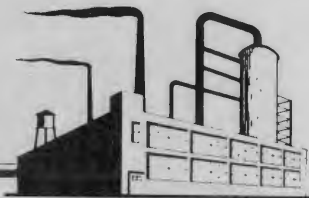


SAFETY REGULATION no. 4



Relating to the

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Effective October 1, 1958

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BUREAU OF ENGINEERING & SAFETY.**

N.J. DEPARTMENT OF LABOR & INDUSTRY.
Trenton, N.J.

Division of Labor

This Safety Regulation No. 4

Supersedes the Following:

"CODE FOR THE SAFEGUARDING

of

MECHANICAL POWER TRANSMISSION APPARATUS"

Which Was Filed with the

Secretary of State

on

January 9, 1948

ES-223 (9-58) (This Regulation was printed by the Department of Labor and Industry)

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This Regulation establishes reasonable standards for the safeguarding of mechanical power transmission apparatus. It is based upon the American Standard Safety Code for Mechanical Power Transmission Apparatus B 15.1-1953.

This Regulation is promulgated by the Commissioner of Labor and Industry of the State of New Jersey under authority vested in him by law:

R. S. 34:1-20. The commissioner may make and publish rules and regulations not inconsistent with law as he shall deem necessary to enforce the provisions of this title.

Whenever any condition is found to exist in contravention of any provision of this title, the commissioner may by written order signed by him specifying the things to be done and the time for compliance require such conditions to be corrected.

The provisions of Title 34 which refer to the subject matter regulated are:

34:6-62. *Machine Guards*. The owner or person in charge of any factory, workshop, mill or place where the manufacture of goods is carried on where machinery is used, shall provide, in the discretion of the commissioner, friction clutches for stopping shafting, and belt shifters or other mechanical contrivances for the purpose of throwing on or off belts or pulleys. Whenever practicable, all machinery shall be provided with loose pulleys. All vats, pans, saws, planers, power presses, foot presses, cogs, gearing, belting, shafting, set screws, drums and machinery of every description shall be properly guarded. No person shall remove or make ineffective any safeguard around or attached to such machinery, vats or pans while the same are in use, unless for the purpose of immediately making repairs thereto, and all such safeguards so removed shall be promptly replaced. If the machinery, or any part thereof, or any vat, pan or vessel containing molten metal or hot liquid is in a dangerous condition or is not properly guarded, the use thereof may be prohibited by the commissioner, and a notice to that effect shall be attached thereto. Such notice shall not be removed until the machinery is made safe and the required safeguards are provided. In the meantime such unsafe or dangerous machinery, vats, pans, or vessels containing molten metal or liquid shall not be used

Prior to its promulgation, this Regulation was reviewed and approved by the New Jersey State Industrial Safety Committee.

SECTION 1 - PURPOSE AND SCOPE

- 1.1 The purpose of this Regulation is to establish reasonable safeguards against injury to workers who use or may come in proximity to mechanical power transmission apparatus.
- 1.2 This Regulation applies to all moving parts of equipment used in the mechanical transmission of power, including prime movers, intermediate equipment and driven machines, excluding point of operation when such equipment is used in any factory, workshop, mill or place where the manufacture of goods is carried on.
- 1.3 The safeguarding of all connecting rods, cranks, flywheels, shafting, spindles, pulleys, belts, link belts, chains, ropes and rope drives, gears, sprockets, friction drives, cams, couplings, clutches, counterweights, revolving or reciprocating parts, up to but not including point of operation, also all bolts, keys, set screws, oil cups or similar projections, is included within the scope of this Regulation.
- 1.4 In cases of practical difficulty or unnecessary hardship, the Commissioner may grant exceptions from this Regulation provided that a request for such exception has been made in writing. Exceptions can only be granted when it is clearly evident that a satisfactory, safe and sanitary condition is attained, but cannot be granted in any case where conflict would be created with mandatory requirements of the law.
- 1.5 This Regulation shall not apply to the following equipment when operating at two hundred and fifty (250) feet per minute or less: flat belts one (1) inch or less in width and flat belts two (2) inches or less in width which are free from metal lacings or fasteners.
- 1.6 The Commissioner, by written order, may require the installation of safeguards not required by this Regulation if in the opinion of the Commissioner a sufficient hazard exists.

SECTION 2 - DEFINITIONS

2.1 General Definitions

- 2.1.1 *Approved* - approved by the Commissioner.
- 2.1.2 *Commissioner* - the Commissioner of Labor and Industry or his authorized representative.

2.2 Special Definitions

- 2.2.1 *Belt* - any power transmission belt such as flat belt, round belt, V-belt, etc., unless otherwise specified.

2.2.2 *Belt Pole* – sometimes called a "belt shipper" or "shipper pole," is a device used in shifting belts on and off fixed pulleys on line or counter-shaft where there are no idler pulleys.

2.2.3 *Belt Shifter* – a device for mechanically shifting belts from tight to loose (idler) pulleys or vice versa, or for shifting belts on cones of speed pulleys.

2.2.4 *Flywheel* – any flywheel, balance wheel, and flywheel pulleys mounted and revolving on crank shaft of engine or other shafting.

2.2.5 *Gears* – a set or train of gears which comprises two or more intermeshing gears.

2.2.6 *Maintenance Runway* – any permanent runway or platform used for oiling, maintenance, running adjustment or repair work, but not for passageway.

2.2.7 *Nip-point Belt and Pulley Guard* – a device which encloses the pulley and is provided with rounded or rolled edge slots through which the belt passes.

2.2.8 *Point of Operation* – that point at which cutting, shaping, or forming is accomplished upon the stock and shall include such other points as may offer a hazard to the operator in inserting or manipulating the stock in the operation of the machine.

2.2.9 *Prime Mover* – any steam, gas, oil and air engine, motor, steam and hydraulic turbine, or other equipment used as a source of power.

2.2.10 *Sheaves* – grooved pulleys, unless used as flywheels.

2.2.11 *Sprockets* – two or more sprockets carrying one or more chains.

SECTION 3 – GENERAL PROVISIONS

3.1 All mechanical power transmission apparatus subject to this Regulation shall conform to all applicable requirements contained herein.

3.2 Vertical and inclined belts (Sections 5.3.2 and 5.3.3) if not more than two and one-half (2½) inches wide and running at a speed of less than one thousand (1,000) feet per minute and if free from lacings or fastenings may be guarded with a nip-point belt and pulley guard.

3.3 For the Textile Industry, because of the presence of the excessive deposits of lint, which constitutes a serious fire hazard, the sides and face sections only of nip-point belt and pulley guards will be required, provided the guard shall extend at least six (6) inches beyond the rim of the pulley on the in-

running and offrunning sides of the belt and at least two (2) inches away from the rim and face of the pulley in all other directions.

SECTION 4 – PRIME MOVER GUARDS

4.1 *Flywheels*

4.1.1 Flywheels located so that any part is seven (7) feet or less above floor or platform shall be guarded in one of the following ways:

a. With an enclosure of sheet, perforated, or expanded metal, or woven wire; (See Section 7)

b. With guard rails placed not less than fifteen (15) inches nor more than twenty (20) inches from rim. When flywheel extends into pit or is within 12 inches of floor, a standard toe board shall also be provided; (See Section 7.3.5)

c. When the upper rim of flywheel protrudes through a working floor, it shall be entirely enclosed or surrounded by a guard rail and toe board.

d. For flywheels without solid web centers but with smooth rims five (5) feet or less in diameter, where the preceding methods cannot be applied, the following may be used: a disk attached to the flywheel in such manner as to cover the spokes of the wheel on the exposed side and present a smooth surface and edge, at the same time providing means for periodic inspection. An open space, not exceeding four (4) inches in width, may be left between the outside edge of the disk and the rim of the wheel if desired, to facilitate turning the wheel over. Where a disk is used, the keys or other dangerous projections not covered by disk shall be cut off or covered. (See Section 7.2)

e. Adjustable guard to be used for starting engine or for running adjustment may be provided at the flywheel of gas or oil engines. A slot opening for jack bar shall be permitted.

f. Whenever flywheels are above working areas, guards shall be installed having sufficient strength to hold the weight of the flywheel in the event of a shaft or wheel mounting failure.

4.2 *Cranks and Connecting Rods*. Cranks and connecting rods, when exposed to contact shall be guarded in accordance with sections 7.1 and 7.2 or by a guard rail as described in section 7.3.5.

4.3 *Tail Rods or Extension Piston Rods.* Tail rods or extension piston rods shall be guarded in accordance with sections 7.1 and 7.3 or by a guard rail on sides and end, with a clearance of not less than fifteen (15) nor more than twenty (20) inches when rod is fully extended.

4.4 *Governor Balls.* Governor balls seven (7) feet or less from the floor or other working level, when exposed to contact, shall be provided with an enclosure extending to the top of the governor balls when at their highest position. The material used in the construction of this enclosure shall conform to sections 7.1 and 7.3.

SECTION 5 - MECHANICAL POWER TRANSMISSION EQUIPMENT

5.1 *Shafting*

5.1.1 *Installation*

- a. Each continuous line of shafting shall be secured in position against excessive endwise movement.
- b. Inclined and vertical shafts, particularly inclined idler shafts, shall be securely held in position against endwise thrust.

5.1.2 *Guarding Horizontal Shafting*

- a. All exposed parts of horizontal shafting seven (7) feet or less from floor or working platform, excepting runways used exclusively for oiling, or running adjustments, shall be protected by a stationary casing enclosing shafting completely or by a trough enclosing sides and top or sides and bottom of shafting as location requires.
- b. Whenever shafting extends over a driveway, it shall be protected as stated above unless it is located fifteen (15) feet or more above driveway.
- c. Shafting under bench machines shall be enclosed by a stationary casing or by a trough at sides and top or sides and bottom, as location requires. The sides of the trough shall come within at least six (6) inches of the underside of table, or if shafting is located near floor within six (6) inches of floor. In every case the sides of trough shall extend at least two (2) inches beyond the shafting or protuberance.

5.1.3 *Guarding Vertical and Inclined Shafting.* Vertical and inclined shafting seven (7) feet or less from floor or working platform, excepting maintenance runways, shall be enclosed with a stationary casing in accordance with requirements of sections 7.1 and 7.3.

5.1.4 *Projecting Shaft Ends.*

- a. Projecting shaft ends shall present a smooth edge and end, and shall not project more than one-half the diameter of the shaft unless guarded by non-rotating caps or safety sleeves.
- b. Unused key-ways shall be filled up or covered.

5.1.5 *Power Transmission Apparatus Located in Basements.* All mechanical power transmission apparatus located in basements, towers, and rooms used exclusively for power transmission equipment shall be guarded in accordance with these standards, except that the requirements for safe-guarding belts, pulleys, and shafting may be waived when the following conditions are met:

- a. The basement, tower, or room occupied by transmission equipment shall be locked against unauthorized entrance.
- b. The vertical clearance in passageways between the floor and power transmission beams, ceiling, or any other objects, should not be less than five feet six inches (5 ft. 6 in.).
- c. The intensity of illumination shall conform to applicable regulations on lighting promulgated by the Commissioner.
- d. The footing shall be dry, firm, and level.
- e. The route followed by the oiler shall be protected in such manner as to prevent accident.
- f. The exemption granted by this rule shall not apply to single isolated hazards which can be guarded without hardship in the usual prescribed manner.

5.2 *Pulleys.*

5.2.1 *Guarding.* Pulleys, any parts of which are seven (7) feet or less from the floor or working platform shall be guarded in accordance with the standards specified under sections 7.1 and 7.3.

Pulleys serving as balance wheels (e. g., punch presses) on which the point of contact between belt and pulley is more than six feet six inches (6 ft. 6 in.) from the floor or platform may be guarded with a disk covering the spokes.

5.2.2 Location of Pulleys

- a. Unless the distance to the nearest fixed pulley, clutch, or hanger exceeds the width of the belt used, a guide shall be provided to prevent the belt from leaving the pulley on the side where insufficient clearance exists.
- b. Where there are overhanging pulleys on line, jack, or countershafts with no bearing between the pulley and the outer end of the shaft, a guide to prevent the belt from running off the pulley shall be provided.
- c. For requirements for guarding pulleys located in basement, towers, and rooms where no employees are regularly stationed, see section 5.1.5.

5.2.3 **Broken Pulleys.** Pulleys with cranks, or pieces broken out of rims, shall not be used.

5.2.4 **Pulley Speeds.** Pulleys intended to operate at rim speed in excess of the manufacturer's normal recommendations shall be specially designed and carefully balanced for the speed at which they are to operate.

5.2.5 **Belt Guides.** Belt guides should not be installed except as provided in section 5.2.1.

5.2.6 **Composition and Wood Pulleys.** Composition or laminated wood pulleys shall not be installed where they are subjected to influences detrimental to their structural composition.

5.2.7 **Pulleys Exposed to Corrosion.** Pulleys used where conditions are such as to produce active corrosion shall be of corrosion-resisting material.

5.2.8 **Pulleys Out of Service.** Pulleys permanently out of service shall not be allowed to remain on shafting which is in use.

5.2.9 **Sheaves for Quarter-Turn V-Belt Drives.** Deep groove sheaves should be used on quarter-turn drives for V-belts.

5.3 Belt, Rope and Chain Drives.

5.3.1 Horizontal Belts and Ropes.

- a. Where both runs of horizontal belts are seven (7) feet or less from the floor level, the guard shall extend to at least fifteen (15) inches above the belt or to a standard height (see section 7.3.1) except that where either run of a horizontal belt is 60 inches or

less from the floor, the belt shall be fully enclosed in accordance with sections 7.1 and 7.3.

- b. In power plants or power-development rooms, a guard rail may be used in lieu of the above.
- c. Overhead horizontal belts with lower part seven (7) feet or less from the floor or platform, shall be guarded on sides and bottom in accordance with section 7.3.3.
- d. Horizontal overhead belts more than seven (7) feet above floor or platform shall be guarded for their entire length if any of the following conditions exist:
 1. If located over passageways or work places and traveling 1800 feet or more per minute.
 2. If center-to-center distance between pulleys is ten (10) feet or more.
 3. If belt is eight (8) inches or more in width.
- e. Where the upper and lower runs of horizontal belts are so located that passage of persons between them would be possible, the passage shall be either:
 1. Completely barred by a guard rail or other barrier in accordance with sections 7.1 and 7.3, or
 2. Where passage is regarded as necessary there shall be a platform over the lower run guarded on either side by a railing completely filled in with wire mesh or other filler, or by a solid barrier. The upper run shall be so guarded as to prevent contact therewith either by the worker or by objects carried by him. In power plants, only the lower run of the belt need be guarded.
- f. Overhead chain and link belt drives are governed by the same rules as overhead horizontal belts and shall be guarded in the same manner as belts.
- g. American or Continuous System rope drives are to be so located that the condition of the rope (particularly the splice) cannot be constantly and conveniently observed, shall be equipped with a "tell-tale" device (preferably electric-bell type) that will give warning when rope begins to fray.
- h. All guards are to be constructed in accordance with section 7.3.4.

5.3.2 Vertical and Inclined Belts.

- a. Vertical and inclined belts shall be enclosed by a guard conforming to standards in sections 7.1 and 7.3.
- b. All guards for inclined belts shall be arranged in such a manner that a minimum clearance of seven (7) feet is maintained between belt and floor at any point outside of guard.

5.3.3 *Vertical Belts.* Vertical belts running over a lower pulley more than seven (7) feet above floor or platform shall be guarded at the bottom in the same manner as horizontal overhead belts, if conditions are such as stated in sections 5.3.1-d, and 3.

5.3.4 Cone-Pulley Belts.

- a. The cone belt and pulley shall be equipped with a belt shifter so constructed as to adequately guard the nip-point of the belt and pulley. If the frame of the belt shifter does not adequately guard the nip-point of the belt and pulley, the nip-point shall be further protected by means of a vertical guard placed in front of the pulley and extending at least to the top of the largest step of the cone.
- b. If the belt is of the endless type or laced with rawhide laces, and a belt shifter is not desired, the belt will be considered guarded if the nip-point of the belt and pulley is protected by a nip-point guard located in front of the cone, extending at least to the top of the largest step of the cone, and formed to show the contour of the cone in order to give the nip-point of the belt and pulley the maximum protection. (See section 6.2.4.)
- c. If the cone is located less than three feet from the floor or working platform, the cone pulley and belt shall be guarded to a height of three feet regardless of whether the belt is endless or laced with rawhide.

5.3.5 Belt Tighteners

- a. Suspended counterbalanced tighteners and all parts thereof shall be of substantial construction and securely fastened; the bearings shall be securely capped. Means shall be provided to prevent tightener from falling, in case the belt breaks.
- b. Where suspended counterweights are used and not guarded by location, they shall be so encased as to prevent accident.

5.4 Gears, Sprockets, and Chains

5.4.1 *Gears.* Gears shall be guarded in accordance with one of the following specifications:

- a. A complete enclosure.
- b. A standard guard as described in section 7.3 at least seven (7) feet high extending six (6) inches above the mesh point of the gears.
- c. By a band guard covering the face of gear and having flanges extended inward beyond the root of the teeth of the exposed side or sides. Where any portion of the train of gears guarded by a band guard is less than seven (7) feet from the floor a disk guard or a complete enclosure to the height of seven (7) feet shall be required.
- d. Hand operated gears should be adequately guarded. However, this section does not apply to hand-operated gears used only to adjust machine parts and which do not continue to move after hand power is removed.

5.4.2 *Sprockets and Chains (except manually operated sprockets).* All sprocket wheels and chains shall be enclosed unless more than seven (7) feet above the floor or platform. Where the drive extends over other machine or working areas, protection against falling shall be provided.

5.4.3 *Openings for Oiling.* When frequent oiling must be done, openings with hinged or sliding self-closing covers shall be provided. All points not readily accessible shall have oil feed tubes if lubricant is to be added while machinery is in motion.

5.5 Friction Drives

5.5.1 Guarding

- a. The driving point of all friction drives when exposed to contact shall be guarded.
- b. All arm or spoke friction drives and all web friction drives with holes in the web shall be entirely enclosed.
- c. All projecting bolts on friction drives where exposed to contact shall be guarded.

5.6 Keys, Set Screws, and Other Projections

5.6.1 Elimination or Guarding.

- a. All projecting keys, set screws and other projections in revolving parts shall be removed or made flush or guarded by stationary metal cover. This does not apply to keys or set screws within gear or sprocket casings or other enclosures, nor to keys, set screws, or oil cups in hubs of pulleys less than twenty (20) inches in diameter where they are within the plane of the rim of the pulley.
- b. Projecting set screws or oil cups should not be used in any revolving pulley or part of machinery, even though they are within the limits stated in section 5.6.1.a.

5.7 Collars and Couplings

5.7.1 *Collars.* All revolving collars, including split collars, shall be cylindrical, and screws or bolts used in collars shall not project beyond any revolving surfaces.

5.7.2 Couplings.

- a. Shaft couplings shall be so constructed as to present no hazard from bolts, nuts, set screws or revolving surfaces.
- b. Bolts, nuts and set screws shall be permitted where they are covered with safety sleeves or where they are used parallel with the shafting and are countersunk or else do not extend beyond the flange of the coupling.
- c. The use of a rib- or clamp-type coupling will be acceptable if the ends of the fastenings are well within the periphery of the body of the couplings and the ends of all bolts are flush with or below the crown of the nut. All outside surfaces shall be turned or ground and outside edges carefully rounded.
- d. The shifting part of jaw clutches, and the shifting or mechanism part of friction clutch couplings should be attached to the driven shaft, i. e., the shaft that will be idle when clutch is disengaged.

5.8 Bearings and Facilities for Oiling

5.8.1 Bearings

- a. Self-lubricating bearings should be used.
- b. All drip cups and pans shall be securely fastened.

5.8.2 *Ladders.* Whenever portable ladders are used in oiling, repairing, or adjusting power transmission machinery, these ladders shall be equipped with safety hooks or anti-slip device at bottom.

SECTION 6 - STARTING AND STOPPING DEVICES

6.1 Clutches, Cut-Off Couplings and Clutch Pulleys

6.1.1 Guarding

- a. Clutches, cut-off couplings, or clutch pulleys having projecting parts, where such clutches are located seven (7) feet or less above the floor or working platform, shall be enclosed by a stationary guard constructed in accordance with these rules and regulations. ("U" type guard is permissible, see section 7.2.3).
- b. Where clutches, cut-off couplings, or clutch pulleys are so situated within a machine or otherwise guarded by location, the application of this section shall be determined by the Commissioner.
- c. In engine rooms a guard rail, preferably with toe board shall be permitted instead of the above, provided this room is occupied only by authorized personnel.
- d. A bearing support immediately adjacent to a friction clutch or cut-off coupling shall have self-lubricating bearings requiring attention at infrequent intervals.

6.2 Belt Shifters, Clutches, Shippers, Poles, Perches and Fasteners

6.2.1 Belt Shifters

- a. Tight and loose pulleys on all new installations made subsequent to the effective date shall be equipped with a permanent belt shifter provided with mechanical means to prevent belt from creeping from loose to tight pulley.
- b. Existing installations should be changed to conform to section 6.2.1 (a).
- c. Belt shifter and clutch handles shall be rounded and be located as far as possible from danger of accidental contact, but within easy reach of the operator. Where belt shifters are not directly located over a machine or bench, the handles shall be cut off six feet six inches (6 ft. 6 in.) above floor level.
- d. All belt and clutch shifters of the same type in each shop should move in the same direction to stop machines, i. e. either all *right* or all *left*.

- e. Section 6.2.1 (c) shall not apply to friction clutch on countershaft carrying two clutch pulleys with open and crossed belts, respectively.

6.2.2 *Belt Shippers and Shipper Poles.* Belt poles should not be used as substitutes for mechanical shifters. Where necessity compels their use, they shall be of sufficient size to enable workmen to grasp them securely. A two-inch (2 in.) diameter or 1½ in. x 2 in. cross-section should be used. Poles shall be smooth and preferably of straight grain hard wood, such as ash or hickory. The edges of rectangular poles should be rounded. Poles shall extend from the top of the pulley to within about forty (40) inches of floor or working platform.

6.2.3 *Belt Fasteners.* Belts which of necessity must be shifted by hand and belts within seven (7) feet of the floor or working platform which are not guarded in accordance with the intent of this Regulation shall not be fastened with metal in any case nor with any other fastening which by construction or wear will constitute an accident hazard.

6.2.4 *Belt Perches.* Where loose pulleys or idlers are not practicable, belt perches in form of brackets, rollers, etc., shall be used to keep idle belts away from the shafts. Perches should be substantial and designed for the safe shifting of belts.

SECTION 7 – GUARD STANDARDS

7.1 General Requirements

7.1.1 Materials

- a. Standard conditions will be secured by the use of the following materials: fire resistant plastics, expanded metal, perforated or solid sheet metal, or wire mesh on a frame of angle iron or iron pipe securely fastened to floor or to frame of machine. (See section 7.3.1).
- b. All material shall be free from burrs and sharp edges.
- c. Wire mesh shall be of the type in which the wires are securely fastened at every cross point either by welding, soldering, or galvanizing, except in case of diamond or square wire mesh made of No. 14 gauge wire, ¾ in. mesh or heavier.

7.1.2 Design of Guards

- a. Where it is necessary to change belts, make adjustments or apply oil or grease, guards shall have hinged sections or be removable. Hinged sections should be self closing.

- b. Guards shall be designed so as not to interfere with the usual machine operations, but to give the maximum protection to the operator.

7.1.3 Methods of Manufacture

- a. Fire resistant plastics, expanded metal, sheet or perforated metal, and wire mesh shall be securely fastened to frame by one of the following methods:
 1. With rivets or bolts spaced not more than five (5) inches center to center. In case of expanded metal or wire mesh, metal metal strips or clips shall be used to form a washer for rivets or bolts.
 2. By welding to frame every four (4) inches.
 3. By weaving through channel or angle frame, or if No. 14 gauge ¾ in. mesh or heavier is used, by bending entirely around rod frames.
 4. Where openings in pipe railing are to be filled in with expanded metal, wire mesh or sheet metal, the filler material shall be made into panels with rolled edges or bound with "V" or "U" edging of No. 24 gauge or heavier sheet metal fastened to the panels with bolts or rivets spaced not more than five (5) inches center-to-center. The bound panels shall be fastened to the railing by sheet-metal clips spaced not more than five (5) inches center-to-center.
 5. Diamond or square mesh made of crimped wire fastened into channels angle or round-iron frames, may also be used as a filler in guards. Size of mesh shall correspond to table given under section 7.3.1.
- b. Where the design of guards requires filler material of greater area than 12 square feet, additional frame members shall be provided to maintain panel area within this limit.
- c. All joints of framework shall be made equivalent in strength to the material of the frame.

7.2 Disk, Shield, and "U" Guards

7.2.1 Disk Guards

- a. A disk guard shall consist of a sheet-metal disk not less than No. 22 gauge or fire resistant plastic of equivalent strength fastened by "U" bolts or rivets to spokes of pulleys, flywheels, or gears.

Where possibility of contact with sharp edges of the disk exists, the edge shall be rolled or wired. In all cases the nuts shall be provided with lock nuts which shall be placed on the unexposed side of the wheel.

7.2.2 Shield Guards

- a. A shield guard shall consist of a frame filled in with fire resistant plastic, wire mesh, expanded, perforated, or solid sheet metal.
- b. If area of shield does not exceed six (6) square feet the wire mesh or expanded metal may be fastened in a framework of 3/8 in. solid rod, 3/4 in. x 3/4 in. x 1/8 in. angle iron or metal construction of equivalent strength.
- c. Metal shields may have edges entirely rolled around a 3/8 in. solid iron rod.
- d. All material of shield guard shall meet the requirements of section 7.3.1.

7.2.3 "U" Guards. A "U" guard consisting of a flat surface with edge members shall be designated to cover the under surface and lower edge of a belt, multiple chain, or rope drive. It shall be constructed of materials specified in table, Section 7.3.1, and shall conform to the requirements of 7.3.3 and 7.3.4. Edges shall be smooth and, if size of guard requires, these edges shall be reinforced by rolling, wiring, or by binding with angle or flat iron.

7.3 Approved Materials

7.3.1 *Minimum Requirements.* The materials and dimensions specified in this rule shall apply to all guards except horizontal overhead belts, rope, cable or chain guards more than seven (7) feet above floor, or platform. (For the latter, see table section 7.3.6).

a. Table of Standard Materials and Dimensions

Material	Clearance from Moving Part at all Points	Largest Mesh or Opening Allowable	Minimum Gauge (U. S. Standard) or Thickness	Minimum Height of Guard from Floor or Platform Level
Woven Wire	Under 2"	3/8"	No. 16	7'-0"
	2"-4"	1/2"	No. 16	7'-0"
	Under 4"	1/2"	No. 16	7'-0"
Expanded Metal	4"-15"	2"	No. 12	7'-0"
	Under 4"	1/2"	No. 18	7'-0"
	4"-15"	2"	No. 13	7'-0"
Perforated Metal	Under 4"	1/2"	No. 20	7'-0"
	4"-15"	2"	No. 14	7'-0"
Sheet Metal	Under 4"	--	No. 22	7'-0"
	4"-15"	--	No. 22	7'-0"
Wood or Metal Strip Crossed	Under 4" 4"-15"	3/8" 2"	Wood 3/4"	7'-0"
			Metal No. 16	
			Wood 3/4"	
			Metal No. 16	
Wood or Metal Strip not Crossed	Under 4" 4"-15"	1/2" width 1" width	Wood 3/4"	7'-0"
			Metal No. 16	
			Wood 3/4"	
Standard Rail	Min. 15" Max. 20"	See Standard for Railings	Section 7.3.5	

b. Framework

1. Minimum dimensions of materials for the framework of all guards except as noted in paragraph 3 shall be angle iron 1 in. x 1/8 in. metal pipe of 3/4 in. inside diameter or metal construction of equivalent strength.

All guards shall be rigidly braced every three (3) feet or fractional part of their height to some fixed part of machinery or building structure. Where guard is exposed to contact with moving equipment additional strength may be necessary.

2. The framework for all guards fastened to floor or working platform and without other support or bracing shall consist of 1 1/2 in. x 1 1/2 in. x 1/8 in. angle iron, metal pipe of 1 1/2 in. inside diameter or metal construction of equivalent strength.

All rectangular guards shall have at least four upright frame members, each of which shall be carried to the floor and be securely fastened thereto. Cylindrical guards shall have at least three supporting members carried to the floor.

3. Guards thirty (30) inches or less in height and with a total surface area not in excess of ten (10) square feet may have a framework of 3/8 in. solid rod 3/4 in. x 3/4 in. x 1/8 in. angle or metal construction of equivalent strength. The filling material shall correspond to the requirements of the table in section 7.3.1.
- c. The specifications given in (a) and (b) are the minimum requirements; where guards are exposed to unusual wear, deterioration or impact, heavier material and construction should be used to protect amply against the specific hazards involved.

7.3.2 Wood Guards

- a. Wood guards shall not be approved except in the woodworking and chemical industries, in industries where the presence of fumes or where manufacturing conditions would cause the rapid deterioration of metal guards, or in construction work and in locations outdoors where extreme cold or extreme heat make metal guards and railings undesirable.

b. Material and Construction

1. Wood shall be sound, tough, and free from any loose knots.
2. Guards shall be made of planed lumber not less than one (1) inch rough board measure and with edges and corners rounded off.
3. Wood guards shall be securely fastened together with wood screws, hard wood dowel pins, bolts, or rivets.
4. While no definite dimensions are given under this heading for framework or filler materials, wood guards shall be equal in strength and rigidity to metal guards specified in section 7.3.1.
5. For construction of standard wood railing, see section 7.3.5.

7.3.3 Guards for Horizontal Overhead Belts

- a. Guards for horizontal overhead belts shall run the entire length of the belt and follow the line of the pulley to the ceiling or be carried to the nearest wall, to enclose the belt effectively. Where belts are so located as to make it impracticable to carry the guard to wall or ceiling, construction of guard shall be such as to enclose completely the top and bottom runs of belt and the face of pulleys. (See section 5.3.1, c and d.)
- b. The guard and all its supporting members shall be securely fastened to the wall or ceiling by gimlet-point lag screws or through bolts. In case of masonry construction, expansion bolts shall be used. Bolts placed horizontally through floor beams or ceiling rafters may be used.
- c. Suitable reinforcement shall be provided for the ceiling rafters or overhead floor beams to sustain safely the weight and stress likely to be imposed by the guard. The interior surface of all guards which may come in contact, shall be smooth, and free from all projections, except that where construction demands it protruding shallow round-head rivets may be used. Overhead belt guards shall be at least one-quarter the width of the belt, wider than the belt which they protect, except that this clearance need not in any case exceed six (6) inches on each side. Overhead rope drive and block and roller-chain-drive guards shall be not less than six (6) inches wider than the drive on each side.

In overhead silent chain-drive guards where the chain is held from lateral displacement on the sprockets, the side clearances required on drives of twenty (20) inch centers or less shall be not less than 1/4 in. from the nearest moving chain part and on drives of over twenty (20) inch centers a minimum of 1/2 in. from the nearest moving chain part.

- d. The table in section 7.3.6 gives sizes of materials to be used and general construction of guards for belts ten (10) inches or more in width. No material for overhead belt guards shall be smaller than that specified in this table for belts ten (10) to fourteen (14) inches wide, even if the belt is less than ten (10) inches in width.

However, No. 20 gauge sheet metal may be used as a filler on guards for belts less than ten (10) inches wide. Expanded metal, because of the sharp edges, should not be used as a filler in horizontal belt guards.

- e. For clearance between guards and belts, ropes or chains of various center-to-center dimensions between the shafts, see section 7.3.6 b.

7.3.4 Guards for Horizontal Overhead Rope and Chain Drives. Overhead-rope and chain-drive guard construction shall conform to the requirements for overhead-belt guard construction of similar width, except that the filler material shall be of the solid type as shown in the table unless the fire hazard demands the use of open construction. A side guard member of the same solid filling material should be carried up in a vertical position two (2) inches above the level of the lower run of the rope or chain drive and two (2) inches within the periphery of the pulleys which the guard encloses thus forming a trough. These side filler members should be reinforced on the edges with 1 1/2 in. x 1/4 in. flat steel, riveted to the filling material at not greater than eight (8) inch centers; the reinforcing strip should be fastened or bolted to all guard-supporting members with at least one 3/8 inch rivet or bolt at each intersection, and the ends should be secured to the ceiling with lag screws or bolts. The filling material shall be fastened to the framework of the guard and the filler supports by 3/16 inch rivets spaced on 4 inch centers. The width of the multiple drive shall be determined by measuring the distance from the outside of the first to the outside of the last rope or chain in the group accommodated by the pulley. This construction is required to give protection against damage due to the failure of a large belt.

7.3.5 Guard Rails and Toe Boards

- a. Guard rail shall be forty-two (42) inches in height, with mid-rail between top rail and floor.
- b. Posts shall be not more than eight (8) feet apart; they are to be permanent and substantial, smooth, and free from protruding nails, bolts, and splinters. If made of pipe, the post shall be one and one-fourth (1 1/4) inches inside diameter, or larger. If made of metal shapes or bars, their section shall be equal in strength to that of one and one-half (1 1/2) by one and one-half (1 1/2) by three-sixteenths (3/16) inch angle iron. If made of wood, the posts shall be two by four (2 x 4) inches or larger. The upper rail shall be two by four (2 x 4) inches, or two one by four (1 x 4) strips, one at the top and one at the side of posts. The mid-rail may be one by four (1 x 4) inches or more. The rails (metal shapes, metal bars, or wood), should be on that side of the posts which gives the best protection and support. Where panels are fitted with expanded metal or wire mesh as noted in tables, section 7.3.1, the middle rails may be omitted. Where guard is exposed to contact with moving equipment, additional strength may be necessary.
- c. Toe boards shall be four (4) inches or more in height, of wood, metal, or of metal grill not exceeding one (1) inch mesh. Toe boards at flywheel pits should preferably be placed as close to edge of the pit as possible.

7.3.6 Guarding Materials and Clearances of Overhead Machinery.

- a. Specification for materials to be used in guarding:

Horizontal Overhead Belts, Ropes and Chains 7 ft. or More Above Floor or Platform

Members	WIDTH			Material
	Over 10" to 14" incl.	Over 14" to 24" incl.	Over 24"	
Framework	1 1/2"x1 1/2"x1/4"	2"x2"x5/16"	3"x3"x3/8"	Angle Iron
Filler (Belt guards)	1 1/2"x3/16"	2"x2"x5/16"	2"x5/16"	Flat iron
Filler and vertical side member	No. 20 A.W.G.	No. 18 A.W.G.	No. 18 A.W.G.	Solid sheet metal
Filler supports	2"x5/16" flat iron	2"x3/8" flat iron	2 1/2"x2 1/2"x1/4" angle	Flat and angle
Guard supports	2"x5/16"	2"x3/8"	2 1/2"x3/8"	Flat iron
Fastenings				
Filler supports to framework	(2) 5/16"	(2) 3/8"	(3) 1/2"	Rivets
Filler flats to supports (belt guards)	(1) 5/16"	(1) 5/16"	(2) 3/8"	Flush rivets
Filler to frame and supports (rope and chain guards)	3/16" rivets spaced	8" centers on sides	4" centers on bottom	
Guard supports to framework	(2) 3/8"	(2) 7/16"	(2) 5/8"	Rivets or bolts
Guard and supports to overhead ceiling	1/4"x3 1/2" lag screws or 1/2" bolts	5/8"x4" lag screws or 5/8" bolts	3/4"x6" lag screws or 3/4" bolts	Lag screws or bolts
DETAILS - SPACING, etc.				
Width of guards	One-quarter wider than belt, rope, or chain drive			
Spacing between filler supports	20" C. to C.	16" C. to C.	16" C. to C.	
Spacing between filler flats (belt guards)	2" apart	2 1/2" apart	3" apart	
Spacing between guard supports	36" C. to C.	36" C. to C.	36" C. to C.	
OTHER BELT GUARD FILLING PERMITTED				
Sheet metal fastened as in rope & chain guards	No. 20 A.W.G.	No. 18 A.W.G.	No. 18 A.W.G.	Solid or perforated
Woven wire, 2" mesh	No. 12 A.W.G.	No. 10 A.W.G.	No. 8 A.W.G.	

- b. Clearance from outside of belt, rope, or chain drive to guard

Distance center- to-center of shafts	Up to 15' incl.	Over 15' to 25' incl.	Over 25' to 40' incl.	Over 40'
Clearance from belt, rope or chain to guard	6"	10"	15"	20"

SECTION 8 - OPERATING RULES

8.1 Care of Equipment

8.1.1 *General.* All power-transmission equipment shall be inspected at intervals not exceeding 60 days and be kept in good working conditions at all times.

8.1.2 Shafting.

- a. Shafting shall be kept in alignment, free from rust and excess oil or grease.
- b. Where explosives, explosive dusts, flammable vapors or flammable liquids exist, the hazard of static sparks from shafting shall be carefully considered.

8.1.3 *Bearings.* Bearings shall be kept in alignment and properly adjusted.

8.1.4 *Hangers.* Hangers shall be inspected to make certain that all supporting bolts and screws are tight and that supports of hanger boxes are adjusted properly.

8.1.5 Pulleys

- a. Pulleys shall be kept in proper alignment to prevent belts from running off.
- b. One or both pulleys carrying a nonshifting belt should have crowned faces.
- c. Cast-iron pulleys should be tested frequently to disclose cracks in rim or spokes.
- d. Split-pulleys shall be inspected to ascertain if all bolts holding together the sections of the pulley are tight.

8.1.6 Care of Belts

- a. Quarter-twist belts when installed without an idler may be used on drives running in one direction only. (They will run off a pulley when direction of motion is reversed).
- b. Inspection shall be made of belts, lacings, and fasteners and such equipment shall be kept in good repair.
- c. Where possible, dressing should not be applied when belt or rope is in motion; but, if this is necessary, it should be applied where belts or rope leave pulley, not where they approach. The same precautions shall apply to lubricating chains. Belt dressing shall not be used for V-belts.
- d. Where explosives, explosive dusts, flammable vapors or flammable liquids exist, an approved method for the discharge to ground of static electricity shall be used. (Conductive belts, radium bar, conductive belt dressing etc.)

8.1.7 Belts and Overhead Pulleys

- a. A belt pole should be used to throw off or put on belts.
- b. In unshipping a belt it shall always be thrown off the driving pulley, not the driven.
- c. An experienced man should take care of overhead belts and put them on and take them off pulleys.
- d. Belts should not be allowed to ride on shafting but should be held it either by loop or belt perch; see section 6.2.3.

8.1.8 *Lubrication.* Oilers shall wear tight-fitting clothing and should use cans with long spouts to keep their hands out of danger. Machinery shall be oiled when not in motion, whenever possible.

APPENDIX

This appendix is not to be construed as being a part of Safety Regulation No. 4. Its purpose is to provide helpful information only.

1. To interpret section 5.1.2, see sections 7.1 and 7.3 for requirements regarding materials and construction.

2. Power Transmission Equipment. Section 5.1.5 states certain conditions under which the guarding of power transmission equipment may be modified. This rule was inserted as frequently in paper or saw mills, woodworking plants, etc., transmission equipment is located in basements, lofts, or transmission towers not used for any other purpose, and it would be a hardship to require the complete guarding of this apparatus.

3. Power Control. Among the methods used for power control may be mentioned motor switches, friction clutches, belt shifters and engine stops. The means for controlling power should be positive and should be so arranged as to permit of operation from a point not more than 100 feet from any machine driven from the source of power in question. If the stations can be arranged to be within 50 feet of any machine, it is highly advisable. There will be cases, as for example in the steel industry, where a greater distance from the machine becomes necessary.

It is advisable to mark the stop station in accordance with present approved color code, together with a sign "Stop Station" or "Emergency Stop". A light of corresponding color should be added where night work is carried on.

All electrical safety devices should operate by the opening of a *normally closed circuit*. Any failure of the current or device will thus be indicated by the stopping of the prime mover. It is advisable to test such devices daily.

4. Horizontal Overhead Belts. Section 5.3.1 d covers guarding of horizontal overhead belts more than seven (7) feet above floor or platform. It is difficult to decide which overhead belts need guarding and which can be left exposed. These belts, under certain operating conditions, offer a decided accident hazard in case they break. Any belt transmitting power is subjected to a certain stress which increases with the load and the speed. In case this belt breaks, this force is reduced somewhat due to the fact that the driving power is eliminated. The belt is impelled only by its momentum, but this is usually sufficient to give it a decided whipping force strong enough to cause considerable damage. This question of overhead belts located more than seven (7) feet above floor or working platform is well worth investigating as the cost of one serious accident might suffice to pay for quite a number of guards.

5. For details of guard construction and for sizes of material, relative to section 5.3.1, see section 7.3.3 and table, section 7.3.6.

6. Regarding section 5.3.1, for exception in case of flat belts 1 inch or less in width, round belts one-half inch or less in diameter, and single strand V belts thirteen thirty-seconds inches in width or less, see section 3.1.

7. Belt Tighteners. Section 5.3.5 states that belt tighteners of the suspended type shall be arranged in such a way as to prevent falling on any person below, should the belt break or throw tightener. This can be accomplished by securely fastening cables or chains of sufficient strength to the tightener and to the roof, or some substantial object above, to prevent it from falling far enough to strike a person.

8. Hand-Operated Gears. Section 5.4.1 states that hand-operated gears need not be equipped with guards. Quite frequently, however, such gears are operated by a short lever or crank, and when the operator braces himself against the frame of the machine he is likely to come in contact with the gears. It is always good practice to look into this matter carefully and whenever there is the slightest chance of injury, it is well to provide guards.

9. Regarding section 7.1.1, for method of fastening diamond or square wire mesh made of crimped wire into frame, see section 7.1.3 (a) (3).

10. Guard Construction. General specifications are given under section 7.3.1 and 7.3.5 on minimum requirements.

11. Section 7.3.1 is made for the purpose of providing a standard for small guards not subject to severe stress for use in locations where guards constructed of framework as specified in the above standards would be cumbersome and unnecessarily expensive.

12. Regarding section 7.3.3, a wood guard unless very carefully constructed is not substantial. Wood guards are a decided fire hazard, specially when they become saturated with oil and when they are located near flammable material.

13. Regarding Section 8.1.2 (b), static electricity may be removed by means of a spring copper brush in contact with the shafting. This brush must be well grounded through No. 12 insulated copper wire. Other effective methods may be used.

14. Mechanical and Electrical Interlocking Guards are recommended in all areas of high-hazard.

15. Removable or Hinged Guards. Inside surfaces should be painted in accordance with the present approved color code indicative of danger, whenever the guard is not in normal position.

16. Center Distances for Endless V-Belts. Endless V-belts should be considered unsafe unless they have adequate installation and take-up allowances.