

SAFETY STANDARDS

The following rules and regulations have been adopted by the Industrial Board, of the Pennsylvania Department of Labor and Industry, subject to the provisions of the law, (Act 267, section 15, P. L. 1913) which provides that persons affected may petition the Board for changes in the regulations. Upon the receipt of such petition, it will be reviewed by the Board and if considered necessary a public hearing will be called in regard thereto.

POWER TRANSMISSION

The word (SHOULD) where used is to be understood as advisory and (SHALL) as mandatory.

Note: Unless otherwise provided for by regulations approved by the Industrial Board, the following safety regulations for transmission of power shall apply also to all power driven machinery having exposed collars, set screws, shafts, couplings, clutches, keys, pulleys, gearings and belts.

Emergency Stops—A station or stations must be provided in each room, section or department to stop immediately all power transmission therein. Such station or stations shall be properly marked and easily accessible. The prompt stoppage of machinery is an emergency hastened by allowing the full load to remain on all machines.

Set Collars shall be cylindrical, and the screws used to fasten the same to the shaft shall not project beyond the largest periphery of the collar.

Split Collars, after assembly, shall conform to the above specifications for solid collars.

All projecting set screws in moving parts of machinery shall be removed and replaced by flush set screws.

Horizontal Shafts less than six feet from the floor or working platform level including dead ends of same, shall be guarded, or protected by standard railing, as provided for horizontal belts.

Shafts less than twenty feet in heights over driveways above floor or ground level shall be guarded.

Vertical Shafts shall be encased or guarded to a height of six feet from floor or working platform, or be guarded by a Standard Railing with not less than 15 inches clearance.

Revolving Shaft Couplings shall be cylindrical, and bolts used shall not project beyond the largest periphery of Coupling or its projecting flanges.

Clamp Couplings—Heads and nuts of all bolts in clamp couplings shall not project beyond the largest periphery. It is recommended that the use of this style of Coupling be discouraged unless guarded by a cylindrical sleeve, the full length of the Coupling. New installations of such Couplings must be guarded by a cylindrical sleeve the full length of Coupling.

Jaw Clutch Couplings shall be provided with a cylindrical sleeve to cover the jaws.

Universal and Flexible Couplings shall be guarded in a manner to remove all hazard.

Friction Clutch Couplings shall have their operating mechanism completely guarded where exposed.

All projecting Keys in revolving shafts, where exposed to contact, shall be made flush or shall be guarded.

Pulleys—When the bearings are not self-oiling and the clearance between the pulley and bearing on line shafting is 3/8 inches or less, pulley shall be completely guarded on side nearest bearing and all key ways in shaft between such pulley and bearing shall be substantially encased or properly filed.

All parts of Pulleys within seven feet of floor or working platform level shall be guarded underneath, or protected by a Railing as provided for horizontal belts. Where the space between two Pulleys or between a Pulley and a bearing is less than the width of the widest belt used, such space shall be guarded so that the belt cannot get between the Pulleys or between the Pulley and bearing. A flange on side of pulley nearest bearing, or adjacent pulley, will be considered a guard.

On Counter Shafts, the space between pulleys and the nearest bearing shall not be less than the width of the belt used unless such space is properly guarded. A flange on side of pulley nearest bearing, or adjacent pulley, will be considered a guard.

Gears—All toothed and driven and sprocket gearing used in the transmission of power or on machinery shall be completely enclosed wherever practicable, otherwise, at least to base of teeth.

It is strongly recommended that pulleys, gears, sprockets, sheaves, etc., having spoke arms should be guarded by discs, as nearly as possible flush with rims of wheels. All friction drives shall be completely guarded.

Belts—Vertical and inclined belts extending to within six feet of floor or working platform level shall be substantially guarded as follows:

If guard is placed less than six inches from belt, with an enclosure on all sides, not over 1-2 inch between members to a height of six feet above floor or working platform. If guard is placed between 6 inches and 15 inches in clearance from belt, with an enclosure on all sides, not over 2 inches between members to a height of 6 feet above floor or working platform.

A standard railing may be used if placed to allow 15 inches clearance from the belt.

Where belts pass through floor, a standard toe board shall protect floor opening.

If upper part of horizontal belt is less than 6 feet from floor level or working platform it shall be guarded on top and sides or provided with a standard railing at least 15 inches horizontally from the edge of the belt.

Overhead belts with lower part 7 feet or less from floor or working platform level, shall be guarded on sides and bottom.

Passageways between upper and lower parts of belts are prohibited unless special permit is granted by the Department of Labor and Industry. Space traversed by such belt shall be completely barred against passage. Overhead belts 10 inches or more in width and more than 7 feet from floor or working platform shall be guarded un-

derneath in such a manner as to insure the safety of persons below.

Every belt shall be equipped with a device to prevent it from slipping off the pulley.

Shifters shall be provided for all tight and loose pulleys and clutches. Shifting and disengaging levers, when suspended overhead shall be arranged to hang vertically when belt is on loose pulley, or clutch is disengaged. Belt shifters shall be automatically held so that the belt will not creep from loose to tight pulley.

All controls for stopping machines shall be within convenient reach of the operator from any operating position. Mechanical shifters for change belts are strongly recommended.

Lubrication—Loose pulleys shall have oiling devices so arranged as to permit oiling, in any position of loose pulley when machinery is shut down.

An efficient system of self-oiling is recommended for all bearings. Shafting shall not be oiled by hand while in motion.

Drip cups and pans shall be securely fastened.

Oiling shall be done only by authorized and experienced persons, properly clothed and in accordance with approved and safe practice.

Starting Signals—Ample notice shall be given before transmission machinery is started by means of an efficient alarm or signal.

Inspection—All power transmission equipment should be given careful and thorough inspection at frequent and regular intervals, and records kept of such inspection.

Caution. It is unlawful to remove guards from machinery, except when shut down, and in that case the guards must be replaced before starting.

STANDARD RAILINGS

Standard Railings shall be not less than three and one-half feet high, and be provided with an additional rail midway between the top rail and the floor, and shall be constructed in a permanent and substantial manner.

If constructed of pipe, shall be not less than 1-4 inches inside diameter. If constructed of structural metal or bars, their section shall be at least equal to that of 1-2x1-2x3-16 angles.

If constructed of wood, the posts shall be not less than 2x4 inches or its equivalent section, having rails not less than 7-8x6 inches or its equivalent section.

Posts and uprights shall be spaced not more than 8 feet apart.

The rails when of metal shafts, metal bars or wood shall be placed on the side of the posts that will afford the greatest support and protection.

One or more sides may be hinged, preferably with self-closing gates.

Railings already installed, if of substantial construction and proper material and approved by the Department of Labor and Industry, will be accepted, although not permitted in new installations.

Where panels are filled with substantial expanded metal or wire mesh, the middle rails may be omitted.

Toe Boards—In addition to standard railings a toe board or toe piece, 6 inches high of wood or metal, shall be provided on working platforms, balconies and galleries if 6 feet or more above floor level.

Floor openings and hoistways. Fly wheel and pulley pits.

All other openings in floors and platforms where the safety of persons below is involved.

STATIONARY STEAM ENGINES

By stationary steam engines it meant an engine normally in one place and used regularly for furnishing motive power, farm and saw mill portable engines, portable hoisting engines, pumps used by contractors are not classed as stationary engines.

Note: These standards are to be considered as also applicable to gas engines, pump engines and air compressors, if their construction is such as to bring them within the scope of these requirements.

Ample notice should be given before machinery is started by the use of an efficient alarm or signal.

All steam, gas and hot air pumping engines and air compressors, shall have all exposed collars, set screws, shafts, couplings, clutches, keys, pulleys, gears, fly wheels and belts guarded as specified in Vol. 1, No. 1, for the transmission of power by the industrial board, unless other regulations have been approved for special cases.

Automatic Stops—It is recommended that an approved type of automatic engine stop, with speed limit device, be put on all stationary engines of more than 500 h. p.

No live steam connections should be made to the receiver of a compound engine without a reducing valve, set so that the pressure will be well within the safe working pressure of the receiver and of the low pressure cylinder.

Such receiver shall be equipped with one or more safety relief valve of ample capacity, adjusted to a pressure well within the safe working pressure of the receiver and of the low pressure cylinder. These valves shall be provided with facilities for testing, such as a hand lever.

Jet condensers shall be provided with vacuum breakers to prevent water from entering the engine cylinders. Steam traps used to discharge water from steam separators shall be so installed that their operation will be evident.

Each engine shall be equipped with an efficient governor which will at all times automatically control the speed of the engine under varied loads, except where the load itself acts as an efficient governor. All belts or rope driven governors shall be equipped with a device for stopping the engine in case the belt or rope should break.

Valve gear shall be so arranged, or other provisions shall be made, that in the event of the load being removed, the engine will stop if the governor would fail to act. (A broken belt stop will be considered sufficient for slide or four-valve engines.)

Positive means shall be provided for blocking vertical and large horizontal engines, compressors, and pumps, during adjustments and repairs.

A safe method should be provided for turning over engines by hand.

Stationary stairs or iron ladders shall be provided for access to such emergency valves as cannot be operated from the floor or other accessible place.

Forms and walks on engines shall have standard railings and toe guards. This applies also to the engine bed along side of the connecting rod or crosshead, when it is used as a foot-walk.

Provisions should be made where practicable for oiling all engine bearings, journals, eccentrics, crank pins, etc., from outside the guard railings.

All power transmission equipment should be given careful and thorough inspection at frequent and regular intervals, and complete records kept of such inspections.

MACHINE TOOLS

Note:—Unless otherwise provided for by regulations approved by the industrial board, all lathes, planers, milling machines, boring mills, metal saws, keyseating machines, shapers, slotters, gear cutter, drill presses, and all other machine tools shall have all gears, sprockets, chains, bands, belts, pulleys, clutches, wheels, shafting, spindles, couplings, clutches, counterweights, revolving and reciprocating parts and all as specified in Volume 1, No. 2, Rules and Regulations for the Transmission of Power.

The use of safety dogs is strongly recommended. Set screws and bolt heads shall be made flush or shall be guarded.

All new installations of face plates, chucks and collets, shall be cylindrical with no projecting parts, on rim or periphery.

Face plates, chucks and collets now in use having projecting parts on rim or periphery shall be encased, guarded with hinged or other effective guard.

The use of drills on dead centers unless securely fastened there, should not be permitted.

Cams and other automatic parts shall be carefully guarded.

In hollow spindle lathes bar stocks should be guarded full length.

Chip guards should be provided on lathes and other machines for the protection of nearby persons as well as the operator, where there is an eye hazard by reason of flying chips or cuttings. Goggles will be considered adequate protection for operator.

Eye protection, in all lathe, machine and grinding work shall be carefully considered.

All openings in bed frames shall be covered with sheet metal, expanded metal or wire mesh aprons, securely fastened in place. Openings in housings shall be filled or guarded.

Not less than 24 inches clearance shall be provided at both ends and sides of planers for planer bed, the work being machined and its chucking.

If clearance is less than 24 inches, clearance space shall be guarded with standard railings.

Floor openings and pits shall be guarded with standard railings and toe boards.

Attention is called to hazard attending the practice of reversing planing table by hand, except when absolutely necessary in setting up work.

Counterweights shall be placed in wells or securely guarded for their entire travel.

FORGING AND STAMPING MACHINERY

Note:—Unless otherwise provided for by regulations approved by the Industrial Board, all forging, pressing, forming and stamping machines, shall have all exposed collars, set screws, shafts, couplings, clutches, keys, pulleys, gears and belts guarded as provided for in Volume 1, No. 1, Rules and Regulations for the Transmission of Power.

A locking device shall be provided for presses and shears to prevent the machine coming into action prematurely or while the tools are being set.

Where tight and loose pulleys are used, the locking device may be applied to the same instead of to the machine. Where direct motor-drive is used the switch shall be secured in an open position.

On all cold work a positive guard, which is controlled by the moving ram is recommended for blanking, drawing and forming presses operating on cold material. The guard should be arranged to throw the operator's hands away from the danger zone.

Sheet metal presses for stamping, blanking, forming, trimming, shearing and punching should, where the nature of the work permits, have an inclined bed or have an automatic or roll feed.

If neither false fingers, sliding dies, double trips, soft metal pliers, or work holders using compressed air of operation for handling of the material operated on, are used, then guards of

metal strips, metal netting or plate glass to protect the operator are recommended; the same being either fixed or automatic.

A positive disengaging device for clutches is recommended.

All hammers operated by steam, air, gravity or stationary, shall be provided with positive locking devices so that when the ram is at the top or the bottom of its stroke, it cannot be accidentally moved.

Every steam and air hammer shall be provided with a stop valve in the admission pipe line, which must be closed, preparatory to, and during the repair of the hammer or while changing dies.

Extreme care shall be taken in making and using hammer die keys on all power hammers to see that they are not only of suitable material, but that they are driven into place with due regard to the safety of the operator and of the neighboring workmen.

It is suggested that hammer die keys be made of open hearth material (Mn. .40 to .50 per cent.; C .50 to .60 per cent.); that they be machined accurately to fit notches; and, that the ends be relieved or recessed at top, setting or breaking. The ends of keys shall be redressed when necessary.

POLISHING AND GRINDING MACHINERY

Note:—All polishing and grinding machines shall have all exposed collars, set screws, shafts, couplings, clutches, keys, pulleys, gears, fly wheels and belts gears as specified in Volume 1, No. 1, for the Transmission of Power by the Industrial Board.

Grinding wheels are to be understood as wheels composed of a practically uniform mixture of an abrasive material and a bonding cement, formed or molded into a single piece. This does not include grinding wheels of natural stone.

Polishing wheels are to be understood as wheels composed of material other than abrasive, to all or a portion of whose surface an abrasive material is applied.

Disc grinders having discs of steel, iron or equally strong material are classed as polishing wheels with respect to safety of operation.

Grinding Wheels—The use of defective grinding wheels is prohibited.

Grinding wheels shall fit freely on their spindles. They should never be forced on, nor should they be too loose. A clearance of .005 inch is recommended.

The soft metal bushings shall not extend beyond the sides of the wheels at their centers. Wheels shall be kept as true as practicable and work rests shall be kept adjusted close to wheels.

Wherever possible, a compressible medium, such as blotting paper, rubber, lead, etc., at least as large as the diameter of the flanges, shall be fitted between a wheel and each of its flanges.

Flanges For Grinding Wheels—Each flange whether straight or tapered must be relieved or recessed at the center at least 1-16 inch on the side next to the wheel for a distance as provided in Table B.

The maximum and minimum dimensions of flanges and the minimum diameter of flat spot at center of wheel, as given in Tables A and B must be observed.

Tapered Flanges for Emery Wheels

A—Maximum flat spot at center of flange.

B—Minimum flat spot at center of wheel.

C—Minimum diameter of flanges.

D—Minimum thickness of flange at bore for wheels 1 inch or less in thickness.

E—Same as D but for wheels over 1 inch in thickness.

TABLE A

Tapered Flanges and Tapered Wheels

| Diameter of Wheel | A | | B | | C | | D | | E | |
|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| | Maximum | Minimum | |
| 6 | 1 | 1 | 3/8 | 3/8 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | |
| 8 | 1 | 1 | 5/8 | 5/8 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | |
| 10 | 1 | 1 | 7/8 | 7/8 | 1 | 1 | 1 | 1 | 1 | |
| 12 | 1 1/4 | 1 1/4 | 1 | 1 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/4 | |
| 14 | 1 3/4 | 1 3/4 | 1 1/8 | 1 1/8 | 1 3/4 | 1 3/4 | 1 3/4 | 1 3/4 | 1 3/4 | |
| 16 | 2 | 2 | 1 1/4 | 1 1/4 | 2 | 2 | 2 | 2 | 2 | |
| 18 | 2 1/4 | 2 1/4 | 1 3/8 | 1 3/8 | 2 1/4 | 2 1/4 | 2 1/4 | 2 1/4 | 2 1/4 | |
| 20 | 2 3/4 | 2 3/4 | 1 1/2 | 1 1/2 | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 | |
| 22 | 3 | 3 | 1 5/8 | 1 5/8 | 3 | 3 | 3 | 3 | 3 | |
| 24 | 3 1/4 | 3 1/4 | 1 3/4 | 1 3/4 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/4 | |
| 26 | 3 3/4 | 3 3/4 | 1 7/8 | 1 7/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 3/4 | 3 3/4 | |
| 28 | 4 | 4 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | |
| 30 | 4 1/4 | 4 1/4 | 2 1/8 | 2 1/8 | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | |

TABLE B

Straight Flanges and Straight Wheels

| Diameter of Wheel | Minimum Outside Diam. of Flanges. | | Diameter of Recess. | Minimum Thickness of Flange at Bore. |
|-------------------|-----------------------------------|-----------|---------------------|--------------------------------------|
| | Minimum | Maximum | | |
| 6 | 3 in. | 1 in. | 3/8 | 3/8 |
| 8 | 3 1/2 in. | 1 1/4 in. | 3/8 | 3/8 |
| 10 | 4 in. | 1 1/2 in. | 3/8 | 3/8 |
| 12 | 4 1/2 in. | 1 3/4 in. | 3/8 | 3/8 |
| 14 | 5 in. | 2 in. | 3/8 | 3/8 |
| 16 | 5 1/2 in. | 2 1/4 in. | 3/8 | 3/8 |
| 18 | 6 in. | 2 1/2 in. | 3/8 | 3/8 |
| 20 | 6 1/2 in. | 2 3/4 in. | 3/8 | 3/8 |
| 22 | 7 in. | 3 in. | 3/8 | 3/8 |
| 24 | 7 1/2 in. | 3 1/4 in. | 3/8 | 3/8 |
| 26 | 8 in. | 3 1/2 in. | 3/8 | 3/8 |
| 28 | 8 1/2 in. | 3 3/4 in. | 3/8 | 3/8 |
| 30 | 9 in. | 4 in. | 3/8 | 3/8 |

Flanges shall be made of steel or other equally strong material.

Both flanges in contact with a wheel shall be of the same diameter.

New installations of tapered flanges shall have a taper of not less than 3-8 inch (preferably 3-4 inch) to the foot on each flange and where a flat spot is used it shall conform to dimensions set forth in above table. But one taper should be used in any one establishment.

If but one tapered flange is used, the taper shall be 1-2 inches to the foot.

Wherever possible only 2 inches of the wheel should project beyond the flanges where the wheel is over 10 inches in diameter.

All grinding wheels shall conform to the dimensions for flanges as set forth in above table.

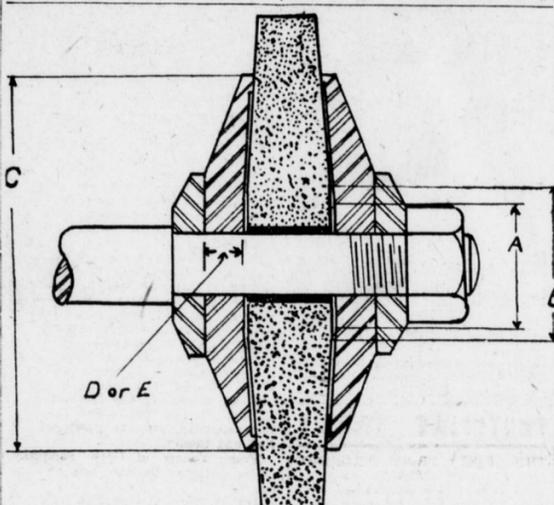
The surface of wheels in contact with straight or tapered flanges, the surface of flanges in contact with wheels and the compressible material between flanges and wheels shall be clean, smooth and free from foreign material.

turns, or elbows in such pipes must be made with easy, smooth surfaces having a radius in the throat of not less than two diameters of the pipe on which they are connected. No branch pipe shall extend into the main duct and all laps shall be made in the direction of air flow.

Emery wheel and buffing wheel exhaust systems shall be kept separate owing to danger of sparks from the former setting fire to the lint dust from the latter, if both are drawn into the same suction main.

The inlet of the exhauster shall be at least 20 per cent. greater in area than the combined areas of the several connections to the hoods, and this increase in the main pipe shall be carried proportionately throughout the entire trunk line. The piping on the outlet of the fan is also to be at least 20 per cent. greater than the combined areas of the several connections to the hoods.

The area of the main duct at any point should be equal as near as possible to the combined areas of all



Tapered Flanges for Emery Wheels

Protection For Grinding Wheels—Either substantial hoods, tapered flanges, or both, sufficiently strong to retain the pieces of a wheel in case of breakage and so designed as to leave exposed the least portion of the wheel compatible with the work in hand shall be fitted to all grinding machines.

Precision Grinding Machines—Precision and tool grinding machines shall be thoroughly guarded where possible.

Proper clamping devices and hoods shall be applied to precision grinding machines where the diameter of the hole in the wheel will not permit the application of the specifications for guards elsewhere set forth in these regulations.

Cup and Cylinder Grinding Wheels—Cup and cylinder grinding wheels shall be surrounded, as such as operating conditions will allow, either by a substantial hood or be retained by a chuck which surrounds the periphery at least 3-4 the height of the rim of the wheel.

All specially shaped wheels shall be substantially guarded.

Arbors, Fixed Collars and Machines—The protruding end of the arbor and its nut shall be guarded.

Arbor bearings shall be of ample size and shall be kept carefully adjusted and lubricated.

Arbors of floor, bench and swing frame grinding machines for wheels 12 inches or more in diameter, shall have fixed collars not less than 1-3 the diameter of the wheel being used.

Floor and bench grinding machines shall be rigidly constructed and securely fastened to a suitable foundation.

Grinding wheel manufacturers shall furnish information regarding speeds at which wheels are recommended to operate safely.

Wheels must not be operated at a speed in excess of that which is recommended by the manufacturer.

Eye Protection—Approved eye protection shall be provided for operators on grinding wheels if the operation involves the possibility of eye injury.

BLOWERS AND EXHAUSTERS FOR GRINDING AND POLISHING MACHINERY

Note:—All blowers and exhausters shall have all exposed collars, set screws, shafts, couplings, clutches, keys, pulleys, gears, fly wheels and belts guarded as specified in Volume 1, No. 1, for the transmission of power by the industrial board.

Suction Test—Sufficient suction head shall be maintained in each branch pipe within 15 inches of the hoods to displace a minimum of two inches of water column in a U-shaped tube. Pressure to be taken by pressing tube attachment over small opening through pipe, commonly called static method. Tests to be made with all branches open and unobstructed.