Occupational Safety Program

Machine Guarding Program
Manual

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Purpose

The purpose of the program is for the protection of personnel and students who utilize machinery and equipment equipped with machine guards. This program is designed to ensure that University employees and students follow procedures which assure that equipment or machines are operated safely and meet state, federal, and industry machine guarding standards. The University shall take every precaution to protect its employees against possible injury from machinery, while in the vicinity of the machinery or while in the process of operating the machinery.

Scope

This program applies to all University employees and students who may work with, or adjacent to, equipment or machines that may pose a safety hazard. Shops for carpentry; metalworking and finishing; heating, ventilating and air conditioning (HVAC); electrical work; machinery; plumbing; electronics; printing; and scenery present special hazards for Towson University employees and students assigned to such areas. The operation of powered machinery, hand tools, and powered tools in these shops can result in a variety of serious accidents.

Machines and machinery included in the scope of the program include, but are not limited to, drill presses, bench grinders, radial arm saws, lathes, mills, abrasive wheel machinery, scroll saws and table saws. Any machine part, function, or process that may cause injury, must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated. A machine hazard occurs at the point of operation where the actual work is performed, and can be created by the following:

- Components which transmit energy, such as pulleys, belts, chains, gears, couplings, or flywheels; or
- Other parts which move while the machine is working, including reciprocating, rotating and transverse parts.

Definitions

As used in §§ 1910.213 and 1910.214 unless the context clearly requires otherwise, the following woodworking machinery terms shall have the meaning prescribed in this paragraph.

Point of operations: That point at which cutting, shaping, boring, or forming is accomplished upon the stock.

Push stick: A narrow strip of wood or other soft material with a notch cut into one end and which is used to push short pieces of material through saws.

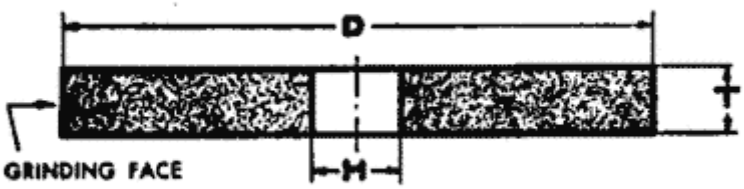
Block: A short block of wood, provided with a handle similar to that of a plane and a shoulder at the rear end, which is used for pushing short stock over revolving cutters.

As used in § 1910.215 unless the context clearly requires otherwise, the following abrasive wheel machinery terms shall have the meanings prescribed in this paragraph.

Type 1 straight wheels: Wheels having diameter, thickness, and hole size dimensions, and they should be used only on the periphery. Type 1 wheels shall be mounted between flanges.

LIMITATION: Hole dimension (H) should not be greater than two-thirds of wheel diameter dimension (D) for precision, cylindrical, centerless, or surface grinding applications. Maximum hole size for all other applications should not exceed one-half wheel diameter.

Figure No. 0-1 - Type 1 Straight Wheels



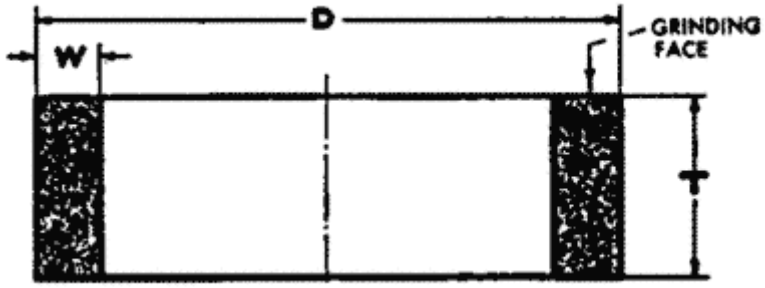
Type 1 - Straight Wheel

Peripheral grinding wheel having a diameter, thickness, and hole.

Type 2 cylinder wheels: Wheels having diameter, wheel thickness, and rim thickness dimensions. Grinding is performed on the rim face only, dimension W. Cylinder wheels may be plain, plate mounted, inserted nut, or of the projecting stud type.

LIMITATION: Rim height, T dimension, is generally equal to or greater than rim thickness, W dimension.

Figure No. 0-2 - Type 2 Cylinder Wheels



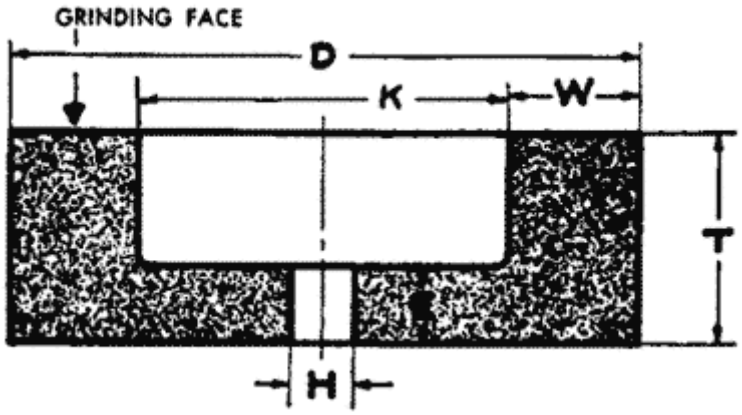
Type 2 - Cylinder Wheel

Side grinding wheel having a diameter, thickness, and wall - wheel is mounted on the diameter.

Type 6 straight cup wheels: Wheels having diameter, thickness, hole size, rim thickness, and back thickness dimensions. Grinding is always performed on rim face, W dimension.

LIMITATION: Minimum back thickness, E dimension, should not be less than one-fourth T dimension. In addition, when unthreaded hole wheels are specified, the inside flat, K dimension, must be large enough to accommodate a suitable flange.

Figure No. 0-3 - Type 6 Straight Cup Wheels



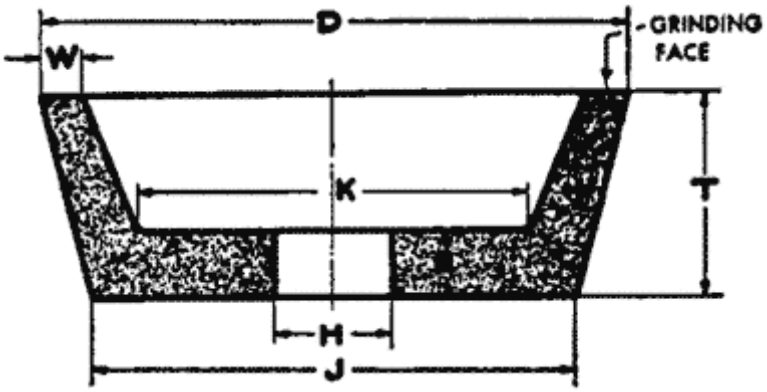
Type 6 - Straight-cup Wheel

Side grinding wheel having a diameter, thickness, and hole with one side straight or flat and the opposite side recessed. This type, however, differs from Type 5 in that the grinding is performed on the wall of the abrasive created by the difference between the diameter of the recess and the outside diameter of the wheel. Therefore, the wall dimension "W" takes precedence over the diameter of the recess as an essential intermediate dimension to describe this shape type.

*Type 11 flaring cup wheels***:** Wheels having double diameter dimensions D and J, and in addition have thickness, hole size, rim, and back thickness dimensions. Grinding is always performed on rim face, W dimension. Type 11 wheels are subject to all limitations of use and mounting listed for type 6 straight sided cup wheels definition.

LIMITATION: Minimum back thickness, E dimension, should not be less than one-fourth T dimension. In addition when unthreaded hole wheels are specified the inside flat, K dimension, shall be large enough to accommodate a suitable flange.

Figure No. 0-4 - Type 11 Flaring Cup Wheels



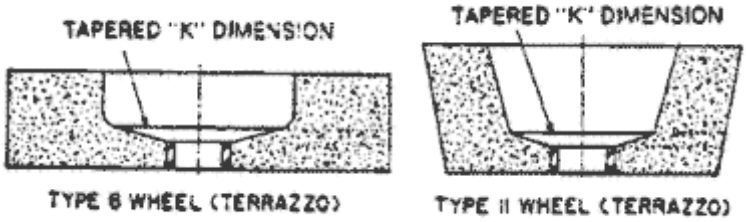
Type 11 - Flaring-cup Wheel

Side grinding wheel having a wall flared or tapered outward from the back. Wall thickness at the back is normally greater than at the grinding face (W).

*Modified types 6 and 11 wheels (terrazzo)***:** Some type 6 and 11 cup wheels used in the terrazzo trade having tapered K dimensions to match a special tapered flange furnished by the machine builder.

LIMITATION: These wheels shall be mounted only with a special tapered flange.

Figure No. 0-5



Typical examples of modified types 6 and 11 wheels (terrazzo) showing tapered K dimensions.

Types 27 and 28 depressed center wheels: Wheels having diameter, thickness, and hole size dimensions. Both types are reinforced, organic bonded wheels having offset hubs which permit side and peripheral grinding operations without interference with the mounting. Type 27 wheels are manufactured with flat grinding rims permitting notching and cutting operations. Type 28 wheels have saucer shaped grinding rims.

Limitations: Special supporting, back adapter and inside flange nuts are required for the proper mounting of these types of wheels subject to limitations of § 1910.215(c)(4) (i) and (ii).

Mounts which are affixed to the wheel by the manufacturer may not require an inside nut and shall not be reused.

Type 27A depressed center, cutting-off wheels: Wheels having diameter, thickness, and hole size dimensions. They are reinforced, organic bonded, offset hub type wheels, usually 16 inches diameter and larger, specially designed for use on cutting-off machines where mounting nut or outer flange interference cannot be tolerated.

LIMITATIONS: See § 1910.215(c)(1).

Surface feet per minute (s.f.p.m.): The distance in feet any one abrasive grain on the peripheral surface of a grinding wheel travels in 1 minute.

Surface Feet Per Minute = 3.1416 × diameter in inches × r.p.m. ÷ 12 or .262 × diameter in inches × r.p.m.

Examples: (a) 24-inch diameter wheel, 1,000 revolutions per minute. Surface Feet per minute .262 × 24 × 1,000 = 6,288 s.f.p.m. (b) 12-inch diameter wheel, 1,000 revolutions per minute. Surface Feet per minute .262 × 12 × 1,000 = 3,144 s.f.p.m.

Flanges: Collars, discs or plates between which wheels are mounted and are referred to as adaptor, sleeve, or back up type. See paragraph (c) of § 1910.215 for full description.

Snagging: Grinding which removes relatively large amounts of material without regard to close tolerances or surface finish requirements.

Off-hand grinding: The grinding of any material or part which is held in the operator's hand.

Safety guard: An enclosure designed to restrain the pieces of the grinding wheel and furnish all possible protection in the event that the wheel is broken in operation. See paragraph (b) of § 1910.215.

Cutting off wheels: Wheels having diameter thickness and hole size dimensions and are subject to all limitations of mounting and use listed for type 1 wheels, the definition in subparagraph (1) of this paragraph and paragraph (d) of § 1910.215. They may be steel centered, diamond abrasive or organic bonded abrasive of the plain or reinforced type.

Wheel diameter	Max. thickness (inch)
6 inch and smaller	3⁄18
Larger than 6 inches to 12 inches	¼
Larger than 12 inches to 23 inches	3⁄18
Larger than 23 inches	½

Limitation: Cutting off wheels are recommended only for use on specially designed and fully guarded machines and are subject to the following maximum thickness and hole size limitations.

Maximum hole size for cutting-off wheels should not be larger than ¼-wheel diameter.

Abrasive wheel: A cutting tool consisting of abrasive grains held together by organic or inorganic bonds. Diamond and reinforced wheels are included.

Organic wheels: Wheels which are bonded by means of an organic material such as resin, rubber, shellac, or other similar bonding agent.

Inorganic wheels: Wheels which are bonded by means of inorganic material such as clay, glass, porcelain, sodium silicate, magnesium oxychloride, or metal. Wheels bonded with clay, glass, porcelain or related ceramic materials are characterized as *vitrified bonded wheels.*

As used in § 1910.216, unless the context clearly requires otherwise, the following mills and calenders in the rubber and plastic industries terms shall have the meanings prescribed in this paragraph.

Bite: The nip point between any two inrunning rolls.

Calender: A machine equipped with two or more metal rolls revolving in opposite directions and used for continuously sheeting or plying up rubber and plastics compounds and for frictioning or coating materials with rubber and plastics compounds.

Mill: A machine consisting of two adjacent metal rolls, set horizontally, which revolve in opposite directions (i.e., toward each other as viewed from above) used for the mechanical working of rubber and plastics compounds.

As used in § 1910.217, unless the context clearly requires otherwise, the following power press terms shall have the meaning prescribed in this paragraph.

Antirepeat: The part of the clutch/brake control system designed to limit the press to a single stroke if the tripping means is held operated. Antirepeat requires release of all tripping mechanisms before another stroke can be initiated. *Antirepeat* is also called single stroke reset or reset circuit.

Brake: The mechanism used on a mechanical power press to stop and/or hold the crankshaft, either directly or through a gear train, when the clutch is disengaged.

Bolster plate: The plate attached to the top of the bed of the press having drilled holes or T-slots for attaching the lower die or die shoe.

Clutch: The coupling mechanism used on a mechanical power press to couple the flywheel to the crankshaft, either directly or through a gear train.

Full revolution clutch: A type of clutch that, when tripped, cannot be disengaged until the crankshaft has completed a full revolution and the press slide a full stroke.

Part revolution clutch: A type of clutch that can be disengaged at any point before the crankshaft has completed a full revolution and the press slide a full stroke.

Direct drive: The type of driving arrangement wherein no clutch is used; coupling and decoupling of the driving torque is accomplished by energization and deenergization of a

motor. Even though not employing a clutch, direct drives match the operational characteristics of "part revolution clutches" because the driving power may be disengaged during the stroke of the press.

Concurrent: Acting in conjunction, and is used to describe a situation wherein two or more controls exist in an operated condition at the same time.

Continuous: Uninterrupted multiple strokes of the slide without intervening stops (or other clutch control action) at the end of individual strokes.

Counterbalance: The mechanism that is used to balance or support the weight of the connecting rods, slide, and slide attachments.

Device: A press control or attachment that: (i) restrains the operator from inadvertently reaching into the point of operation, or (ii) prevents normal press operation if the operator's hands are inadvertently within the point of operation, or (iii) automatically withdraws the operator's hands if the operator's hands are inadvertently within the point of operation as the dies close, or (iv) prevents the initiation of a stroke, or stops of stroke in progress, when there is an intrusion through the sensing field by any part of the operator's body or by any other object.

Presence sensing device: A device designed, constructed, and arranged to create a sensing field or area that signals the clutch/brake control to deactivate the clutch and activate the brake of the press when any part of the operator's body or a hand tool is within such field or area.

Gate or movable barrier device: A movable barrier arranged to enclose the point of operation before the press stroke can be started.

Holdout or restraint device: A mechanism, including attachments for operator's hands, that when anchored and adjusted prevent the operator's hands from entering the point of operation.

Pull-out device: A mechanism attached to the operator's hands and connected to the upper die or slide of the press, that is designed, when properly adjusted, to withdraw the operator's hands as the dies close, if the operator's hands are inadvertently within the point of operation.

Sweep device: A single or double arm (rod) attached to the upper die or slide of the press and designed to move the operator's hands to a safe position as the dies close, if the operator's hands are inadvertently within the point of operation.

Two hand control device: A two hand trip that further requires concurrent pressure from both hands of the operator during a substantial part of the die-closing portion of the stroke of the press.

Die: The tooling used in a press for cutting or forming material. An upper and a lower die make a complete set.

Die builder: Any person who builds dies for power presses.

Die set: A tool holder held in alignment by guide posts and bushings and consisting of a lower shoe, an upper shoe or punch holder, and guide posts and bushings.

Die setter: An individual who places or removes dies in or from mechanical power presses, and who, as a part of his duties, makes the necessary adjustments to cause the tooling to function properly and safely.

Die setting: The process of placing or removing dies in or from a mechanical power press, and the process of adjusting the dies, other tooling and safeguarding means to cause them to function properly and safely.

Die shoe: A plate or block upon which a die holder is mounted. A die shoe functions primarily as a base for the complete die assembly, and, when used, is bolted or clamped to the bolster plate or the face of slide.

Ejector: A mechanism for removing work or material from between the dies.

Face of slide: The bottom surface of the slide to which the punch or upper die is generally attached.

Feeding: The process of placing or removing material within or from the point of operation.

Automatic feeding: Feeding wherein the material or part being processed is placed within or removed from the point of operation by a method or means not requiring action by an operator on each stroke of the press.

Semiautomatic feeding: Feeding wherein the material or part being processed is placed within or removed from the point of operation by an auxiliary means controlled by operator on each stroke of the press.

Manual feeding: Feeding wherein the material or part being processed is handled by the operator on each stroke of the press.

Foot control: The foot operated control mechanism designed to be used with a clutch or clutch/brake control system.

Foot pedal: The foot operated lever designed to operate the mechanical linkage that trips a full revolution clutch.

Guard: A barrier that prevents entry of the operator's hands or fingers into the point of operation.

Die enclosure guard: An enclosure attached to the die shoe or stripper, or both, in a fixed position.

Fixed barrier guard: A die space barrier attached to the press frame.

Interlocked press barrier guard: A barrier attached to the press frame and interlocked so that the press stroke cannot be started normally unless the guard itself, or its hinged or movable sections, enclose the point of operation.

Adjustable barrier guard: A barrier requiring adjustment for each job or die setup.

Guide post: The pin attached to the upper or lower die shoe operating within the bushing on the opposing die shoe, to maintain the alignment of the upper and lower dies.

Hand feeding tool: Any hand held tool designed for placing or removing material or parts to be processed within or from the point of operation.

Inch: An intermittent motion imparted to the slide (on machines using part revolution clutches) by momentary operation of the *Inch* operating means. Operation of the *Inch* operating means engages the driving clutch so that a small portion of one stroke or indefinite stroking can occur, depending upon the length of time the *Inch* operating means is held operated. *Inch* is a function used by the die setter for setup of dies and tooling, but is not intended for use during production operations by the operator.

Jog: An intermittent motion imparted to the slide by momentary operation of the drive motor, after the clutch is engaged with the flywheel at rest.

Knockout: A mechanism for releasing material from either die.

Liftout: The mechanism also known as knockout.

Operator's station: The complete complement of controls used by or available to an operator on a given operation for stroking the press.

Pinch point: Any point other than the point of operation at which it is possible for a part of the body to be caught between the moving parts of a press or auxiliary equipment, or between moving and stationary parts of a press or auxiliary equipment or between the material and moving part or parts of the press or auxiliary equipment.

Point of operation: The area of the press where material is actually positioned and work is being performed during any process such as shearing, punching, forming, or assembling.

Press: A mechanically powered machine that shears, punches, forms or assembles metal or other material by means of cutting, shaping, or combination dies attached to slides. A press consists of a stationary bed or anvil, and a slide (or slides) having a controlled reciprocating motion toward and away from the bed surface, the slide being guided in a definite path by the frame of the press.

Repeat: An unintended or unexpected successive stroke of the press resulting from a malfunction.

Safety block: A prop that, when inserted between the upper and lower dies or between the bolster plate and the face of the slide, prevents the slide from falling of its own deadweight.

Single stroke: One complete stroke of the slide, usually initiated from a full open (or up) position, followed by closing (or down), and then a return to the full open position.

Single stroke mechanism: An arrangement used on a full revolution clutch to limit the travel of the slide to one complete stroke at each engagement of the clutch.

Slide: The main reciprocating press member. A slide is also called a ram, plunger, or platen.

Stop control: An operator control designed to immediately deactivate the clutch control and activate the brake to stop slide motion.

Stripper: A mechanism or die part for removing the parts or material from the punch.

Stroking selector: The part of the clutch/brake control that determines the type of stroking when the operating means is actuated. The stroking selector generally includes positions for "Off" (Clutch Control), "Inch," "Single Stroke," and "Continuous" (when Continuous is furnished).

Trip or (tripping): Activation of the clutch to "run" the press.

Turnover bar: A bar used in die setting to manually turn the crankshaft of the press.

Two-hand trip: A clutch actuating means requiring the concurrent use of both hands of the operator to trip the press.

Unitized tooling: A type of die in which the upper and lower members are incorporated into a self-contained unit so arranged as to hold the die members in alignment.

Control system: Sensors, manual input and mode selection elements, interlocking and decision-making circuitry, and output elements to the press operating mechanism.

Brake monitor: A sensor designed, constructed, and arranged to monitor the effectiveness of the press braking system.

Presence sensing device initiation: An operating mode of indirect manual initiation of a single stroke by a presence sensing device when it senses that work motions of the operator, related to feeding and/or removing parts, are completed and all parts of the operator's body or hand tools are safely clear of the point of operation.

Safety system: The integrated total system, including the pertinent elements of the press, the controls, the safeguarding and any required supplemental safeguarding, and their interfaces with the operator, and the environment, designed, constructed and arranged to operate together as a unit, such that a single failure or single operating error will not cause injury to personnel due to point of operation hazards.

Authorized person: One to whom the authority and responsibility to perform a specific assignment has been given by the employer.

Certification or *certify:* In the case of design certification/validation, means that the manufacturer has reviewed and tested the design and manufacture, and in the case of

installation certification/validation and annual recertification/revalidation, that the employer has reviewed and tested the installation, and concludes in both cases that the requirements of § 1910.217 (a) through (h) and appendix A have been met. The certifications are made to the validation organization.

Validation or *validate:* For PSDI safety systems that an OSHA recognized third-party validation organization: (i) for design certification/validation has reviewed the manufacturer's certification that the PSDI safety system meets the requirements of § 1910.217 (a) through (h) and appendix A and the underlying tests and analyses performed by the manufacturer, has performed additional tests and analyses which may be required by § 1910.217 (a) through (h) and appendix A, and concludes that the requirements of § 1910.217 (a) through (h) and appendix A have been met; and (ii) for installation certification/validation and annual recertification/revalidation has reviewed the employer's certification that the PSDI safety system meets the requirements of § 1910.217 (a) through (h) and appendix A and the underlying tests performed by the employer, has performed additional tests and analyses which may be required by § 1910.217 (a) through (h) and appendix A, and concludes that the requirements of § 1910.217 (a) through (h) and appendix A have been met.

Certification/validation and *certify/validate:* The combined process of certification and validation.

As used in § 1910.218, unless the context clearly requires otherwise, the following forging and hot metal terms shall have the meaning prescribed in this paragraph.

Forging: The product of work on metal formed to a desired shape by impact or pressure in hammers, forging machines (upsetters), presses, rolls, and related forming equipment. Forging hammers, counterblow equipment and high-energy-rate forging machines impart impact to the workpiece, while most other types of forging equipment impart squeeze pressure in shaping the stock. Some metals can be forged at room temperature, but the majority of metals are made more plastic for forging by heating.

Open framehammers (or blacksmith hammers): Hammers used primarily for the shaping of forgings by means of impact with flat dies. Open frame hammers generally are so constructed that the anvil assembly is separate from the operating mechanism and machine supports; it rests on its own independent foundation. Certain exceptions are forging hammers made with frame mounted on the anvil; e.g., the smaller, single-frame hammers are usually made with the anvil and frame in one piece.

Steam hammers: A type of drop hammer where the ram is raised for each stroke by a double-action steam cylinder and the energy delivered to the workpiece is supplied by the velocity and weight of the ram and attached upper die driven downward by steam pressure. Energy delivered during each stroke may be varied.

Gravity hammers: A class of forging hammer wherein energy for forging is obtained by the mass and velocity of a freely falling ram and the attached upper die. Examples: board hammers and air-lift hammers.

Forging presses: A class of forging equipment wherein the shaping of metal between dies is performed by mechanical or hydraulic pressure, and usually is accomplished with a single workstroke of the press for each die station.

Trimming presses: A class of auxiliary forging equipment which removes flash or excess metal from a forging. This trimming operation can also be done cold, as can coining, a product sizing operation.

High-energy-rate forging machines: A class of forging equipment wherein high ram velocities resulting from the sudden release of a compressed gas against a free piston impart impact to the workpiece.

Forging rolls: A class of auxiliary forging equipment wherein stock is shaped between power driven rolls bearing contoured dies. Usually used for preforming, roll forging is often employed to reduce thickness and increase length of stock.

Ring rolls: A class for forging equipment used for shaping weldless rings from pierced discs or thick-walled, ring-shaped blanks between rolls which control wall thickness, ring diameter, height, and contour.

Bolt-headers: The same as an upsetter or forging machine except that the diameter of stock fed into the machine is much smaller, i.e., commonly three-fourths inch or less.

Rivet making machines mean the same as upsetters and boltheaders when producing rivets with stock diameter of 1-inch or more. Rivet making with less than 1-inch diameter is usually a cold forging operation, and therefore not included in this subpart.

Upsetters (or forging machines, or headers) type of forging equipment, related to the mechanical press, in which the main forming energy is applied horizontally to the workpiece which is gripped and held by prior action of the dies.

As used in § 1910.219, unless the context clearly requires otherwise, the following mechanical power-transmission guarding terms shall have the meaning prescribed in this paragraph.

Belts: All power transmission belts, such as flat belts, round belts, V-belts, etc., unless otherwise specified.

Belt shifter: A device for mechanically shifting belts from tight to loose pulleys or vice versa, or for shifting belts on cones of speed pulleys.

Belt pole (sometimes called a *belt shipper* or *shipper pole*): A device used in shifting belts on and off fixed pulleys on line or countershaft where there are no loose pulleys.

Exposed to contact: The location of an object is such that a person is likely to come into contact with it and be injured.

Flywheels: Flywheels, balance wheels, and flywheel pulleys mounted and revolving on crankshaft of engine or other shafting.

Maintenance runway: Any permanent runway or platform used for oiling, maintenance, running adjustment, or repair work, but not for passageway.

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.

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.

Prime movers: Steam, gas, oil, and air engines, motors, steam and hydraulic turbines, and other equipment used as a source of power.

Sheaves: Grooved pulleys and shall be so classified unless used as flywheels.

Responsibilities

A. Environmental Health & Safety (EHS)

1. EHS will provide consultation for machine guarding concerns and questions.
2. EHS will prepare and updating the written Machine Guarding Program with periodic review and revisions as needed.
3. EHS will investigate and document all reported accidents and/or near-miss accidents that are directly or indirectly related to machine guards.
4. EHS will coordinate training and retraining of those who may be involved in using machine guards.

B. Department of Facilities Management (FM)/Other Departments

1. Facilities Management will ensure guards on facility equipment and machines operated by facilities personnel are kept in place and used as originally designed.
2. In academic areas, the Instructor, Lab Director, or Department Head is responsible for ensuring guards on machines operated by personnel or students under their supervision are kept in place and used as originally designed.
3. Responsible individuals in B2 will report issues/violations, and submit names of individuals requiring training to EHS as required.
4. Responsible individuals will replace any damaged, missing, or inadequate machine guards.

C. Employees

1. Employees will complete all safety training requirements and request further instruction, if unclear on any part of Machine Guarding Program.
2. Employees will use appropriate safety and personal protective equipment (PPE).
3. Employees will report all workplace injuries and unsafe conditions to their Supervisor or the appropriate responsible individual.

4. University Employees are responsible for reporting any unguarded machine hazard to their supervisor immediately.
5. All University employees should forward any student concerns or observations regarding the lack of machine guarding to their supervisor.

Introduction

Machine guarding is an essential part of work with powered tools and other machinery. Personnel and students, in general, must be trained in the safe use of hand tools, power tools, and other machinery, and counseled to take every precaution to prevent accidents. The diversity of activities conducted on the University campus requires use of such machinery in the arts to produce crafts/works; in science and engineering workshops for fabrication, alteration, or maintenance of devices or material; and by Facilities Management to produce parts or other useful products. Thus, personnel and students must be properly supervised and provided the correct type of equipment, personal protective devices, and safely guarded machinery to perform their assigned tasks.

Any machine part or process may cause injury if it is not properly safeguarded and maintained, or if the operator or other people in the work area are not familiar with or cautious of its hazards. Crushed hands and arms, crushed/severed fingers, abrasions, lacerations, amputations, burns, blindness, etc. are part of a list of possible machinery-related injuries. Any machine part, function, or process which may cause injury must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must either be eliminated or controlled.

One common mechanical hazard source is in-running nip points (pinch points), which often leads to hand injuries. There are several other hazard sources from various machine parts: reciprocating (often used for punching or piston compression), rotating (cutting), transversing (often bending, shearing), or parts otherwise moving that may pull the individual, their limbs, their hair, or loose clothing or jewelry into the apparatus. It is important to protect the following three parts of a machine to avoid injury: point of operation (where work is done to material), power transmission apparatus (used to convey energy to the point of operation, e.g. belt, chain, gear, flywheel, connecting rods, etc.), and other machine parts that move for proper operation. Related machine hazards may include projectiles (e.g. chipped material, sparks, dust byproducts) ejected during the work operation, noise (e.g. high pitch, vibration), heat (leading to warmer surroundings, burns, fire/explosions), and chemical (from fluids, fuels, related residues during its operation), and proper precautions should be taken to reduce or protect against such hazards.

Machine guards may be employed to create a physical barrier between a user and the hazard, but not all hazards may be guarded in this manner. For example, combustible dust (sawdust, metal dusts) should be ventilated out during work operations and any residue removed to avoid fires or explosions; and respirable dust (particles < 10 μm in size) may also be produced while working with machinery, requiring use of a particulate respirator. In addition to

physical/mechanical hazards, energized equipment will also present an electrical hazard, and must also be properly guarded against electrocution, shock, and burns. See the Electrical Safety Program for more information regarding electrical hazards from equipment and machinery.

Any maintenance work requiring lockout/tagout of the equipment should be handled by the responsible individual who is trained to do so. Depending on the nature of the equipment, it may involve other hazard sources such as high-pressure hydraulic systems or lasers related to the guarding device, so any related hazards should also be taken into account with appropriate controls. Each of the hazards and processes mentioned highlights the importance of machine guards and use of personal protective equipment. Appropriate training on hazards in the work area, hazards associated with the machines used, and use of machine guards will ensure a safe workplace.

There are four general types of guards: fixed, interlocked, adjustable, and self-adjusting. A fixed guard is a physical barrier and permanent part of the machine, independent of its moving parts. It is durable and requires minimum maintenance with maximum protection; it may, however, interfere with visibility and require removal for machine repair/maintenance. When an interlocked guard is opened or removed, a tripping mechanism shuts off or disengages the power to the machine until the guard is back in place. It may also provide maximum protection while providing access to the machine (e.g. to remove caught material) without removing guard completely from machine; the limitations to this guard are more careful adjustment/maintenance for the part, and the guard may be more easily disengaged than a fixed guard.

Adjustable guards provide barriers that may be adjusted depending on the operation or the stock (or material) being used; however, there are many disadvantages associated with its used, such as interfering with visibility, operator hands may enter the point of operation, the guard may be rendered ineffective more easily by the operator, and it may require more frequent maintenance. Self-adjusting guards provide a barrier that moves depending on the size of the stock that enters the point of operation (danger area) have similar disadvantages to adjustable guards.

The appropriate guard will likely be included with the machine purchased from the manufacturer; any new machinery purchased should include such parts. If there is no guard on machinery where it is required (e.g. legacy equipment), shop supervisors or other responsible individuals for the work areas should seek the appropriate guard from the manufacturer or approved vendor, or the equipment should be removed from service. Regardless of the type of guard employed, guards should meet the following minimum general requirements:

- Durability to not be damaged during normal operation;
- Efficacy in preventing contact with body parts;
- Integrity in being secure to the machine, so that operators or bystanders may not easily defeat (remove/tamper with) the guard, and preventing objects from falling into moving parts;

- Safety in not creating new hazards such as shear point, a jagged/pointy edge, or an unfinished surface that could cause lacerations;
- Facility in not creating interference to the operator from performing the job quickly and comfortably; and
- Allowing safe lubrication of machine (if possible, without removing the guards).

Guards shall be affixed to the machine where possible and secured elsewhere, if for any reason attachment to the machine is not possible. Personal protective equipment should be used during operation of machinery with guards in place.

Applicable Regulations

- 29 CFR 1910 Subpart O – Machinery & Machine Guarding (specifically, 29 CFR 1910.211 - 29 CFR 1910.213, 29 CFR 1910.215 -29 CFR 1910.219, and all Appendices)

Procedure

A. General Guidelines & Requirements

1. Electrical Power/Controls
   a) Each machine must be equipped with a master switch that can be locked and tagged during repair or maintenance operations.
   b) Power controls and operating controls must be located within easy reach of the operator at his/her regular workstation. Controls should be brightly marked and easily identified allowing the operator to cut off power at the point of operation.
   c) Each machine must be provided with an appropriate electrical ground.
   d) A trip device must be provided on machinery where injury might result if motors were to restart after power failures. This prevents the machine from operating when electric service is restored.
   e) Main kill switches (e.g. emergency stop, emergency [power] off, emergency brake) should be centrally installed, easily identified, and accessible to shop supervisors or co-workers for use in interrupting power in emergency situations.
2. Guarding
   a) Appropriate guards are provided to protect the operator and others in the area from hazards such as exposed belts, pulleys, sheaves, drive shafts, drive couplings, chains rotating parts, flying chips, and sparks.
   b) No employee or student shall operate and/or cause to be operated, any machinery without proper protective devices in place, nor should operators attempt to defeat the guards.
   c) Combs (feather boards) or suitable jigs must be provided for use when a standard guard cannot be used as in dadoing, grooving, jointing, moulding, and rabbeting.
   d) The operator should never perform layout, assembly, or set-up work on the table/work area when the machine is running.

3. Personal Protective Equipment
    a) All machine operators and assistants must wear appropriate eye protection (in accordance with ANSI Z87.1 and the Personal Protective Equipment Program) where the operation of the machine may produce flying objects or dust.
    b) Hearing protection must be utilized for jobs that involve the risk of loss of hearing. See the Hearing Conservation Program.
    c) Personnel must not wear loose fitting clothing or neckties while operating shop equipment. Gloves, rings, neck chains, and other jewelry can be hazardous and must not be worn while operating or working on moving machinery.
    d) Long hair must be restrained to prevent poor visibility and being caught in the machinery.
    e) Personnel are encouraged to wear heavy aprons when operating machinery that may produce kickbacks of stock.
    f) Shoes must be worn at all times when working with or around the machinery. No sandals are allowed.

4. Housekeeping
    a) Metal slivers, sawdust, and other debris should be cleaned from the machine using a brush or rag. Never use bare hands for the task. Never clean a machine while it is in motion.
    b) If available, the dust collection system should be used at all times. Combining wood dust and metal filings (or aluminum filings and metal filings) can create a fire hazard. Metal filings and wood dust should be kept separate at all times. Magnesium should not be sanded because it is highly flammable.
    c) To reduce the airborne dust levels, compressed air may be used for minor cleaning purposes only after the majority of the dust has been cleaned up manually, and where the pressure is reduced to less than 30 psi. Appropriate ventilation and/or dust masks should be used. Eye protection must be worn while using compressed air to clean equipment.
    d) Oily rags, waste, and other materials saturated with combustible substances must be disposed of in approved metal containers equipped with self-closing lids. These containers should be clearly marked for disposal of oily waste materials and must be emptied on a daily basis.
    e) Local exhausts should be installed on machines where large amounts of dust are produced, such as sanders and planers.
    f) Safety zones surrounding machines should be established and marked. Machines should be spaced to allow for the establishment of safety zones.

B. Hierarchy of Hazard Controls for Machine Guarding

1. Machine guarding decisions should be made in the following order of preference:
    a) Design out or eliminate the hazard
    b) Physically engineer out the exposure to the hazard (e.g. increase distance/location of the hazard from the machine user)

c) Guard or enclose the hazard with a physical barrier, isolating the hazard, and use personal protective equipment.
d) Use other safeguarding devices such as controls or attachments to prevent unintended access (e.g. two-hand tripping, presence sensing [pressure, laser, etc.], pullback, restraint, electronic safety controls, gates, etc.), which may stop the machine or otherwise restrain the operator.
e) Use awareness/warning devices (e.g. flashing lights, alarms) to make the danger clearly apparent.
f) Use awareness/warning signs and labels (which employ danger colors, symbols, wording) to visually make the danger apparent.
g) Use safe working practices and procedures.

C. Inspections & Audits

1. Machines that require guarding will be inspected regularly.
2. Guards will be inspected to assure that minimum requirements for use are met, especially the prevention of bodily contact from moving parts.
3. Based on the results of these inspections, maintenance or replacement of guards will be conducted as necessary.
4. EHS will audit the program annually and recommend appropriate corrective actions.

D. Lockout and Tagging

1. Before any maintenance is attempted, the machine must be completely shut down and the control switch locked and tagged by the person performing the repairs. This will prevent accidental starting during the repair process.
2. See the Lockout/Tagout Program for complete lockout and tagging procedures and requirements. Only lockout/tagout (LOTO) trained individuals can perform LOTO procedures.

E. Recordkeeping

1. EHS will maintain records of every machine guarding inspection it generates. A copy of this inspection will be kept in the EHS Office.

F. Training

1. Training requirements apply to personnel and students who use machinery equipped with machine guarding.
   a) Only those personnel and students who are thoroughly trained by their supervisor or instructor in the operation of the specific piece of equipment can operate machines. All manufacturer's operation manuals and diagrams should be kept by the shop supervisor/instructor and made available to employees/students responsible for operating the machine. The shop supervisor or instructor should contact the manufacturer in writing or contact EHS, if insufficient information on the machinery could result in unsafe operations.
   b) Shop supervisors and instructors are responsible for constant observation of shop practices to ensure that all safety regulations are being followed. When

unsafe acts are noted, it is the supervisor's/instructor's responsibility to ensure that they are corrected and do not recur.

c) Area- and department-specific training shall include safe operations and review of safety measures including knowing the hazards in the work area, including equipment available, machine-specific hazards, machine operating procedures, lockout/tagout procedures, and safe work practices (e.g. buddy system, appropriate PPE). This training will include appropriate safeguards for machinery/tools, how the guards work (how to use them and why), what hazards the guards isolate, and what to do if guards are damaged, missing, or inadequate.

2. Employees and/or students cannot operate any machinery while under the influence of drugs, alcohol, or medication.
3. Training may be accessed virtually through Vector Solutions SafeColleges found at the following URL: https://towsonehs-md.safecolleges.com/training/home. Employees shall request training by emailing safety@towson.edu or by calling the Environmental Health & Safety (EHS) office at 410-704-2949.

Resources

A. OSHA

1. Machine Guarding e-Tool

B. Environmental Health & Safety

1. Lockout/Tagout Program

2. To request documents, reviews for procedures or equipment, or general inquiries, contact EHS by emailing safety@towson.edu or by calling the Environmental Health & Safety (EHS) office at 410-704-2949.

Appendix A: Machinery and Machine Guarding Standards & Regulations

29 CFR 1910.211: Definitions
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.211

29 CFR 1910.212: General Requirements for All Machines
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.212

29 CFR 1910.213: Woodworking Machinery Requirements
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.213

29 CFR 1910.215: Abrasive Wheel Machinery
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.215

29 CFR 1910.216: Mills and Calenders in the Rubber and Plastics Industries
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.216

29 CFR 1910.217: Mechanical Power Presses
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.217

29 CFR 1910.218: Forging Machines
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.218

29 CFR 1910.219: Mechanical Power-Transmission Apparatus
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.219

Appendix B: Machines Used for Both Woodworking and Metalworking

Buffing and Wire Brushing Wheels

Operators must wear eye protection when using buffing wheels, in order to protect against the dust particles generated during the buffing operation. Impact resistant goggles are preferred where the buffing operation is likely to produce large amounts of dust. Operating wire brushing wheels can be especially hazardous because the wires tend to break off during operation, becoming high speed missiles. Goggles or face shields and leather gloves must be worn when operating wire brushing wheels. Use of an apron is encouraged to allow greater body protection.

Drill Presses

The most common causes of injury in drilling operations are the following: coming in contact with the drill bit; being struck by insecurely clamped materials being worked on; flying metal chips, or wood shavings; leaving the key in the chuck; and brushing shavings away with the bare hand. General requirements include:

- Stock must be properly secured to the press to prevent accidental movement during drilling;
- The operator must not attempt to make measurements near the tool, reach across the table, or adjust the machine or stock while the machine is in motion;
- Operators and assistants must wear eye protection when operating or within close proximity of the drill press when it is being operated;
- All power transmission parts must be effectively guarded. A spring-safety guard is recommended to guard the drill bit and catch metal slivers and wood chips.

Lathes

The most common cause of injury in lathe operations are: contact with projections on work or stock; flying metal chips or wood shavings; hand breaking the machine; leaving the key in the chuck; and catching loose clothing or wiping rags in the revolving parts. General requirements include:

- Operators and assistants must wear eye protection when operating the lathe or within close proximity of the lathe during operation;
- Operators must allow lathes to stop of their own accord. Hand pressure should never be used to stop spinning chucks after power has been turned off;
- Each exposed power transmission part must be effectively guarded for complete operator protection;
- Operators must avoid taking deep cuts when working with wood since this can result in the cutting tool being forcibly ejected;
- Operators must not wear loose clothing, long hair and jewelry that may become tangled in the revolving parts of the machinery;
- Stock must not be measured or calibrated while the lathe is in motion; and
- Cutting heads must be covered as completely as possible by metal hoods or shields. The guard should be designed in such a manner as to allow easy access to make adjustments

to the stock or cutting head. Where an exhaust system is used, the metal guard must form part of or the entire exhaust hood.

Appendix C: Metalworking Machines

Milling Machines

Most milling machine accidents occur when operators unload or make adjustments. Examples include the following: failure to draw the job back to a safe distance when loading or unloading; leaving the cutter to remove chips while the machine is in motion; and using incorrectly dressed cutters. General requirements include:

- Eye protection must be worn while operating such machinery;
- Shims, blocks, and clamps must be used to hold stock in place. The operator must make certain that such clamping devices are mounted low enough to clear the arbor and cutter;
- The table must be lowered before backing work under a revolving cutter;
- Adjustments must not be made to the speed of the machine, the rate of feed or coolant flow, or other function, while the machine is in operation. If the machine is equipped with hand-adjusting wheels, they must be mounted on the shaft by clutches or ratchet devices, so that the wheels do not revolve when the automatic feed is used;
- Horizontal machines must have a splash guard and pans for catching thrown cutting lubricant and lubricant running from the tools;
- Hand tools must not be left on the worktable at any time; and
- Operators must not reach around cutters to remove metal chips or debris. Brushes should be used to clean machines.

Metal Shapers

The most common causes of injury in shaping operations are the following: placing the hand or fingers between the tool and work; running the bare hand over sharp metal edges; measuring the job while the machine is running; and failing to clamp the work or tools securely before starting the cut. General safety procedures include:

- Eye protection must be worn when operating power presses;
- Mechanical presses containing full revolution clutches must incorporate a single stroke device and an anti-repeat mechanism into the press system;
- Pressure on hydraulic presses must be bled off and switches locked out before maintenance is performed;
- Point of operation guards must protect the operator by one of the following methods by:
    - Preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation;
    - Preventing the operator from inadvertently reaching into the point of operation;
    - Designing the controls such that the operator must use both hands to operate the press and locating the controls at a safe distance from the point of operation;
    - Enclosing the point of operation before a press stroke can be initiated.
- Hand tools must be used to free and remove stuck work or scrap pieces from the die. This should never be attempted with hands.

A regular inspection program must be established and maintained to ensure that all parts, auxiliary equipment, and safeguards are in good repair and properly adjusted.

Appendix D: Woodworking Machines

Band Saws

The most common type of injury associated with band saws results when the operator's hand(s) make contact with the saw blade. General requirements for the use of band saw include the following:

- Eye protection must be worn when operating band saws;
- The cutting edge of the blade must be completely enclosed by an adjustable guard, except at the point of operation.
- Both upper and lower drive wheels must be completely enclosed by solid metal, woven wire mesh or expanded sheet metal and securely fastened to the metal framework.
- Each saw must be provided with a tension control device to ensure proper operating tension at all times.
- Effective brakes must be provided to stop the wheel in case of blade breakage.
- The operator must use extreme caution to ensure that his hands are not exposed to the saw blade during operation.

Circular Saws

Table saws, radial arm saws, overhead swing saws, straight line pull cutoff saws, electrical miter saws, and other machines containing circular saw blades are included in this section.
Circular saw operators are most frequently injured when their hands slip off the stock while pushing it into the saw, or when holding the hands too close to the blade during the cutting operations. Injuries involving kickbacks are also quite common. General requirements include the following:

- Eye protection must be worn when operating circular saws;
- Table saws must be equipped with a guard that protects the portion of the saw above the table. The guard must automatically adjust itself to the thickness of the material being cut in order to provide continuous protection from the blade.
- Table saws (unless self-fed with rollers or a wheel in the back of the saw) must be provided with a spreader fastened securely behind the saw. Circular ripsaws must be provided with sectional non-kickback fingers or dogs.
- The part of the saw blade underneath the table must be completely enclosed.
- Swing saws, radial saws and cutoff saws must be designed to return gradually and automatically to the starting position when released by the operator.
- Stock must be held against a gage, never sawed freehand. Freehand sawing endangers the hands and may cause work to get out of line and bind on the saw.
- The operator should stand out of the line of the stock he is ripping to avoid being injured by kickbacks. A heavy leather or plastic apron or abdomen guard gives additional protection.
- A circular saw should be stopped when the operator leaves it. Injuries have been caused by saws still coasting with the power off.

Sanding Machines

General requirements for personnel operating sanding machines including:

- Eye protection must be worn by operators and assistants;
- Dust respirators must be worn by those operating the machine, in close proximity of the operation, and/or when cleaning up (when ventilation does not provide adequate protection);
- Belt sanders must have guards placed at each in running nip point on the power transmission and feed roll parts;
- The unused run of the sanding belt must be guarded.
- Manually fed sanders must have a work rest which is used by the operator to support the work properly;
- Sanding belts should be the same width as the pulley-drum, should be free of cracks and badly worn spots and frays, and should be adjusted tightly against the pulley-drum before use.

Jointers

Hand-feed jointers are one of the most dangerous machines in wood working shops. They are responsible for injuries caused when operators catch their hands and/or fingers on the knives, especially when short lengths of stock are being jointed. General requirements for jointers include:

- Operators must wear eye protection when working with the jointer;
- The jointer blade should be guarded as work is fed into it. A guard that adjusts itself covering the table on the working side of the gage is recommended. The unused end of the gage should be enclosed at all times.
- Push blocks with handles for both hands should be used for surfacing work or when jointing short pieces of stock.
- Jointers should have rounded heads no deeper than 7/16 inch, no wider than 5/8 inch. The openings between the table and the head should be just large enough to clear the knife.
- The clearance between the edge of the rear table and the cutter head must not be more than 1/8 inch. The table throat opening must not be more than 2 1/2 inches when tables are set with each other for zero cut.

Wood Shapers

Shapers can be dangerous when operator's hands are exposed to revolving knives. Severe accidents also result from broken knives thrown by the machine. General requirements for shapers include:

- Operators must wear eye protection.
- The cutting heads of wood shapers must be enclosed with a cage or adjustable guard;
- Knives must be of the best shaper steel and set by fully qualified installers;
- Knives and the grooves in the collars must fit perfectly and be free of dust;
- Knives must not be used after they are worn down to the middle point of the collar. Knives must be balanced perfectly;

- Operators should avoid deep cuts and should start the work in short starts and stops, bringing the spindle up to operating speed slowly. The operator should listen for any evidence that the knives are out of balance;
- There should be a braking device on the shaper to stop the spindle after the power is shut off;
- Only a long-handled brush should be used to remove chips and dust from the blades;
- Shaper work should be held against guide pins or a fence.

Planers

General requirements for the use of power-fed planers include:

- Operators and assistants must wear eye protection and dust respirators. It is recommended that hearing protection if the planer is not sound insulated.
- Cutter heads must be completely enclosed in solid metal guards which should be kept closed when the planer is running;
- All belts and pulleys should be completely enclosed on the backside of the planer;
- Feed rolls must be guarded by a wide metal strip or bar keeping operator's fingers out of the rolls while allowing boards to pass. Sectional kickback finger devices must be provided in lieu of feed rolls;
- The operator should stand out of the way of board travel.

Appendix E: Machine Guarding Safety Checklist

The following checklist is intended to assist supervisors and/or workers to determine if machinery and machine guarding are required, if such protection readily available and is it properly used. Any no answers should cause the supervisor/worker to initiate corrective action. Reference OSHA Standards 29 CFR 1910.211-1910.219.

General Requirements	Yes	No

Electrical Power/Controls		
Is each machine equipped with a master switch that can be locked and tagged during repair or maintenance operations?	☐	☐
Are power controls and operating controls located within easy reach of the operator at his/her regular workstation?	☐	☐
Are controls brightly marked and easily identified allowing the operator to cut off power at the point of operation?	☐	☐
Is each machine provided with an appropriate electrical ground?	☐	☐
Is a trip device provided on machinery on which injury might result if motors were to inadvertently restart after power failures?	☐	☐
Are main "kill" switches centrally located, easily identified, and accessible to shop supervisors or co-workers for use in interrupting power in emergency situations?	☐	☐

Personal Protective Equipment		
Is appropriate eye protection provided to, and its use required by, operators and assistants where the operation of the machine may produce flying objects or dust?	☐	☐
Is appropriate hearing protection provided to, and its use required by, operators and helpers, who must work around equipment which may emit noise levels above 85 dBA (see the TU Hearing Conservation Program)	☐	☐
Is the wearing of loose-fitting clothing or neckties prohibited for employees who operate shop equipment?	☐	☐
Is the wearing of gloves, rings, neck chains and other hazardous jewelry prohibited of employees who operate or work on machines with working parts?	☐	☐
Are employees with long hair required to keep the hair restrained while working around machinery with moving parts?	☐	☐

Housekeeping		
Are appropriate brushes provided to employees working at machines that produce slivers, sawdust, and other debris?	☐	☐
Are operators instructed to never clean their machines or the surrounding area with bare hands?	☐	☐
Are operators instructed to never clean their machines while they are operating?	☐	☐

Is compressed air allowed for cleaning ONLY where it can be reduced to 30 psi? Does the supervisor enforce such reduction?	☐	☐
Is eye protection provided and its use required where compressed air is used for cleaning operations?	☐	☐
Are oily rags, waste, and other materials saturated with combustible substances disposed of in approved metal containers with self-closing lids?	☐	☐
Are such containers clearly marked for disposal of combustible materials and emptied on a daily basis?	☐	☐
Are local exhausts installed on machines that produce large amounts of dust, sawdust, or other fine debris?	☐	☐
Is a safety zone established and well-marked around each machine?	☐	☐

Lockout and Tagging		
Is each machine completely shut down and the control switch locked and tagged by the LOTO trained person performing maintenance, prior to any maintenance attempt?	☐	☐

Training		
Are only personnel/students who are thoroughly trained in the operation of a machine allowed to operate machinery?	☐	☐
Does the supervisor/instructor constantly observe shop practices to ensure that all safety regulations are being observed?	☐	☐
When unsafe acts are noted, does the supervisor/instructor ensure they are corrected and that they do not recur?	☐	☐

Machines Used for Both Woodworking and Metalworking

Buffing and Wire Brushing Wheels		
Is a work rest present?	☐	☐
Is the work rest less than 1/8 inch from the wheel?	☐	☐
Are goggles or face shields and leather gloves provided and their use required by employees operating wire-brushing wheels?	☐	☐

Abrasive Wheel Equipment Grinders		
Do side guards cover the spindle, nut, and flange and 75% of the wheel diameter?	☐	☐
Is the work rest used and kept adjusted to within 1/8-inch (0.3175 cm) of the wheel?	☐	☐
Is the adjustable tongue guard on the top side of the grinder used and kept to within 1/4-inch (0.6350cm) of the wheel?	☐	☐
Is the maximum RPM rating of each abrasive wheel compatible with the RPM rating of the grinder motor?	☐	☐
Before new abrasive wheels are mounted, are they visually inspected and ring tested?	☐	☐
Is cleanliness maintained around grinders?	☐	☐

Are dust collectors and powered exhausts provided on grinders used in operations that produce large amounts of dust?	☐	☐
Are goggles or face shields always worn when grinding?	☐	☐
Are bench and pedestal grinders permanently mounted?	☐	☐
Is each electrically operated grinder effectively grounded?	☐	☐
Are fixed or permanently mounted grinders connected to their electrical supply system with metallic conduit or other permanent method?	☐	☐
Does each grinder have an individual on and off control switch?	☐	☐

Drill Presses		
Is it required that all stock be properly secured to the press to prevent accidental movement during drilling?	☐	☐
Are operators prohibited from making measurements near the tool, reaching across the table or adjusting the machine or stock while the machine is in motion?	☐	☐
Are all power transmission parts effectively guarded?	☐	☐
Is a spring-safety guard provided to guard the drill bit and to catch metal slivers and wood chips?	☐	☐

Lathes		
Is each exposed power transmission part effectively guarded for complete operator protection?	☐	☐
Note: If a supervisor or operator has reason to believe that a machine may not be effectively guarded, consult Environmental Health and Safety.		
Are operators instructed to avoid taking deep cuts when working with wood to avoid the cutting tool's being forcibly ejected?	☐	☐
Are operators prohibited from measuring or calibrating while the lathe is in motion?	☐	☐
Are all cutting heads covered as completely as possible by metal hoods or shields?	☐	☐
Are guards designed in such a manner as to allow easy access to make adjustment to the stock or cutting head?	☐	☐
Where an exhaust system is used, does the metal guard form part or all of the exhaust hood?	☐	☐

Metalworking Machines

Milling Machines		
Are shims, blocks and clamps provided to hold stock in place?	☐	☐
Are adjustments to the speed of the machine, the rate of feed or coolant flow, or other function prohibited while the machine is in operation?	☐	☐
Are machine equipped with hand-adjusting wheels, mounted on the shaft by clutches or ratchet devices, so that the wheels do not revolve when the automatic feed is in use?	☐	☐
Do horizontal machines have a splash guard and pans for catching thrown cutting lubricant and lubricant running from the tools?	☐	☐

Is the placing of hand tools on the worktable prohibited at all times?	☐	☐
Are operators prohibited from reaching around cutters to remove metal chips or debris?	☐	☐
Are brushes provided and their use required for cleaning the machines?	☐	☐

Woodworking Machines

Band Saws		
Is the cutting edge of the blade completely enclosed by an adjustable guard, except at the point of operation?	☐	☐
Are both upper and lower drive wheels completely enclosed by solid metal, woven wire mesh or expanded sheet metal and securely fastened to the metal framework?	☐	☐
Is each saw provided with a tension control device to ensure proper operating tension at all times?	☐	☐
Are effective brakes provided to stop the wheel in the event of blade breakage?	☐	☐

Circular Saws		
Are table saws equipped with a guard that protects the portion of the saw above the table?	☐	☐
Does the guard automatically adjust itself to the thickness of the material being cut in order to provide continuous protection from the blade?	☐	☐
Are table saws (unless self-fed with rollers or a wheel in the back of the saw) provided with a spreader fastened securely behind the saw?	☐	☐
Are circular ripsaws provided with sectional non-kickback fingers or dogs?	☐	☐
Is the part of the saw blade underneath the table completely enclosed?	☐	☐
Is it required that stock be held against a gauge, never sawed freehand?	☐	☐
Is the operator required to stand out of the line of the stock he is ripping to avoid being injured by kickbacks?	☐	☐
Are operators required to stop the saw completely prior to leaving it?	☐	☐

Radial Arm Saws		
Are radial saws designed to return gradually and automatically to the starting position when released by the operator?	☐	☐
Is the table wide enough so that the saw does not extend over the table when pulled to capacity?	☐	☐
Is the “Do Not Rip or Plough from This End” sticker present?	☐	☐
Is the blade rotation marked?	☐	☐
Are blade guards/rings present?	☐	☐

Sanding Machines		
Are dust respirators provided and their use required by those operating the machine or who must stand in close proximity of the operation and when cleaning up?	☐	☐

Do belt sanders have guards placed at each in-running nip point on the power transmission and feed roll parts?	☐	☐
Is the unused run of the sanding belt guarded?	☐	☐
Do manually fed sanders have a work rest to be used by the operator to properly support the work?	☐	☐
Are sanding belts the same width as the pulley-drum, are they free of cracks and badly worn spots and frays, and are they adjusted tightly against the pulley-drum before each use?	☐	☐

Jointers		
Is the jointer blade guarded as work is fed into it?	☐	☐
Note: A guard which adjusts itself covering the table on the working side of the gage is recommended. The unused end of the gage should be enclosed at all times.		
Are push blocks provided and their use required when performing surfacing work or when jointing short pieces of stock?	☐	☐
Is the opening between the table and the knife just large enough to clear the knife?	☐	☐
Is the clearance between the edge of the rear table and the cutter head not more than 1/8 inch?	☐	☐
Is the table throat opening not more than 2 1/2 inches, when tables are set with each other for zero cut?	☐	☐

Wood Shapers		
Are the cutting heads of wood shapers enclosed with a cage or adjustable guard?	☐	☐
Is there a braking device on the shaper to stop the spindle after the power is shut off?	☐	☐
Is it required that shaper work be held against guide pins or a fence?	☐	☐

Planers		
If the planer is not sound insulated, is hearing protection provided and its use required in accordance with the TU Hearing Conservation Program?	☐	☐
Are cutter heads completely enclosed in solid metal guards, which should be kept closed when the planer is running?	☐	☐
Are all belts and pulleys completely enclosed on the backside of the planer?	☐	☐
Are feed rolls guarded by a wide metal strip or bar to keep the operator's fingers out of the rolls while allowing boards to pass?	☐	☐