile, the thickness of such enclosure walls shall be not less than six (6) inches and such tile enclosure walls shall serve the purpose of curtain enclosure walls only.

If constructed of metal studding, wire lath and plaster such construction shall be subject to the approval of the Commission.

Where there are windows in a hoistway of an elevator open to a court or yard, all such window openings within the first four (4) floors must be guarded with an iron grille or iron bars on the outside installed in a manner approved by the Commission.

The hoistway of every elevator shall not be used for, and shall be kept free of any apparatus, device, pipe, piping, wire or wiring, etc., that is not a part of the elevator equipment or mechanism.

A substantial metal grating or a flooring shall be placed directly under the overhead machinery of all power driven elevators whenever the driving machine is located in the basement and wherever clearance is sufficient to give proper clearance above the flooring. The grating or flooring must fill the entire hoistway. Grating or flooring must be of sufficient strength and

so supported that it will safely sustain a load of 300 pounds at any point without undue deflection. Grating must be such that it will reject a ball three-fourths ($\frac{3}{4}$) of an inch in diameter.

Counterweight runways of power elevators located in the elevator hoistway shall be enclosed from a point twelve (12) inches above the floor of the pit to a point at least seven (7) feet above the floor of its own pit and any other pit adjacent to such counterweight runway, except where compensating chains or cables are attached to the counterweight. In this case counterweight enclosures shall not be required on the side facing the elevator.

Sec. 15. Hoistway Clearance.—The minimum clearance between the edge of the car platform and the edge of any landing sill, shall be $\frac{1}{2}$ of an inch. The clearance between the edge of the car platform and edge of any landing sill shall be not greater than $1\frac{1}{4}$ ".

The clearance between a hoistway enclosure and a loading side of the car platform shall be not more than five (5) inches except when the doors are installed wholly within the hoistway, in which case the maximum permissible clearance shall be seven and one-half ($7\frac{1}{2}$) inches, except when a door or gate is provided which is so arranged as to be mechanically locked at all times except when the elevator car is within the landing zone of a landing served by car entrance.

The clearance between the car and any other projection in the hoistway shall be not less than $\frac{3}{4}$ ".

Sec. 16. Pit Depth and Overhead Clearance.—All elevator hoistways shall have pits below the lowest landing extending the entire area of the hoistway which shall be of a depth sufficient to contain bumpers and all other devices located therein, and shall be of sufficient depth that when the bumpers are compressed there shall be not less than twelve (12) inches clearance between the underside of the car sling and the bottom of the pit. The pit floor shall be of concrete throughout its entire area.

The minimum pit depth and overhead clearance for all passenger and freight elevators except hand power elevators shall be as follows:

Car Speed (Feet per Minute)	Minimum Pit Depth and Overhead Clearance
50 or less.....	3' - 0"
51 through 100.....	4' - 0"
101 through 200.....	5' - 0"
201 through 300.....	6' - 0"
301 through 400.....	7' - 0"
401 through 500.....	8' - 0"
501 through 600.....	9' - 0"
601 through 700.....	10' - 0"
701 through 800.....	11' - 0"
801 through 1000.....	12' - 0"

Where spring bumpers are used, pits shall be of a depth to allow at least twelve (12) inches clearance between the top of such bumpers and the underside of the car frame, when the platform is level with the bottom landing.

Where hydraulic buffers are installed, the elevator manufacturer shall be required to give the necessary increase in pit depth and overhead clearance.

Where practical difficulty is experienced in securing the required pit depths when installing, relocating or altering elevators in existing buildings due to existing footings or other construction conditions, the Commission may grant exceptions to the requirements of this section.

Sec. 17. Penthouse Construction. — All elevator penthouses shall be of fireproof construction as approved by the Commission. Penthouses shall be of a size to allow safe access to and around all machinery and shall provide a minimum of seventy-eight (78) inches headroom above the floor.

Penthouse floors shall be solid concrete slabs on the upper flange of machine supporting beams and continuous throughout the entire area of the penthouse except for cable slots.

Safe and convenient access to the penthouse shall be provided. The penthouse door shall be of fire resistant material not less than twenty-eight (28) inches wide and not less than sixty-six (66) inches high and free from obstructions. If the entrance to a penthouse is more than two (2) feet above the adjacent roof level, access shall be provided by a metal ladder or stairs having an angle not exceeding 60 degrees. Entrance to the penthouse from the hoistway shall not be permitted and a stairway or other approved means of entry to the roof or penthouse shall be provided within the building.

Every penthouse shall have at least two (2) pivoted metal windows of the Underwriters approved type. It is recommended that each penthouse be provided with a roof ventilator of the gravity type for proper ventilation.

Permanent provision shall be made in each penthouse for adequate artificial lighting with the switch located within easy reach of the entrance to the machine room.

All elevator penthouses shall be kept locked to prevent access by unauthorized persons.

Sec. 18. Hoistway Doors for Passenger Elevators. — Landing openings in passenger elevator hoistway enclosures shall be protected by sliding doors, combination sliding and swinging doors or by swinging doors.

All hoistway doors for passenger elevators shall be equipped with interlocks which meet the requirements of the interlock definition given in this article.

The distance between the hoistway side of the landing door and the hoistway edge of the landing sill shall be not more than four (4) inches. For automatic operation elevators this distance shall be no more than the following: (1) for swinging doors — one-half ($\frac{1}{2}$) inch; and (2) for sliding doors — two and one-quarter ($2\frac{1}{4}$) inches. In no case shall the hoistway face of the hoistway door project into the hoistway beyond the edge of the landing sill. (If the hoistway door consists of two or more sections, the distance shall be measured from the door nearest to the hoistway edge of the landing sill.)

All passenger elevator hoistway doors shall be so constructed that it will be unnecessary to reach back of the stationary panel, jamb or sash in order to reach the handle or handhold for the purpose of operating said door.

Manually operated hoistway doors of the sliding or swing type for automatic elevators shall be provided with a vision panel. The area of any single panel shall be not more than forty-five (45) square inches and the open panel

shall reject a ball six (6) inches in diameter. Vision panels shall be of clear wired glass.

Hoistway doors for elevators which can be operated only from the car shall have interlocks to prevent the car from being started unless the hoistway door is within three (3) inches of being closed and cannot be reopened until after it has been first completely closed.

The door at the lowest landing may be opened by means of a special key not easily duplicated and said key shall be available only to elevator mechanics and inspectors, provided the interlocks are so designed and adjusted as to prevent movement of the car until after the door is closed and in the locking position.

No emergency release system which permits the operation of the car by the normal operating devices when the hoistway doors are open shall be provided other than at the top landing (except as permitted in subsection "g" above), where a continuous pressure key operated five pin lock type tumbler device may be installed in the door jamb. This key shall cut out all corridor operating devices and shall permit operation only when all landing doors except the top landing door are closed and locked, and shall permit operation of the car only in a zone extending below the top landing for a distance not exceeding the height of the car cab enclosure. This key shall not be master keyed and shall be available only to elevator mechanics and inspectors.

Sec. 19. Hoistway Doors and Gates for Freight Elevators. — All hoistway doors for freight elevators shall be equipped with interlocks which meet the requirements of the interlock definition given in this code. Electro-mechanical locks as herein defined shall be permitted on manually operated hoistway gates or doors of freight elevators where car speed is not in excess of 100 feet per minute.

Each landing opening in a freight elevator hoistway enclosure shall be equipped with a hoistway door or gate.

Freight elevator gates of the full automatic or semi-automatic type will not be permitted, except on hand power elevators.

Hoistway doors may be horizontal or vertical sliding, combination horizontal sliding and swinging, or swinging type. Hoistway gates shall be vertical sliding type only.

Freight elevator gates are to be made of metal or of wood, and are to be of sufficient strength to withstand a lateral pressure of 250 pounds applied at any point of the gate, and sufficiently rigid and so constructed and installed that they cannot be sprung from their guides or sprung sufficiently to bind in the guides.

Hoistway doors when closed shall guard the full width and height of the opening.

No power freight elevator gates shall be less than five feet six inches (5' 6") in height, measured from the sill to the upper cross member. The lowest edge of the lowest horizontal member of any freight elevator gate, when closed, shall be not more than two (2) inches above the sill.

Hoistway doors shall be of fireproof construction and shall be equipped with vision panels when used with automatic or constant pressure elevators. Vision panels to conform to the regulations set forth for passenger elevator doors.

Hoistway gates shall be constructed of vertical wood slats, wire mesh or expanded metal and shall reject a ball two (2) inches in diameter.

Freight elevator gate counterweights shall be boxed in or shall run in guides from which they cannot be dislodged. The bottoms of the boxes of the guides shall be of such construction that the counterweights will be securely held if the counterweight ropes should break.

Sec. 20. Car and Counterweight Guide Rails.—All guide rails for power driven elevator cars and counterweights shall be of steel, fastened securely to the building construction with iron or steel brackets in such a manner as to sustain the car and its load when the car safeties set, at any point in the hoistway, and in such a manner that the car shoes cannot be forced from the guides. Ordinary wood headers will not be regarded as base for bracket fastenings.

Car guide rails shall be tongued and grooved and secured with plates at joints so as to be free from motion in any direction.

All guide rails for cars and counterweights shall extend from the bottom of the pit and to the overhead beams, and shall be strongly fastened in place and braced as approved by the Commission.

Rail brackets must be located in close alignment with lower car guide shoes when the car platform is at floor level. Distance between car rail brackets shall not exceed twelve (12) feet unless approved by the Commission.

The weight of steel guide rails shall be not less than shown in the following table:

Total Weight of Car and Load. Total Wt. of Counterweights Per Pair of Rails	Minimum Wt. of Each Car Guide Rail	Minimum Weight of Each Counterweight Guide Rail (Lbs. per Ft.)		
		With Guide Rail Safeties	Without Guide Rail Safeties 1 to 1 Roping	2 to 1 Roping
(Lbs.)	(Lbs. per Ft.)			
4,000	7½	7½	7½	7½
15,000	14	14	7½	7½
27,000	22½	22½	14	14
40,000	30	30	14	14

All steel elevator guide rails, except those used for hand-power elevators and for sidewalk elevators and dumbwaiters, shall have smooth machined or cold rolled guiding surfaces.

Sec. 21. Car and Counterweight Buffers.—Car and counterweight bumpers or buffers must be installed in the pits of all power-driven elevators except dumbwaiters.

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

Oil buffers shall be used with elevators having a contract speed in excess of two hundred (200) feet per minute. Oil buffers shall be provided with a means for gauging the amount of oil in them.

Buffers or bumpers shall be of such design and construction as to absorb, within the limits of the moving parts of the buffers or bumpers, all the

energy of the car loaded to its full capacity descending at governor tripping speed.

Car or counterweight bumpers or buffers shall be located symmetrically with reference to the center of the car sling or the counterweights.

Car bumpers or buffers shall be so located that the car will strike its bumpers or buffers within 24 inches below the bottom landing.

Sec. 22. Counterweights.—The weight sections comprising the counterweights shall be contained within a substantial steel or wrought iron frame. Weight sections within the frames shall be secured by at least two (2) tie rods passing through all of the weight sections to prevent the weight sections from leaving the frame.

Counterweights for power elevators shall run in guides.

Where car counterweights are used on existing drum type elevators, the counterweights shall weigh not more than seventy-five (75) per cent of the weight of the empty car for cars weighing five thousand (5,000) pounds or less, and not more than eighty (80) per cent for cars weighing more than five thousand (5,000) pounds.

The weight sections of a counterweight for hand-power elevators shall be fastened together with not less than two (2) bolts.

Counterweights for existing drum type machines: Whenever two (2) counterweights are used in the same guides, the car counterweight shall be located above the machine counterweight. Machine and car counterweights that are not independent of and separated from each other will not be permitted.

Counterweights for traction type elevators shall not exceed the weight of the elevator car plus forty (40) per cent of the contract load.

Sec. 23. Car Construction.—Cars of all power elevators shall run in guides.

No cast iron shall be used in the construction of any member of car frames or platforms subject to tension or bending except for compensating cable anchorages, releasing carriers and guide shoe stands.

If car leveling devices are used, the platform shall be provided with a substantial vertical face flush with its outer edge, extending a sufficient distance below the car floor so that there shall be no horizontal opening into the hoistway while the car is within the landing zone and the hoistway door is wholly or partially open.

Elevator cars shall be lighted at all times when in use. Means shall also be provided in all elevators for adequate ventilation.

No glass shall be used in elevator cars except to cover certificates, lighting fixtures, and appliances necessary for the operation of the car and as a vision panel in the car door.

Every power elevator shall have a permanently installed convenience outlet on both the car crosshead and on the underside of the platform.

All elevator pumps connected to accumulators other than the regulating type, not containing air, shall be equipped with automatic pressure-regulating devices controlling the motor or with automatic by-passes.

No elevator car, except a dumbwaiter car, shall have more than one (1) vertical compartment, except that two (2) compartments in the same horizontal plane will be permitted, provided access to the hoistway can be had through only one of them.

The car platforms of direct-plunger elevators shall be secured to the heads of the plungers. If the plungers of counterbalanced elevators are made in more than three (3) sections, the car platforms shall be secured to the bottom heads of the plungers by safety cables or rods run inside the plungers. The factor of safety of these cables or rods shall be not less than four (4). Such cables or rods shall be galvanized and shall be provided with means of adjustment.

Power freight elevators may be arranged to serve a truck loading level of no more than four (4) feet above a regular landing. If the elevator is arranged so as to reach this loading level with the hoistway door or gate open, the following shall be provided:

An operating device separate from the regular operating device shall be provided to serve the truck loading level only. This operating device shall not be operative except within a four (4) foot zone above the normal landing.

The elevator car shall be equipped with a vertical sliding car gate so arranged that when the car gate is open it will completely fill the opening between the car top and the top of the hoistway door or gate opening when the car is standing at the regular landing. The separate control system for the loading level shall be so arranged that it is not operative unless the car gate is in the open position.

The elevator platform shall be equipped with a substantial vertical face flush with its outer edge extending a sufficient distance below the car floor so that there shall be no opening into the hoistway when the car is at its maximum distance away from the landing with the hoistway door or gate open.

Sec. 24. Car Enclosures.—Cars for power passenger elevators shall be solidly enclosed at sides and top except for openings necessary for entrance, exit or ventilation.

Cars for power freight elevators except sidewalk elevators shall be solidly enclosed at sides except for openings necessary for loading and unloading. The enclosure shall be of solid metal and shall extend to a height of not less than six (6) feet from the car floor. The section of the car opposite the counterweight shall be extended to the car top.

Elevators located in adjacent hoistways without intervening hoistways partitions, counterweights or similar obstructions shall, where the distance between cars does not exceed three (3) feet, have side emergency exits and said doors shall be electrically contacted.

All passenger elevator car tops shall be provided with an emergency exit panel not less than four hundred (400) square inches in area with the smaller dimension not less than sixteen (16) inches. Exit panels shall be arranged so that they can be opened from both the inside and the outside of the car.

Car enclosures for passenger elevators may be of metal or wood. If enclosures are of wood, the entire outside area of the enclosure shall be covered with sheet metal at least No. twenty-seven (27) U. S. Gauge.

All power freight elevators shall be equipped with a car top. The top may be of wire grille work, perforated metal or other metal construction of equivalent strength. Openings in grille work and perforated metal shall be not larger than one inch by one inch (1" by 1"). Car tops shall cover the entire area of the car regardless of car length and shall sustain a load of two hundred fifty (250) pounds. The car top shall be set back not more than twelve (12) inches from the edge of the landing thresholds, and shall be hinged on the landing sides not less than eighteen (18) inches back, so as to fold back should this edge of the top be obstructed in any manner in its descent.

No power passenger elevator hereafter installed shall have more than two (2) entrance openings to the elevator car. Such entrance openings, whether single or double, shall have car gates or car doors installed to completely fill the opening or openings.

A car gate or car door shall be provided at each entrance opening to power freight elevator cars and shall be provided with an electric contact so wired into the elevator control circuit as to prevent operation of the elevator by the normal operating device until gates or doors are in the fully closed position. Car gates shall guard the full opening except that they need not be more than six (6) feet high.

Vertical sliding gates shall conform to the following regulations:

They shall be of wood or metal and if of open work shall reject a ball two (2) inches in diameter.

They shall be constructed and guided as to withstand a lateral force of one hundred (100) pounds concentrated at the center of the gate without being deflected past the line of the car sill and a force of two hundred fifty (250) pounds without forcing the gate from its guides or causing it to break or permanently deform.

They shall be counterbalanced so that they will not close or open by gravity.

Suspension members shall have a factor of safety of not less than six (6).

Collapsible gates shall conform to the following regulations:

The space between vertical members shall not exceed four and one-half (4½) inches when the gate is extended to its operating position.

The gates shall be guided top and bottom and shall be of such strength as not to deflect past the line of the car sill when subjected to a force of 100 pounds applied horizontally at any point.

Elevator cars shall be secured to the car floor and the suspension slings in such a manner that they cannot work loose or be readily displaced. Rubber insulation of passenger elevator platforms and car enclosures will be permitted if they are arranged to be firm and secure in the suspension frame.

No material not a part of the elevator equipment and no working platform shall be permitted upon the top of any elevator car.

Sec. 25. Car and Counterweight Safeties and Speed Governors.—All electric elevators suspended by cables shall be provided with a car safety or safeties located beneath the car and operated by a speed governor and such device shall be capable of stopping and sustaining the car with contract load at governor tripping speed.

Where car safety devices are actuated by means of cable unwinding from a drum, said drum shall contain at least twice the number of turns of cable required to actuate the safety.

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

The type of safety device shall be such that, when applied, any further motion in the same direction will not release the gripping devices in the event of the adjustment being faulty, and in the event of the tension on the governor cable being released, the gripping device will remain engaged.

Governor ropes shall be provided with a device to maintain them in tension, and shall have one hundred eighty (180) degrees contact with the governor sheave.

A manual reset cut-out switch that will open the motor and brake control circuits shall be provided in connection with every car safety device on every electric elevator hereafter installed. Where car safety devices are of the instantaneous type, this cut-out switch shall be mounted upon the upper car beam and so located that application of the car safety device will cause its operation, thereby opening the brake and motor circuit. When gradual stop type car safeties are used, a cut-out switch shall be provided on both the car safety and speed governor.

The maximum allowable and minimum allowable stopping distances for all sliding type safeties shall be as given in the following table:

Governor Tripping Speed (Feet per Minute)	Minimum Stopping Distance	Maximum Stopping Distance
200.....	0' - 6".....	1' - 6"
300.....	0' - 9".....	2' - 0"
400.....	1' - 0".....	3' - 0"
500.....	1' - 6".....	4' - 0"
600.....	2' - 0".....	5' - 0"
700.....	2' - 0".....	6' - 9"
800.....	3' - 0".....	8' - 6"
900.....	4' - 0".....	11' - 0"
1000.....	4' - 9".....	13' - 0"

Every type of car safety device used shall be subject to an actual drop or runaway test with contract load before its approval by the Commission.

Instantaneous car safeties will not be allowed on any elevator hereafter installed whose car speed exceeds 150 feet per minute.

Sec. 26. Operation and Control.—The maximum rated system or circuit voltage permitted in the operating devices of power elevators shall be 250 volts.

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

An emergency stop switch shall be provided in the car of all electric elevators and shall be located adjacent to the operating switch and within easy reach of the operator. This switch shall cut off the power to the machine independent of the normal operating device.

Handles of operating devices of car switch elevators shall be so arranged that the movement of the handle toward the entrance which the operator usually faces will cause the car to descend and the movement away from the entrance will cause the car to ascend.

A manually operated multi-pole service switch shall be installed in the main line of electric elevator machines or motor generator sets adjacent to and visible from the machines or generators. Where practicable this switch shall be located at the lock jamb side of the machine room entrance door.

Automatic elevators shall be so arranged that once the car has started for a given landing, no impulse can be given from any landing to send the car in the reverse direction until the car has reached the destination corresponding to the first impulse.

Each electric elevator driven by a polyphase alternating current motor shall be provided with a device which will prevent starting the motor if the phase rotation is in the wrong direction or there is a failure in any phase.

Slack cable devices shall be provided in connection with all existing drum type elevators so arranged as to stop the machine at once should the hoisting cables become slack regardless of the position of the car in the hoistway. All electric parts of slack cable devices shall be covered and insulated. Every drum type machine shall be equipped with an automatic machine limit stop device.

All electro-hydraulic elevators shall be equipped with an anti-creep switch for each landing above the lowest, the purpose of which is to prevent the car from creeping away from the landing at which the car is parked with the hoistway gate or door in the open position.

No power elevator hereafter installed shall be operated by a shipper rope, by a wheel or level mechanism or directly by a hand rope.

All existing power elevators operated by means of a hand operated shipper rope, except sidewalk elevators, shall be provided with centering ropes or other centering devices which will insure the operating mechanism being placed in the neutral position when it is desired to stop the car.

The substitution of wire or any other current carrying device in place of proper fuses or circuit breakers is prohibited.

The use of a control system which depends upon electric batteries for the interruption of the operating circuit of any electric elevator is prohibited.

The breaking or holding open of any safety circuit on any electric elevator shall not be dependent solely upon the action of a spring or springs.

All traveling conductors shall have flame-resistant moisture-resistant outer covers.

All electric elevators shall be provided with both normal and final terminal stopping devices. Normal terminal stopping devices shall automatically stop the car from normal speed within the top and bottom overtravel independently of the operating device. The final terminal stopping device shall automatically stop the car from normal speed within top and bottom overtravel independent of the operating device and the normal terminal stopping device. Final terminal stopping device shall prevent movement of the car in both directions of travel. Limit switches shall be located at top and bottom ends of travel — in the shaftway.

Shipper ropes of all existing hand rope control elevators shall be provided with limitation stop balls on hand rope which will shut off the current from the machine in case of overtravel of the car.

Some system of constant pressure operation, for the convenience of elevator mechanics and inspectors, may be provided on the car crosshead if so arranged that when the system is operative, the elevator cannot be operated by the normal operating device in the car or at the landings.

All magnetic controllers hereafter installed shall have at least three switches as follows. One magnetically operated main line switch besides the up and down switches which shall be labeled so as to designate the up and down car movements.

Sec. 27. Cables.—Car and counterweight cables for all power elevators shall be of iron or steel.

When elevators are designed to use steel hoisting cables for car or counterweights, said cables shall be so designated by a metal plate bearing the words, "USE STEEL CABLES ONLY," in raised or stamped letters. This plate shall be firmly attached in plain sight on top of the crosshead adjacent to the hitchblock. The plate must also have printed on it the weight and speed of the car and such other information as may be specified at the time the permit is issued.

All hoisting and counterweight cables hereafter installed on new or existing installations must be provided with metal tags having the date of installation stamped thereon and such tags shall be attached to the cables at the car crosshead.

If doubt exists as to the nature of the cables, the capacity of the cables shall be limited to the capacity of iron cables of the same size.

All existing winding drum elevators shall have at least two hoisting cables and two cables attached to each set of counterweights except: (1) handpower dumbwaiters may have one hoisting cable and one counterweight cable, and two (2) handpower freight elevators may have two hoisting cables and two counterweight cables.

The ultimate strength of the cables shall be based on the cable manufacturers' standard lists. The minimum diameter of all hoisting and counterweight cables on passenger and freight elevators, except dumbwaiters, handpower elevators and sidewalk elevators, shall be one-half ($\frac{1}{2}$) inch. The diameter of a sheave or winding drum for a car or counterweight cable shall be not less than forty (40) times the diameter of the cable with which it is used.

A minimum factor of safety of eight (8) shall be used for car and counterweight cables on passenger and freight elevators.

All traction type elevators shall have not less than four (4) hoisting cables provided that the load on the cables will not be greater than that allowed by the factor of safety of eight (8) as specified in subsection 14 (g) above.

All hydraulic freight elevators, whose speed does not exceed one hundred (100) feet per minute, shall have not less than two (2) hoisting cables, and shall have not less than two (2) counterweight cables where independent counterweights are used.

There shall be not less than one and one-half ($1\frac{1}{2}$) turns of each cable on the winding drum when the car or counterweights have reached the extreme limit of travel. This shall apply to all cable requirements after this code becomes effective, where the drum capacity will permit.

No car or counterweight cable, whether new or used, shall be extended or repaired by splicing another piece of cable to it.

Iron or steel ropes shall be used on governors on all power-driven elevators. The minimum diameter of all metal governor cables shall be three-eighths ($\frac{3}{8}$) of an inch up to and including one hundred (100) feet per minute car speed. Where car speed exceeds one hundred (100) feet per minute, the minimum diameter of governor cables shall be one-half ($\frac{1}{2}$) inch. Tiller cable shall not be used.

The drum ends of the car and counterweight cables shall be secured inside of the drum by clamps or by tapered sockets.

The car and counterweight ends of all cables, except such fastenings as are required for compensating counterweight cables or for cables of dumbwaiters, shall be fastened by passing through tapered and babbitted sockets. The length of socket shall be not less than four (4) times the diameter of the cable. The hole at the small end shall be slightly rounded, with no cutting edges, and its diameter shall be at least one-sixteenth ($\frac{1}{16}$) inch larger than the diameter of the cable. The hole at the large end of the socket shall be at least three (3) times the diameter of the cable. The socket shall be of sufficient strength so that the cable will break before the socket gives any indication of distress. Where hoisting or car counterweight cables pass through plates at the hitchblock or car crosshead, said plates shall be chamfered, and free from sharp projections. This shall apply to all cable renewals.

After passing through the socket the fastening shall be made by the turned-in method which consists of separating the strands, cleaning them with kerosene or gasoline and turning them in to the center (the length of the turned-in portion being not less than two (2) times the diameter of the cable). Cable clips shall not be used on new or old cable fastenings including governor cables or any part thereof.

Sec. 28. Sheaves.—All sheaves shall be of cast iron or steel of sufficient strength to support the load imposed upon it. All sheaves except vibrator sheaves and sheaves operating loose on their shafts shall be either keyed to or pressed on their shafts.

Sheave bearings shall be of such a size that the pressure on their projected area, when full load is on the ropes, shall not exceed four hundred (400) pounds per square inch.

All hoisting and counterweight sheaves and winding drums, except for hand power elevators and sidewalk elevators, must have a diameter of at least forty (40) times the diameter of the ropes which pass over them, the sheave diameter to be measured at the bottom of the groove. All such members shall have machine-cut grooves.

Sec. 29. Signal Devices.—The hoistway of every power elevator, except automatic operation, continuous pressure operation and signal operation elevators, shall be provided with a signal system by means of which signals can be given from any landing whenever the elevator is desired at that landing.

All passenger elevators, except full automatic push-button elevators, and all power freight elevators, except sidewalk elevators, and elevators serving only two (2) contiguous landings, shall be equipped with a signal alarm system. This signal shall also serve as a call button whenever a person has failed to close the elevator hoistway door upon leaving the elevator.

All power elevators shall be provided with electric lights in the car.

Sec. 30. Sidewalk Elevators.—The regulations governing sidewalk elevators shall be the same as those listed for freight elevators with the exceptions for sidewalk elevators as stated in the previous sections plus the rules of this subsection.

Sidewalk elevator openings shall not exceed five (5) feet at right angles to the curb nor seven feet parallel to the curb.

Sidewalk openings shall be protected by metal doors at the sidewalk level capable of safely sustaining a load of 300 pounds per square foot and shall have a non-slip surface.

Any person, firm or corporation operating a sidewalk elevator shall not be permitted to open the sidewalk doors without first posting a responsible person on the sidewalk to guard the opening.

Sidewalk doors shall be so arranged that they will automatically open and close by means of a substantial bow iron on the top of the elevator car.

When sidewalk doors are opened, the exposed sides shall be protected by a gate or screen which shall extend to the height of the sidewalk doors. Such gate or screen may be removed on the curb side during the period of loading and unloading.

Sidewalk elevator hoistways for new installations shall be enclosed below the sidewalk level as required for freight elevators.

DUMB-WAITERS

Sec. 31. Dumb-waiter Car Construction.—Cars shall be made of wood or metal and of solid construction. Cars for power dumb-waiters shall be of metal. Cars shall be of metal sections rigidly riveted, welded or bolted together. Cars may be provided with hinged or removable shelves.

Where there is occupied space below the bottom landing of a dumb-waiter, car and counterweight shall be provided with safety devices of the broken rope or inertia type arranged to stop the car and counterweight on the guide rails in the event the hoisting cables should break.

All dumb-waiter cars shall be provided with broken rope safety devices.

Sec. 32. Dumb-waiter Machines.—Dumb-waiter machines may be either traction or uncounter weighted drum type and machines shall be securely fastened to their supports.

Sheaves or idlers shall not be fastened in cast iron stirrups to the underside of the supporting beams.

Electric dumb-waiters shall be equipped with brakes which are automatically applied when the power is cut off at the motor.

Sec. 33. **Guide Rails.**—Guide rails shall be rigidly secured to the hoistway.

Guide rails for power dumbwaiters shall be of steel.

One set of guides may be used for both the car and the counterweights.

Sec. 34. **Counterweights.**—Sections of counterweights for dumbwaiters having a capacity exceeding one hundred (100) pounds or having a speed exceeding one hundred (100) feet per minute shall be secured by at least two (2) tie rods passing through holes in all sections unless suitable counterweight frames are provided. The tie rods shall have lock nuts at each end secured by cotter pins.

Sec. 35. **Cables or Chains.**—Power dumbwaiters except those of the direct plunger type shall be provided with one or more iron or steel hoisting cables or chains.

No car or counterweight hoisting cable or chain of power dumbwaiters shall be lengthened or repaired by splicing.

The winding drum end of the car cables of drum type dumbwaiters shall be secured by clamps inside the winding drum.

All cables secured to a winding drum shall have not less than one (1) turn of cable on the winding drum when the car has reached the extreme limit of its travel.

Chain suspended dumbwaiters may be used within the limits of the State of Minnesota provided: (1) the travel is not more than twenty (20) feet; (2) it is equipped with a broken chain safety device and a device for taking up slack in the chain. All such chain driven dumbwaiters shall comply in all respects with the provisions of this code. The factor of safety shall be twenty-five (25) for all hoisting chains. Hoisting chains shall not be allowed on drum type machines.

Sec. 36. **Control.**—All power operated dumbwaiters shall be arranged for automatic operation from push buttons located at the landings. This control may be either from all landings or from one or more master station landings.

Power dumbwaiters shall be provided with a slack cable or slack chain device which will cut off the power to the motor and stop the car if the car is obstructed in its descent.

Power dumbwaiters shall be provided at terminal landings with terminal limit stops to automatically stop the car within the limits of overtravel.

Sec. 37. **Hoistway Doors.**—All dumbwaiters shall be provided with solid doors which when closed will protect the full width and height of each opening.

All hoistway doors for power dumbwaiters shall be of metal and shall be equipped with electro-mechanical locks.

MANLIFTS

Sec. 38. **General Requirements.**—New and replaced manlifts shall be permitted in feed, flour and cereal mills, in grain elevators and in such other places as may be permitted by the Commission.

Before final acceptance, an inspection of each new or relocated manlift shall be made by the Commission, covering the items contained in this article.

Manlift inspection must cover, but is not limited to, the following items:

Steps, stepbolts, driving mechanism, bolts, electrical switches, pulleys, handholds, rollers or slides, guard rails, relays and lights, motors, rails, landing floors, brakes and brake ropes, and signaling equipment.

Floor openings on both the up and down runs of manlifts shall be not less than twenty-eight (28) inches nor more than thirty-two (32) inches in width. Such openings shall be uniform in size and approximately circular.

The entrances and exits at all floors or landings affording access to the manlift shall be guarded by a maze or staggered railing with toe boards or self closing swinging gates. Gates shall swing away from the floor opening. The railings and gates shall be placed approximately two feet (2) from the edge of the floor opening.

A mounting platform shall be provided in front, or on one side of the belt, for the up run at the lowest landing. This platform shall be high enough to meet the steps when they reach a level position.

Clearance shall be provided above the top floor landing extending at least eight (8) feet in a vertical direction above the landing without any obstruction other than an automatic stop trip.

When floor height becomes excessive, it will be necessary to provide a fixed ladder accessible from both runs of the manlift.

Steps shall not be less than fourteen (14) inches deep measured from the plane of the belt to the edge of the step.

Each step shall be so constructed to support a load of not less than 400 pounds without undue deflection.

The speed shall not exceed fifty (50) feet per minute.

Sec. 39. Safety Devices and Requirements.—The use of manlifts shall be restricted to employes. New employes shall be adequately and personally instructed in the use of manlifts.

No article shall be carried by an employe which will prevent his having one hand free to grasp the handhold.

Tools shall not be carried in pockets but may be carried in a sling. Manlifts shall not be used to carry materials or merchandise.

The floor space adjoining openings shall be kept clear and be adequately lighted at all times.

Handholds with at least a two-inch clearance from the belt shall be securely attached to the belt at points not less than four feet nor more than four feet eight inches (4' 8") above each step tread on both runs.

If handholds other than the cup type are used, a flap shall be provided at each handhold arranged to drop over and cover the handhold when it is following a step on the up run or is ahead of a step on the down run.

An automatic stop device shall be provided to cut off the power and stop the belt when an employe on a step passes the top floor landing by twelve (12) inches. A weight of 50 pounds centered on the step shall be sufficient to operate this device.

After the automatic stop device has been thrown by a loaded step it shall not be possible to start the manlift except by resetting the automatic stop switch at the top floor or landing by hand.

An emergency stop line shall be provided, accessible for the entire travel of the manlift and within easy reach of ascending or descending employes. It shall be directly connected to the automatic stop device to stop the belt.

An electrically released mechanically applied brake shall be provided which shall apply automatically when the power is cut off.

In new manlifts, the brake shall be so located that its action to stop the manlift will not be affected by failure of the motor or of a drive belt. In new manlifts the automatic stop device shall be located so that the person resetting it cannot do so while standing on the manlift.

Conspicuous signs shall be posted on each landing or stenciled on the belt at approximate eye level above each step. These signs shall bear the following minimum instruction or a reasonable facsimile thereof:

"Employes Only," "Use the Handhold," "Face the Belt," and "To Stop, Pull Rope."

CONSTRUCTION REQUIREMENTS FOR MOVING STAIRWAYS.

Sec. 40. Angle of Inclination.—The angle of inclination of a moving stairway shall not exceed 30 degrees from the horizontal.

Sec. 41. Width.—The width of all moving stairways shall be measured between balustrading at a vertical height of twenty-four (24) inches above the nose line of treads. (No moving stairways shall have a width less than twenty-two (22) inches and the width shall not be greater than twenty-nine (29) inches unless a horizontal tread formation is utilized.)

Sec. 42. Handrails.—All moving stairways shall be equipped on both sides with moving handrails operating at the speed of the escalators and in the same direction of travel.

Sec. 43. Balustrading.—Each moving stairway shall be enclosed on each side from the handrail to the moving stairway treads. These enclosures shall be smooth on the moving stairway side, without depressed or railed paneling or moulding. There should be no jogs or abrupt changes in width between the enclosing sides. Should any change in width be necessary, same must not be more than eight (8) per cent of the greatest width and the enclosing sides shall be moulded to such change in width at an angle not greater than fifteen (15) degrees from the line of moving stairway travel.

Sec. 44. Tread Guards.—Every moving stairway must be provided with a stationary metal guard directly underneath and along the whole length of the upper line of the moving stairway treads.

Sec. 45. Track Arrangement.—The track arrangement for guiding the moving stairway treads shall prevent the displacement of the upper line of treads in case the tread chain breaks.

Sec. 46. Strength of Truss or Girder.—The lower end of the moving stairway truss or girder shall be of sufficient strength to safely sustain the moving stairway treads with the maximum passenger load, should the tread chain break.

Sec. 47. Chains.—The chain or chains used for driving moving stairway treads shall be of sufficient strength to have a total safety factor of not less than ten (10) when the moving stairway is operating at its load capacity.

Sec. 48. Electric Brake.—Every moving stairway drive shall be provided with an electrically released mechanically applied brake which shall

automatically and immediately stop the moving stairway when the circuit is opened.

Sec. 49. Load Capacity.—The load capacity of a moving stairway shall be determined as follows:

- (1) For widths up to and including 29 inches, the load capacity in total pounds equal 110 times the horizontal projected length of incline in feet.
- (2) For widths greater than 29 inches, the load capacity in total pounds equals six (6) times the width in inches, times the horizontally projected length of incline in feet.

Sec. 50. Speed.—The speed of a moving stairway shall not exceed 100 feet per minute.

Sec. 51. Drive.—Each moving stairway shall preferably be driven by an independent electric motor, but under no circumstances shall more than two (2) moving stairways be driven by one motor, and the latter arrangement shall only be permissible when the two moving stairways are placed so close together as to be practically a unit.

Sec. 52. New moving stairways shall have capacity tests and the over-speed safety tests shall be made by increasing the speed to governor tripping speed. With power stairs driven by alternating current motors, the governor may be tripped by hand with the moving stairway traveling at its normal rate of speed.

Sec. 53. Reversal Test.—The accidental reversal device shall be made to function by manually operating or attempting to operate the moving stairway or motor stair in the reverse direction.

SAFETY DEVICES AND REQUIREMENTS.

Sec. 54. Emergency Stops.—There shall be a button or other type of switch located in a conspicuous position at the top and at the bottom of each moving stairway and accessible to the public. The operation of either one of these buttons or switches shall cause interruption on the power supply, application of the brake and stoppage of the moving stairway. Under no circumstances shall the arrangement be such that these buttons or switches can be used to start the moving stairway.

Sec. 55. Safety Pawls or Safety Mechanism.—Each moving stairway operated in the ascending direction shall be equipped with a safety pawl or safety mechanism at or near the lower landing, and applied to the upper line of the moving stairway chain. This safety pawl or safety mechanism shall, under all circumstances prevent accidental reversal of motion of the moving stairway. On a reversible moving stairway this safety pawl or mechanism must be so arranged as to be made inoperative when the moving stairway is operating in the descending direction, and operative when the moving stairway is used in the ascending direction. The releasing device must be so interlocked with the starting device that the moving stairway can only be started in the direction for which the safety pawl or mechanism has been set. The safety pawl or mechanism shall be equipped with a contact, the opening of which upon operation of the safety will cause the interruption of the power supply, application of the electric brake and stoppage of the motor.

Sec. 56. Excess Voltage Relay.—The starter of a descending or reversible moving stairway operated by a direction current motor must be provided with an excess-voltage relay arranged to stop the moving stairway in case of excessive voltage of the motor armature.

INDUSTRIAL ENVIRONMENTAL SANITATION

Sec. 1. Authority.—This code has been adopted by the Industrial Commission in the discharge of its duties under Minn. St. 1949, Sec. 176.668, relating to occupational diseases.

Purpose.—The purpose of this Code is to prescribe the minimum requirements for the prevention and control of those conditions in industry which may deleteriously effect the health or well-being of the employee and to recommend supplemental measures designed to further promote the health and well being of employees.

Administration.—The Code will be enforced by the Industrial Commission. The Division of Industrial Health of the State Health Department will act as consultants to the Commission on the technical phases in the evaluation and controlling of industrial disease hazards.

Appeal for Variation.—The Industrial Commission may, upon application in writing, permit variation by individual plants, or on an industry-wide basis from the requirements when other means or equivalent protection are provided. Any variation granted under the provisions of this paragraph shall be limited to the particular case covered in the application of an appeal or variation, and may be revoked for cause.

Penalty for Violation.—The law provides that any person, firm, or corporation violating any of the provisions of this Code shall be guilty of a misdemeanor, and upon conviction therefor shall be punished by a fine of not more than \$100 or not less than \$25, or by imprisonment for not more than 90 days and not less than 30 days, or by both such fine and imprisonment for each offense. Each day of violation shall constitute a separate offense.

Unconstitutionality Clause.—In the event that any section, paragraph, sentence, clause, phrase, or word of this Code is declared unconstitutional or invalid for any reason, the remainder of such Code shall not be affected thereby.

Employer Responsibility.—Every employer shall provide, install and maintain in good repair such control measures and protective equipment as is required in accordance with the provisions of this Code, and shall inform affected employees regarding the nature of the hazards and the reasons for and the methods of use of control measures and protective equipment.

Employee Responsibility.—Every employee shall use control measures and protective equipment provided by the employer in accordance with this Code. Employees shall not violate, abuse or mishandle control measures and protective equipment provided by the employer for the employee's protection against health hazards.

Additional Requirements.—The specific provisions contained in this Code define minimum standards for protection of the health and well-being of workers. In the event that injury to health does occur despite compliance

with the provisions of this Code, the Industrial Commission may require additional control measures.

Sec. 2. **Scope.**—The provisions of this Code shall apply to all places of employment, and shall cover such environmental factors which affect the health, safety, comfort, and efficiency of employees such as dusts, fumes, gases, vapors, mists, temperatures, pressures, noise, air condition, illumination, water supply and waste disposal.

Sec. 3. **Definitions.**—“Approved” is construed to mean approved by the Industrial Commission.

“Contaminant” is construed to mean an undesirable substance or material.

“Maximum concentration” is defined as that amount of atmospheric contaminant which can be tolerated by man for continuous daily exposure with no impairment of health or well-being either immediately or after years of exposure.

“Shall” is construed to mean mandatory.

“Should” is construed to mean advisable.

ENVIRONMENTAL PROVISIONS.

Sec. 4. **Control of Atmospheric Contaminants.**—Workers shall not be exposed to concentrations of atmospheric contaminants hazardous to health.

Atmospheric contaminants should not be permitted in concentrations tending to:

Accumulate or condense upon equipment, floors, rafters, lodges or walls of any workroom in an insanitary or unsafe manner.

Provide a fire or explosion hazard.

Condense in the air in a manner which will significantly reduce visibility.

Produce any other nuisance condition within the place of employment.

Except where specifically provided for in this Code, control of atmospheric contaminants may be accomplished by any of the following methods:

Substitution of a less toxic material for the material contaminating the workroom atmosphere.

Local exhaust ventilation so that the contaminant is removed from the workroom atmosphere.

Isolation of the operation so that the contaminant does not enter the atmosphere of the general working area in hazardous concentrations, provided that any worker who is exposed to a health hazard by entering the isolated area shall be furnished personal protection in accordance with the provisions of this Code.

Enclosure of the operation so that the contaminant does not escape into the workroom atmosphere in hazardous concentrations.

Change of process or operation method (such as by wet method, the use of foams, colloids, etc.) so that the hazard is controlled.

Increase the general ventilation so that the contaminant is diluted to a safe concentration.

Any other method approved by the Commission.

The following lists of maximum concentrations shall be used to guide in appraising health hazards and in evaluating control of atmospheric contaminants:

GASES AND VAPORS.

Substance	P.P.M.*	Substance	P.P.M.*
Acetaldehyde	200	0-Dichlorobenzene	50
Acetic acid	10	Dichlorodifluoromethane	1,000
Acetic anhydride	5	1,1-Dichloroethane	100
Acetone	500	1,2-Dichloroethane	
Acrolein	0.5	(ethylene dichloride)	75
Acrylonitrile	20	1,2-Dichloroethylene	200
Ammonia	100	Dichloroethyl ether	15
Amylacetate	200	Dichloromethane	500
iso-Amyl alcohol	100	Dichloromonofluoromethane	1,000
Aniline	5	1,1-Dichloro-1-nitroethane	10
Arsine .....	.005	1,2-Dichloropropane	
Benzene (benzol)	35	(propylene dichloride)	75
Ethyl acetate	400	Dichlorotetrafluoroethane	1,000
Ethyl alcohol	1,000	Dimethylaniline	5
Ethyl benzene	200	Dimethylsulfate	1
Ethyl bromide	200	Dioxane	100
Ethyl chloride	1,000	Pentanone (methyl propan-	
Ethylene chlorohydrin	5	one)	200
Ethylene oxides	100	Phosgene	1
Ethyl ether	400	Phosphine	0.05
Ethyl formate	100	Phosphorus trichloride	0.5
Ethyl silicate	100	iso-Propanol	400
Formaldehyde	5	Propyl acetate	200
Gasoline	500	iso-Propyl ether	500
Bromine	1	Stibine	0.1
1,3-Butadiene	1,000	Stoddard solvent	500
n-Butanol	50	Styrene monomer	200
2, Butanone	250	Heptane	500
n, Butyl acetate	200	Hexane	500
Butyl cellosolve	200	Hydrogen chloride	5
Carbon dioxide	5,000	Hydrogen cyanide	10
Carbon disulfide	20	Hydrogen fluoride	3
Carbon monoxide	100	Hydrogen selenide	0.05
Carbon tetrachloride	50	Hydrogen sulfide	20
Cellosolve	200	Iodine	1
Cellosolve acetate	100	Isophorone	25
Chlorine	1	Mesityl oxide	50
2-Chlorobutadiene	25	Methanol	200
Chloroform	100	Methyl acetate	200
1-Chloro-1-nitropropane	20	Methyl bromide	20
Cyclohexane	400	Methyl butanone	100
Cyclohexanol	100	Methyl cellosolve	25
Cyclohexanone	100	Methyl cellosolve acetate	25
Cyclohexene	400	Methyl chloride	100
Cyclopropane (propene)	400	Methylcyclohexane	500

*P.P.M. = parts per million

Substance	P.P.M.*	Substance	P.P.M.*
Methylcyclohexanol	100	Nitromethane	100
Methylcyclohexanone	100	2-Nitropropane	50
Methyl formate	100	Octane	500
Methyl iso-butyl ketone.....	100	Ozone	1
Monochlorobenzene	75	Pentane	1,000
Monofluorotrchloromethane ..	1,000	Sulfur chloride.....	1
Mononitrotoluene	5	Sulfur dioxide.....	10
Naphtha (coal tar).....	200	1,1,2,2-Tetrachloroethane	5
Naphtha (petroleum).....	500	Tetrachloroethylene	100
Nickel carbonyl.....	1	Toluene	200
Nitrobenzene	1	Toluidine	5
Nitroethane	100	Trichloroethylene	100
Nitrogen oxides (other than		Turpentine	100
N ₂ O	25	Vinyl chloride.....	500
Nitroglycerin	0.5	Xylene	200

TOXIC DUSTS, FUMES AND MISTS.

Substance	Mg. per* cu. m.	Substance	Mg. per* cu. m.
Antimony	0.5	Mercury	0.1
Arsenic	0.5	Pentachloronaphthalene	0.5
Barium	0.5	Pentachlorophenol	0.5
Cadmium	0.1	Phosphorus (yellow)	0.1
Chlorodiphenyl	1	Phosphorus pentachloride.....	1
Chromic acid and chromates		Phosphorus pentasulfide	1
as CrO ₃	0.1	Selenium, as Se.....	0.1
Cyanide as CN.....	5	Sulfuric acid	1.0
Dinitrotoluene	1.5	Tellurium	0.1
Fluoride	2.5	Tetryl	1.5
Iron oxide fume.....	15	Trichloronaphthalene	5
Lead	0.15	Trinitrotoluene	1.5
Magnesium oxide fume	15	Zinc oxide fume.....	15
Manganese	6		

MINERAL DUSTS.

Substance	M.P.P.C.F.	Substance	M.P.P.C.F.
Alundum	50	medium (5 to 50% free	
Asbestos	5	SiO ₂)	20
Carborundum	50	low (below 5% free SiO ₂)....	50
Dust (nuisance, no free silica)	50	Slate (below 5% free SiO ₂)....	50
Mica (below 5% free silica)....	50	Soapstone (below 5% free	
Portland cement	50	SiO ₂)	20
Talc	20	Total dust (below 5% free	
Silica:		SiO ₂)	50
high (above 50% free SiO ₂)	5		

RADIATIONS.

Material or Radiation	Radiant Energy	Material or Radiation	Radiant Energy
Gamma (roentgen per week)..	0.3	Thoron (curies per cubic	
Radon (curies per cubic		meter)	10 ⁸
meter)	10 ⁸	X-Ray (roentgen per day).....	0.1

*g. per cu. m. = milligrams per cubic meter

*M.P.P.C.F. = million particles per cubic foot of air, standard light field count.

Maximum concentrations shall not be used as the sole criterion for establishing evidence of hazards to health or well-being, but the evaluation of a possible hazard shall also be subject to other pertinent factors such as the nature of the contaminant, and the frequency and duration of the exposure or clinical evidence of harmful effects.

It shall be the duty of the Commission to review the concentration values listed herein at regular intervals, and based upon progress in toxicological knowledge to alter or amend the list where indicated after due notice and public hearing.

The Commission shall, where necessary, specify other concentrations which shall apply in exposures of short or intermittent duration, to contaminants capable of causing acute impairment of health.

The contaminants known or believed to be capable of causing impairment to health which are not listed herein shall be controlled within such limits as may be required by the Industrial Commission.

Sec. 5. Infectious Agents.—Measures shall be provided as specified by the Commission to eliminate or control the transmission of infectious diseases through processing or handling industrial products or wastes.

Sec. 6. Illumination.—Illumination shall be provided and distributed to all working areas as required in this Code.

Seeing tasks requiring discrimination of fine detail under conditions of fair contrast, and where the nature of the work is very exacting and prolonged, shall be provided with a minimum of 100 foot candles of illumination.

Seeing tasks requiring discrimination of detail over prolonged periods of time, and under conditions of moderate contrast, shall be provided with a minimum of 50 foot candles of illumination.

Seeing tasks requiring discrimination of detail over intermittent periods of time and under conditions of normal contrast shall be provided with a minimum of 30 foot candles of illumination.

Casual seeing tasks not involving discrimination of fine detail shall be provided with a minimum of 10 foot candles of illumination.

Rough seeing tasks not requiring critical seeing shall be provided with a minimum of 5 foot candles of illumination.

Efforts shall be made to prevent glare and flicker, and to avoid excessive brightness ratios between the visual tasks and its surroundings.

The Commission will review the illumination values listed herein, at regular intervals, and based upon progress in knowledge in the field of illumination and related physiological effects will alter or amend the values where indicated after due notice and public hearing.

Sec. 7. General Ventilation and Temperature Requirements.—Air shall be provided and distributed in all workrooms as required in this Code.

Outside air shall be provided to all workrooms at the rate of 15 cubic feet per minute per person or 1½ air changes per hour, whichever is greater.

Air circulated in any workroom shall be supplied through air inlets arranged, located and equipped so that the workers shall not be subjected to air velocities exceeding 200 feet per minute except under special circumstances specified in this Code or where approved by the Industrial Commission.

The following tables shall be used as a guide in appraising and controlling health hazards associated with extremes in temperature and humidity.

High Environmental Dry and Wet-Bulb Temperatures* That Can Be Tolerated in Daily Work by Healthy, Acclimatized Men Wearing Warm Weather Clothing

Activity	Relative Humidity %	15-25 Dry Bulb	fpm Wet Bulb	Air Movement		300 Dry Bulb	fpm Wet Bulb
				100 Dry Bulb	fpm Wet Bulb		
Summer season	80	89	84	91	85	93	87
Light sedentary activities	60	94	82	96	84	98	85
(ET 85° F.)	40	100	79	101	81	103	82
	20	109	75	110	75	110	75
	5	119	69	118	69	117	68
Summer season	80	83	78	86	81	89	83
Heavy work	60	88	76	90	78	93	80
(ET 80° F.)	40	93	73	95	75	97	76
	20	100	69	101	70	102	70
	5	107	64	107	64	106	63
Winter season	80	78	73	81	77	85	79
Light or heavy work	60	81	71	85	74	88	76
(ET 75° F.)	40	86	68	89	70	91	72
	20	91	63	93	65	94	66
	5	97	58	97	58	97	59

*(Including Radiation Effect.)

If thermal radiation appears to be an important factor, the value listed above should be corrected accordingly.

The minimum air temperature of 60° F. shall be maintained in all rooms where work of a strenuous nature is performed, and the minimum air temperature of 65° F. shall be maintained in all other workrooms unless prohibited by process requirements.

Air from any exhaust system handling materials listed herein shall not be recirculated without written permission from the Commission.

Local Exhaust Ventilation.—The air velocity and/or rate of air flow as hereinafter required through a hood, booth, enclosure or other point of ventilation, and through the pipes shall be maintained at all times when the machine or process for which the ventilation is applied is in operation or use.

The effectiveness of every local exhaust ventilation system shall be judged by:

The ability of the hood, booth or other openings to produce a movement of air toward the opening sufficient to prevent escape of contaminants to the workroom beyond the limits required herein.

Air flow through branch and main duct shall be sufficient to transport the contaminants through the system without settling.

Piping shall be located so as to be accessible for inspection and maintenance.

Air flow equipment including hoods, pipes, fans, motors and collectors shall be effectively grounded.

Two or more operations involving more than one substance shall not be permitted to be connected to the same exhaust system when a combination of the substance removed may constitute a fire hazard, an explosion hazard or otherwise dangerous mixture.

Those processes or operations using or generating flammable dusts, gases, fumes, vapors, mists, fibers or other impurities shall be completely protected from all sources of ignition.

The capacity of an exhaust system shall be calculated on the basis of all hoods, booths, and enclosures connected to the system being open, except where the system is so interlocked that only a portion of it can be operated at a given time in which case the capacity should be calculated on the basis that all the hoods in the group requiring the greatest volume rate of exhaust are open.

Suitable air inlets shall be provided for replacement of air exhausted.

Exhaust systems handling dusts and discharges to the outer air shall be provided with suitable air cleaning devices to remove air contaminants prior to the discharge to the outer air unless otherwise approved by the Industrial Commission.

The discharge from any exhaust system shall be such that no air contamination therefrom will enter any window, door or other opening of any work space in quantities sufficient to create a health hazard to such space or create a nuisance to surrounding areas.

Collected materials shall be removed at intervals frequent enough to insure that the exhaust system will meet the requirements of this Code at all times.

Collected materials shall be disposed of in a manner which will not result in a nuisance for health hazards.

Sec. 8. Personal Protective Equipment.—Personal protective equipment shall not be used in lieu of control measures specified herein except when approved by the Commission.

Personal protective equipment and/or protective barriers approved by the Commission shall be provided whenever substances, radiations or mechanical irritants are encountered in a manner capable of causing any pathological change or injury or impairment in function of any part of the body through skin and/or mucous membrane absorption.

Personal protective equipment shall be fitted to each exposed worker when the wearing of such equipment is necessary for worker protection, and shall be maintained in an efficient and sanitary condition.

In any job where safety glasses are indicated the individual should have suitable vision tests to determine whether or not he needs refraction and correction for the job. Such correction should be incorporated in the safety glasses.

Working clothes shall be washed and/or dried between shifts on any job where the process is such that washing or drying is needed or a change of clothes shall be supplied so that dry clothes are assured for returning to work.

Sec. 9. Housekeeping.—All places of employment, passageways, store-rooms, service rooms, machinery equipment and supplies shall be kept in

a clean and sanitary condition with all necessary dust, spillage and debris removed at regular intervals frequent enough to maintain good house-keeping.

Where wet processes are used, reasonable drainage shall be maintained and false floors, platforms, mats or other dry standing places shall be provided.

So far as possible, sweeping and cleaning shall be done in such a manner as to avoid the contamination of the air with the dust during working hours.

Expectorating within the place of employment shall not be permitted except in the facilities (cuspidors) approved by the Commission as to type and maintenance.

All waste incident to operation of the place of employment shall be collected, stored and disposed of in a manner not a hazard to health or a nuisance.

Effective measures shall be taken to prevent the entrance or harborage of insects, rodents or other vermin within the working environment.

SERVICE FACILITIES.

Sec. 9. When ten or more women are employed at any one time, at least one retiring room for their exclusive use shall be provided.

When less than 10 women are employed and a retiring room is not furnished, some equivalent space shall be provided which can be properly screened and made suitable for the use of women employes.

The minimum space provided for the retiring room for ten women shall be 60 square feet. The minimum increased space for more shall be at least 2 square feet for each additional woman employed.

At least one couch or bed shall be provided in every place where more than ten women are employed. The number of such beds or couches required shall be as follows:

10 to 100 women, one bed;

100 to 250 women, two beds;

One additional bed for each additional 250 women employed.

In all places of employment where employees are permitted to lunch on the premises, and adequate space suitable for that purpose shall be provided for the maximum number of employees who may use such space at any one time.

No employee shall be permitted to partake of any part of his lunch, or eat other food at any time where there is present any industrial poison or other substance that may be injurious to the employee's health.

In every establishment where there is significant exposure to injurious dusts or other toxic materials, a separate lunch room shall be maintained unless it is convenient for the employees to lunch away from the premises.

Where a lunch room, cafe, or cafeteria is provided within the plant, it shall be constructed, maintained and operated to conform with the requirements of the State Board of Health for the control of sanitation in public eating establishments.

WATER SUPPLY AND WASTE DISPOSAL.

Sec. 10. In all places of employment, a safe source of drinking water which meets the requirements of the State Board of Health shall be available to the workers. All wastes which affect or tend to affect the public health in any manner shall be disposed of in accordance with the requirements of the State Board of Health. No system of water supply or system for the disposal of sewage, industrial wastes, garbage or refuse shall be installed or any existing system materially altered or extended until complete plans and specifications of the installation have been approved by the State Board of Health as required by Regulation 200 of that Board. All plumbing shall be installed in accordance with the Minnesota Plumbing Code.

SUBMISSION OF PLANS.

Sec. 11. Plans showing the location and type of dust, fumes, gas, vapor or mist generating operation and the method of control to be employed at each point of dissemination, together with the details of design and operation of such dust, fumes, gas, vapor, or mist control measures, shall be submitted in duplicate before installation of the proposed equipment by the owner of his authorized agent. One copy each to the Commission and to the State Board of Health for review and conditional approval subject to final acceptance after tests have been conducted to determine whether the control measure is effective in maintaining the concentrations of toxic materials below those specified herein.

DEGREASING TANK REQUIREMENTS.

Minimum Requirements for Operation.

Design of Equipment.—Avoid the use of tanks and appurtenances other than of standard manufacture to insure proper design with respect to required heat input, cooling capacity and thermostatic control.

In every case provide a tank large enough to permit the complete immersion in the solvent of all parts to be handled and wherever possible use an enclosed tank with automatic feed.

Provide a free-board distance from the maximum vapor level to the lip of the tank of not less than 15 inches.

Provide a clean out door for the removal of sludge.

Provide thermostatic control of the heating and condensing zones, and in addition provide safety thermostats to limit the solvent temperature and vapor height.

For gas-heated tanks, install a flue from the combustion chamber to the outside of adequate capacity and equipped with a proper diverter. The flue should be of acid-proof construction throughout its length.

Location of Equipment.—Wherever possible, locate degreasing tanks in rooms 20,000 cubic feet or more in volume.

Avoid locations in pits below the floor level or in pockets opening off large rooms.

Do not locate tanks near paint spray booths or other similarly ventilated equipment.

Eliminate all drafts in the area of the tank.

Gas-heated equipment provided with natural draft ventilation must not be located in a room equipped with mechanical exhaust ventilation unless adequate fresh air inlets are provided to prevent the development of a negative room pressure.

Operations involving open flames, electric arc, or other sources of high heat must not be carried on near degreasing tanks.

Local Exhaust Ventilation.—All degreasing tanks in confined rooms and other installations not favorably located or properly operated must be provided with local exhaust ventilation. General ventilation is not recommended in place of local exhaust ventilation, but may be required in addition.

Exhaust ventilation should be by lateral movement into slots along the edge of the tank with a ventilating rate of 60 C.F.M. per foot of tank perimeter. The slot velocity should be approximately 500 F.P.M. and provide for uniform ventilation over the entire tank area. **DEGREASING TANKS GREATER THAN 30 INCHES WIDE SHALL HAVE VENTILATION SLOTS ON EACH OF THE LONG SIDES.**

WHERE NECESSARY PROVIDE A VENTILATED BOOTH HAVING A FACE VELOCITY OF AT LEAST 100 LINEAR FEET PER MINUTE OR A DOWNDRAFT TABLE VENTILATED AT THE RATE OF AT LEAST 50 C.F.M. PER SQUARE FOOT OR GRILL AREA FOR THE TEMPORARY HOLDING OF CLEANED PARTS FOR DRYING OR COOLING.

Operation.—Operate the degreasing tank in accordance with the manufacturer's instructions.

Pass work IN AND OUT OF the tank at a rate of 8 to 12 FEET per minute.

Keep the tank closed when not in use.

Clean the solvent and tank at proper intervals and otherwise follow the manufacturer's instructions to avoid decomposition and loss of solvent.

Provide solvent vapor-absorbing type of respirators, to be worn during tank cleaning operations.

PAINT SPRAY BOOTHS.

The description of paint spray booths herein contained are the minimum requirements of the Commission. Diagrams may be obtained from the Accident Prevention division, room 137, State office building.

Paint spray booths must be clean, well lighted and well ventilated to assure health and safety. Booths must be designed to accommodate the product being finished.

First consideration in the original design must be to confining all over-spray within the booth.

The construction of the booth itself must be non-combustible, with the inside surface as smooth as possible to facilitate cleaning. Do not build this booth larger than necessary as it will require an oversize fan and more heat loss.

No electric lights of any type may be placed within a booth. Lighting may be obtained most satisfactorily by installing one-fourth inch wire glass panels in the side walls and/or ceiling, with reflecting type ordinary fixtures placed outside to direct light through the wire glass. Lighting fixtures must be arranged so they can be relamped from outside the booth.

Ventilation must be of sufficient capacity to assure an air travel past the breathing area of the employee of 100 lineal feet per minute or more. Exhaust opening must be either in the floor or walls and the center of the opening cannot be more than four feet above the floor level. Air intake openings, with filters, shall be placed in booth ceiling for a floor level exhaust, or in upper half of opposite end of booth from wall mounted exhausts. Motors driving exhaust fans must not be located within the duct, and may drive the fan either by an enclosed belt or shaft extended through an elbow in the duct. All electrical equipment and controls for either the lights or motors must be outside the booth. Fan blades must be of non-ferrous material, and for other than water spray booths should be of the propeller-blade type.

The floor within booths and extending eighteen inches in front shall be non-combustible.

Booths must be kept clean, and this can best be done by keeping inside surface of walls and ceilings coated with a special liquid spray shield furnished by concerns manufacturing spraying equipment or a light petroleum grease, such as vaseline. Overspray coating may then be readily removed from wire glass and walls and ceilings whenever necessary. If considerable overspray strikes any portion of the walls or ceiling, a lightweight wrapping paper may be used on such surfaces to make cleaning less difficult, using grease or the prepared coating to hold the paper in place.

The Booths Shall Not Be Located Below Grade Floors.—When they are used for the finishing of products other than those which are hand removable, they should be equipped with sprinkler heads, with one head for each eighty square feet of floor area and one or more heads in the duct. Pipe connection to water distribution system should consist of 1-inch pipe for a single head, 1¼-inch for two heads, 1½-inch for five heads, and 2-inch for more than five and up to eight heads. Water pressure at heads should not be less than twenty-five pounds per square inch. Heads must not be covered with paper bags. Nothing but grease or shielding dope is considered suitable for their protection. Booths provided with sprinkler protection must have a drain or scuppers capable of discharging the water from all heads.

Paint and solvent stocks kept in containers of more than 10-gallon capacity and all paint and solvent stocks in other than sealed containers shall be kept in an approved Class "A" storage room as described in Section 66 of the Regulation of the National Board of Fire Underwriters or in a separate detached paint storage building.

REFRIGERATING PLANTS.

Every Electric Motor driving a compressor of a refrigerating plant, shall be provided with an automatic pressure actuated circuit breaker, directly responsive to pressure of the compressor. This circuit breaker to cut off the electric current feeding the motor, when 90% of the maximum allowable pressure is reached. The refrigerant line of the pressure circuit breaker shall be connected between the main discharge stop valve and the

compressor. There shall be no stop valves on the refrigerant line between the compressor and the circuit breaker. No overload relays or fuses shall be considered as pressure circuit breakers.

Every Steam Engine driving a compressor of a refrigerating plant, with a steam feed line less than three inches in diameter, shall be provided with an automatic pressure control that shall shut off the steam supply of the steam engine when 90% of the maximum allowable working pressure is reached. The refrigerant line of the pressure control shall be connected between the main discharge stop valve and the compressor. There shall be no stop valves on the refrigerant line of the pressure control.

Every Compressor of a refrigerating plant, driven by a steam engine with a steam feed line three inches in diameter or over, shall be provided with a pressure actuated alarm unit approved by the Commission, that will sound when 90% of the maximum allowable working pressure has been reached. The refrigerant line of the pressure alarm shall be connected between the main discharge stop valve and the compressor. There shall be no stop valves on the refrigerant line of the pressure alarm. There shall be no switches on the electric circuit of the pressure alarm.

Every Compressor having a receiver containing more than ten pounds of refrigerant and where the capacity of the system is less than twenty-five tons, shall be provided with a one-half inch external automatic relief valve connected between the main discharge stop valve and the compressor, and discharging into the low pressure side of the system on either side of the main suction stop valve.

The relief valve shall be set to discharge at the maximum allowable working pressure. There shall be no stop valves on the automatic by-pass line.

Where the capacity of the system is over twenty-five tons, the following sizes of automatic valves used as by-passes shall be used:

Over 25 tons to 40 tons.....	1 inch
Over 40 tons to 60 tons.....	1¼ inches
Over 60 tons to 100 tons.....	1½ inches
Over 100 tons to 140 tons.....	2 inches
Over 140 tons to 190 tons.....	2½ inches
Over 190 tons to 300 tons.....	3 inches

Every Receiver, where the refrigerating plant contains more than 15 pounds of refrigerant, shall be provided with a pressure relief valve discharging to the outside atmosphere when the maximum allowable pressure is reached. The location of the pressure relief valve and its outlet to the outside air shall be designated by a representative of the Commission. Only one shut-off valve shall be permitted between the pressure relief valve and the receiver—this valve must be sealed open.

The sizes of relief valves for receivers shall be as follows:

Charge of refrigerating plant less than 1,000 lbs. use	½ in. valve
Charge of refrigerating plant 1,000 lbs. to 1,800 lbs. use	¾ in. valve
Charge of refrigerating plant 1,800 lbs. to 3,000 lbs. use	1 in. valve
Charge of refrigerating plant 3,000 lbs. to 5,250 lbs. use	1¼ in. valve
Charge of refrigerating plant 5,250 lbs. to 7,500 lbs. use	1½ in. valve
Charge of refrigerating plant 7,500 lbs. to 13,500 lbs. use	2 in. valve
Charge of refrigerating plant 13,500 lbs. to 27,000 lbs. use	3 in. valve

The Commission, in cases of practical difficulties or unnecessary hardships, may approve other conditions or arrangements, so long as equivalent protection is thereby secured.

Inspectors must instruct foremen that in every case where owing to the lack of material or lack of authority to change a condition that in the opinion of the inspector is unsafe, the job must be stopped until persons in authority are notified and conditions are made safe.

All ammonia compressors and ammonia plants installed in the state of Minnesota shall be provided with tags attached stating capacity of compressor and amount of refrigerant in plant.

VENTILATION FOR GARAGES.

Provide a ventilation system capable of removing a volume of air equal to the floor area times a height of six (6) feet not less than once every ten (10) minutes. Exhaust ducts are to be not more than fourteen (14) inches from the floor, so placed as to remove carbon monoxide gas from the entire garage. An equal amount of tempered fresh air should be provided for, preferably ten to 11 feet high.

Plans showing the location and type and the method of control to be employed at each point of dissemination, together with the details of design and operation of control measure, shall be submitted in duplicate before installation of the proposed equipment by the owner or his authorized agent, one copy each to the Commission and to the State Board of Health, for review and conditional approval, subject to final acceptance after tests have been conducted to determine whether the control measure is effective in maintaining the concentration of toxic materials below those specified in this code.

Dust Collection System Requirements for Stone Cutting.

LARGE SURFACING MACHINES

SIZE PISTONS OVER 2½" D.	DISTANCE FROM HOOD	AIR FLOW CU. FT. PH.	VELOCITY FOR SIZE OF HOSE	CONSTRUCTION OF HOOD
LARGE—STATIONARY	3" FIXED HOOD FROM CUTTING POINT OF TOOL TO BOTTOM OF HOOD	1000 MIN.	4000' MAX. 6000' MAX.	HOOD FIXED TO MACHINE TO MAINTAIN 3" FROM CUTTING TOOL
LARGE—MOVABLE	SAME AS ABOVE	600	4000' MIN. 6000' MAX.	ENCLOSURE HOOD AT SIDES AND TOP
SMALL SIZE OF PISTON LESS THAN 2½" DIAMETER	SAME AS ABOVE	500	4000' MIN. 6000' MAX.	FIXED HOOD FLANGED HOOD

TRAPS SHALL BE PROVIDED FOR EACH EXHAUST UNIT TO REMOVE CHIPS FROM AIR STREAM
HAND-HELD PNEUMATIC TOOLS

3" FROM CUTTING POINT OF TOOL TO BOTTOM OF HOOD	400 540	4000' MIN. 6000' MAX. TO CHIP TRAP	FLANGED HOOD OPEN HOOD AREA OF HOOD 1½ TO 2 TIMES GREATER THAN DIAMETER OF HOSE OR DUCT
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IN NO CASE SHALL THE FLEXIBLE DUCT FROM THE HOOD TO THE
EXHAUSTER BE LESS THAN 4" IN DIAMETER

TRAPS SHALL BE PROVIDED FOR EACH EXHAUST UNIT TO REMOVE CHIPS FROM AIR STREAM
HOODS ATTACHED TO FLEXIBLE DUCTS SHALL BE EASILY MANEUVERABLE TO REACH AND
MAINTAIN ANY DESIRED POSITION TO WITHIN 3" OF THE CUTTING TOOL IN VERTICAL OR
HORIZONTAL POSITION. A TURNABLE TYPE BENCH IS DESIRABLE AND SHOULD BE PRO-
VIDED FOR SMALL STONE WORK. SAND BLAST CABINETS. AIR VELOCITY AT CURTAIN SHALL
BE NO LESS THAN 300 FEET PER MINUTE.

MECHANICS:

DUST ARRESTERS MUST BE PROVIDED, CONSTRUCTED AND MAINTAINED SO THAT DUST CAN-
NOT RE-ENTER THE WORKING AREA OR CAUSE A NUISANCE TO THE PUBLIC, OR CREATE
DAMAGE TO MATERIALS, MACHINERY OR BUILDINGS, OR CREATE A HEALTH HAZARD TO EM-
PLOYEES IN NEAR-BY INDUSTRIES. SAME TO BE OF SUBSTANTIAL CONSTRUCTION SUBJECT
TO THE APPROVAL OF DEPARTMENT OF LABOR AND INDUSTRY.

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