1. Purpose

The purpose of this program is to establish Kennesaw State University (KSU) requirements for machine safety through hazard identification, evaluation, safeguarding, training, and operation. The objective of the program is to eliminate injuries to employees, students and contractors from machines and machine systems. This program is designed to work in conjunction with other Environment, Health & Safety programs.

2. Scope

This procedure covers all faculty, staff, students, contractors and other individuals who operate KSU-owned machines or equipment, regardless of their affiliation to KSU. This program applies to all machines and equipment used in education, research, operations, and maintenance activities, whether the equipment was purchased turnkey or designed and built by KSU affiliates.

This program does not cover the use of powered and non-powered portable hand tools, such as hammers, screw drivers, wrenches, staple guns, sanders, drills, etc.

For the purpose of this program, the terms “machine” and “equipment” will be used interchangeably.

3. Roles and Responsibilities

A. Authorized users

Authorized users must do the following:

- Complete required training and obtain authorization prior to operating machines.
- Understand and practice approved machine safeguarding methods.
- Observe all safety guidelines.
- Inspect machines and equipment before each use to verify they are in good operating condition with all the required guards in place.
- Wear all appropriate personal protective equipment.
- Practice good housekeeping.
- Report machine safeguarding malfunctions or problems to a supervisor immediately.
- Report unauthorized or unsafe use of machines and equipment to a supervisor.
- Do not defeat or remove guards or safety devices .

- Do not operate machines without safeguards in place.

B. Managers, Supervisors, PIs

Managers, supervisors, and PIs of personnel who operate machines and equipment must:

- Ensure all newly acquired machines are properly guarded prior to being put into service.
- Restrict access to machines and equipment to prevent unauthorized use or unnecessary exposure.
- Ensure machines are properly safeguarded and that guards remain in place and functional by conducting periodic, machine-specific safeguarding evaluations.
- Immediately correct machine safeguard deficiencies or remove damaged or unprotected equipment from service (lockout and tag out, as necessary).
- Ensure users are trained, qualified, and competent in the proper and safe operation before authorizing access to machines and equipment.
- Communicate safety operating practices and rules to authorized users and affected personnel.
- Exercise appropriate disciplinary action when users fail to follow safety requirements
- Provide personal protective equipment to all users.

C. Maintenance and Service Personnel

- Lockout and tag out machines and equipment prior to removing or bypassing guards.
- Report any damaged or ineffective guards or safeguarding devices.
- Replace all safeguards and interlocks after maintenance and servicing is complete.

D. EH&S

- Provide training on this program, its implementation and requirements to all affected personnel.
- Provide guidance and assistance in the development of specific machine guarding procedures, processes and training.
- Assist in the selection of appropriate guards, safeguarding methods, and PPE.
- Conduct periodic inspections to ensure that machine guarding safety guidelines are being followed.
- Review this program annually or whenever there is a change or update to the governing standards.

4. Definitions

a. **Machine Guard** – A barrier placed between the machine user and hazardous parts of a machine. Also called a safeguard.

b. **Personal Protective Equipment (PPE)** – Specialized clothing or equipment worn by employees for protection against health and safety hazards.

c. **Risk Assessment** – The process to identify hazards and estimate the level of risk involved.

5. Guarding Requirements for All Machines

One or more methods of machine guarding must be provided to protect the operator and other personnel in the machine area from hazards such as those created by point of operation, the power transmission device, and other hazardous motions and actions.

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 be either controlled or eliminated.

All guards must be appropriate for the hazard involved, secured in place, constructed of substantial material and have surfaces free of hazardous projections.

Machine guards must protect employees from mechanical, electrical, pneumatic, thermal and other hazards. To do so, these machine guards must:

a. **Prevent contact** – The machine guard must prevent hands, arms, or any other part of an operator’s body from making contact with dangerous moving parts. A good machine guard system eliminates the possibility of the operator or another person placing his or her hands near hazardous moving parts. As a general rule, safeguard all openings of ¼ inch or greater and all equipment that is less than eight feet above the floor or working level.
b. **Be secured to the machine** – Guards must be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not as possible. Operators should not be able to remove or tamper easily with the guard.
c. **Protect from falling objects** – Objects should not be able to fall into any moving parts of the machine. Small objects or tools dropped into cycling machines can easily become projectiles.
d. **Create no new hazards** – Machine guards must have surfaces free of hazardous projections, unfinished surfaces or sharp edges.
e. **Not interfere with job performance** – All machine guards should allow the operator to perform their job quickly and comfortably while also not being overridden or disregarded.
f. **Allow for safe lubrication of the machine** – Guards must be hinged or have sliding or removable sections to allow for the admission of oil and lubricants. Where machines or parts must be lubricated while in motion, the lubricant fittings must be located at least 12 inches from all unguarded moving parts. Machine parts or transmission equipment in inaccessible locations must be equipped with extension lubricant fittings. Locating oil reservoirs outside the guards with a line leading to the lubrication point will reduce the need for operator or maintenance worker to enter the hazardous area.

E. Hazardous Parts, Motions and Actions

Despite all machines having the same basic components, their safeguarding needs widely differ due to varying physical characteristics and operator involvement. Regardless of whether a process is manual or automated, any hazardous movement which poses a risk to workers must be guarded. The following section addresses which parts, motions and actions contribute to machine hazards.

1) Hazardous Parts of a Machine

a) *Point of operation* –

The point of operation is the point where material is positioned, inserted, or manipulated, or where work such as shearing, punching, shaping, cutting, boring, forming, or assembling is being performed on the stock.

Milling machines, power presses, CNC turning machines, jointers, power saws, hand tools, guillotine cutters, and shears are all examples of machines that require point of operation guards.

b) *Power transmission apparatus*

Power transmission apparatus are all components of the mechanical system which transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, crank, and gears.

c) *Other hazards*

Auxiliary parts of a machine and any part that moves while the machine is working must be guarded to prevent accidental contact. Electrical hazards must be isolated inside solid-walled or flexible metal conduits to prevent contact with electrical conductors. Hydraulic or pneumatic hazards must be isolated inside solid-walled or flexible conduits. Additional physiological hazards (e.g., noise, illumination, vibration), ventilation (dust, emissions), chemical hazards, environmental concerns, radiation or ergonomic hazards may be present as well.

2) Motions and Actions

A wide variety of mechanical motions and actions can present a hazard to the worker. These include the movement of rotating parts, reciprocating arms, moving belts, meshing gears, cutting teeth, and any portions that impact or shear. These different types of mechanical motions and actions are found, in varying combinations, on nearly every machine. Recognizing these hazards is the first step toward protecting workers.

The basic types of hazardous mechanical motions are:

a) Rotating

Rotating motion is very dangerous. Even smooth, slowly rotating shafts can grip hair and clothing, pulling a worker into a hazardous position. Common rotating mechanisms are: collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting. Projections (such as set screws and bolts) or nicks and abrasions exposed on rotating parts increases the hazard.

b) In-running nip points

In-running nip point hazards are caused by the rotating parts on machinery. Parts can rotate in opposite directions while their axes are parallel to each other. These parts may be in contact or in close proximity. For example, stock fed between two rolls produces a nip point.

Nip points are also created between rotating and tangentially moving parts. Some examples would be: the point of contact between a power transmission belt and its pulley, a chain and a sprocket, and a rack and pinion.

Nip points can occur between rotating and fixed parts which create a shearing, crushing, or abrading action, such as flywheels, screw conveyors, or the periphery of an abrasive wheel and an incorrectly adjusted work rest and tongue.

c) Reciprocating

Reciprocating motions may be hazardous because, during the back-and-forth or up-and-down motion, worker may be struck by or caught between a moving and a stationary part.

d) Transversing

Transverse motion (movement in straight, continuous line) creates a hazard because a worker may be struck or caught in a pinch or shear point by the moving part.

e) Cutting

Cutting action may involve rotating, reciprocating, or transverse motion. The danger of cutting action exists at the point of operation where finger, arm and body injuries can occur and where flying chips or scrap material can strike the head, particularly in the area of the eyes or face. Such hazards are present at the point of operation in cutting wood, metal, and other materials. Examples of mechanisms involving cutting hazards include band saws, circular saws, boring and drilling machines, turning machines, lathes, or milling machines.

f) Punching

Punching action results when power is applied to a slide (ram) for the purpose of blanking, drawing, or stamping metal or other materials. The danger of this type of action occurs at the point of operation where stock is inserted, held, and withdrawn by hand. Typical machines used for punching operations are power presses and iron workers.

g) Bending

Bending action results when power is applied to a slide in order to draw or stamp metal or other materials. A hazard occurs at the point of operation where stock is inserted, held, and withdrawn. Equipment that uses bending action includes power presses, press brakes, and tubing benders.

h) Shearing

Shearing action involves applying power to a slide or knife in order to trim or shear metal or other materials. A hazard occurs at the point of operation where stock is actually inserted, held, and withdrawn. Examples of machines used for shearing operations are mechanically, hydraulically, or pneumatically powered shears.

3) Additional Mechanical and Non-Mechanical Hazards

There can be many other parts, motions or actions that present a hazard to the operator and surrounding personnel. Any part that could suddenly or unexpectedly move and injure a worker should be safeguarded. Examples of these are:

a) Compressed gases and hydraulic fluids

Normally associated with machines that run on hydraulic and pneumatic power, compressed gases and fluids are under extreme pressure. Incidents may occur with parts that are not hard piped or shrouded in heavy duty tubing.

b) Utilities

Steam or water piping and hoses are common hazard and should always be securely fastened to prevent hose ends from whipping around. Electrical supplies and equipment must be designed/installed per IEE design code requirements with guards that are strong enough to prevent any kind of access to the electrical conductor even when accidentally impacted by heavy equipment or falling objects.

c) Counterweights, springs, shock absorbers

Weights that act to balance or offset another are commonly found on elevator car frames, cranes, and valves. Springs may be under tension or compression with large amounts of stored energy. Shock absorbers may have stored energy/pressure inside the absorber when the machine is “at rest”. All these components should be guarded to prevent access to the hazard. The area directly below counterweights must be effectively barricaded against passage.

d) Temperature extremes

Extreme temperatures can present a hazard by creating dangerously hot or cold surfaces. Surfaces in excess of 140 degrees F must be covered with a thermal insulating material or otherwise guarded against contact to meet code requirements.

F. Machine Guards

1) Types of Guards

Guards are barriers which prevent access to danger areas. There are four general types of guards: fixed, interlocked, adjusted, and self-adjusting.

a) Fixed

As its name implies, a fixed guard is a permanent part of the machine. It is not dependent upon moving parts to function. This guard is usually preferable to all other types. Fixed guards can be constructed to suit many specific applications and provides maximum protection to operators, while requiring minimum maintenance. One limitation of a fixed guard is that it may interfere with visibility. Also, adjustments and repairs to machine often require its removal, thereby necessitating other means of protection for maintenance personnel.

b) Interlocked guards

When an interlocked guard is opened or removed, the tripping mechanism or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place. An interlocked guard may use electrical, mechanical, hydraulic, or pneumatic power or any combination of these. Replacing the guard should not automatically restart the machine. To be effective, all removable guards should be interlocked to prevent occupational hazards.

Interlocks should be designed to discourage the capability to easily bypass the interlock with readily available items such as tape, pieces of metal, screws, tools, etc. Some interlock devices use special keys, trapped keys or actuators that make the interlock more difficult to bypass. There are also interlocking devices that physically obstruct or shield the interlock with the guard open, and others that use electrical, mechanical, magnetic, or optical coding.

c) Adjusting Guards

Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock. They provide a barrier that may be adjusted to facilitate a variety of production operations; however, because they are adjustable, they are subject to human error.

d) Self-adjusting Guards

The openings of these barriers are determined by the movement of the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator. Self-adjusting guards offer different degrees of protection. Off-the-shelf guards are often commercially available, but they don’t always provide maximum protection.

e) Safeguarding Devices

A safeguarding device or control works by keeping the operator’s hands and body outside of the danger zone or by stopping the machine if the operator’s hands or body enter the danger zone.

f) Barriers and Gates

A barrier is a device or object that provides a physical boundary to the hazard. Barrier devices are designed and constructed to enclose the hazard zone prior to the start of the hazardous portion of the machine cycle. They are held closed until completion of the cycle or until the machine has ceased motion.

Gates are movable barriers that protect the operator at the point of operation before the machine cycle can be started. Gates are, in many instances, designed to be operated with each machine cycle. If the gate does not fully close, the machine will not function.

There are two types of gates: Type A and Type B. Both gates protect the operator during the entire machine stroke.

Type A gate will not open until after the crankshaft rotation is complete (360°) and the machine is stopped at top dead center. Although Type A Gates can be used on either part or full revolution clutch presses, best safety practice is the "A" gate should be used only on full revolution clutch presses. Type A prevents access to the hazardous area during machine the machine cycle.

Type B allows access after the hazardous portion but before the machine fully completes its cycle (before); access while cutting tool enters the part, but allows access as tool exits part Type B Gates protect the operator during the down stroke only. The gate starts to open before the crankshaft rotation is complete (generally after 180° crankshaft rotation). The gates must open on the upstroke of the machine cycle before the crankshaft rotation is complete.

g) Presence-Sensing Devices

An optical presence-sensing device uses a system of light beams or curtains that can interrupt the machine's operating cycle. If the sensing field is broken, the machine stops and will not cycle. This device must be used only on machines that can be stopped before the worker can reach the danger area.

An electromechanical presence-sensing device has a probe or contact bar that descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full pre-determined distance, the machine will not cycle.

h) Pressure-sensitive Devices

When depressed, a pressure-sensitive device will deactivate the machine. Examples of pressure–sensitive devices are body bars, bump or contact strips, or mats.

i) Pullbacks and Restraints

A pullback device is designed to protect the machine operator by keeping the operator's hands out of the danger zone during the hazardous portion of the machine cycle. It utilizes a series of cables attached to the operator’s hands, wrists, or arms which physically withdraws them before a cycle.

The restraint device protects the operator by physically holding the operator's hands away from the hazard zone at all times. This is usually accomplished by the use of wrist straps.

Both pullback and restraint devices are adjustable and thereby subject to human error.

j) Two-hand Control and Trip Devices

A two-hand control requires constant, concurrent pressure to activate the machine. The operator's hands are required to be at a safe location (on control buttons) and at a safe distance from the danger area while the machine completes its closing cycle.

A two-hand trip requires concurrent application of both of the operator's control buttons to activate the machine cycle, after which the hands are free. This device is used with machines equipped with full-revolution clutches. The trips must be placed far enough from the point of operation to make it impossible for the operators to move their hands from the trip buttons or handles into the point of operation before the first half of the cycle is completed to prevent them from being accidentally placed in the danger area prior to the slide/ram or blade reaching the full "down" position.

G. Safeguarding through Design

1) Anti-restart Device

An anti-restart device, or drop-out protection, is used to protect the operator from injury if a motor was to automatically restart after a power failure. This is particularly applicable for woodworking equipment, grinders & sanders.

Equipment is likely restart automatically if:

- The switch is left in the "on" or "closed" position.
- It can be restarted through a computer.
- It has instrumentation, such as a level switch, which will re-set itself, allowing the machine to restart once power has been restored.
- It is wired to a different power source for control power (When there are two separate sources of power, and a local electrical outage occurs for the main power circuit, the "control power" remains energized even though the main power is off. This means that the starter will remain energized, or in the "closed" position. When the main power is restored, the equipment will restart because the starter is already energized).
- Personnel must be protected by either fully guarding the equipment or the equipment must be retrofitted with an anti-restart device.

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2) Fail-Safe Design

Fail-Safe Design is the design of interlocks and machine-logic-controllers and programming to ensure the safety of the operator and processes. A fail-safe system should be designed to default to its safest mode of operation in the event of any kind of "out-of-normal" failure condition, such as wiring or component failures. The design assumption is that failure will eventually occur but when it does, it will fail in a manner as to mitigate injuries and losses

3) Interruption of Energy Source

Machinery must be designed to prevent hazardous conditions resulting from interruption or excessive fluctuation of any the energy sources used by the machine. In the event of loss of energy, the stopping function of the machine must remain available. All devices whose permanent operation is required for safety must operate in an effective way to maintain safety (e.g., locking, clamping devices, cooling or heating devices, braking) and potentially be interlocked with the machine's operational logic. The process(es) for safely controlling or dissipating hazardous stored energy must be identified for all machines as part of the design for easy Energy Isolation – Lockout /Tag out.

H. Complementary Safeguarding and Risk Reduction Methods

The following safeguards and methods may be used in conjunction with primary machine guarding devices and controls to reduce the risk or create awareness of a hazard. Although these aids do not give complete protection from machine hazards, they may provide the operator with an extra margin of safety. Most concepts and techniques for safeguarding machines focus on mechanical motion; however, machines create many non-mechanical hazards which should be protected against as well.

1) Access to Machinery

Machines must be designed and constructed in a way that allows all necessary tasks to be carried out, but provides an acceptable level of protection for surrounding personnel. When feasible, access to hazardous machinery should be restricted to authorized personnel only. This can be accomplished by locating the machines and equipment in a separate room accessible only by key or keycard. Another option would be establishing a one-way traffic flow where users pass a check-in desk. Access may also include restrictions to certain hours and dates, although this is impossible to accomplish with a mechanical lock and key.

2) Anchoring Fixed Machinery

A machine designed for a fixed location must be securely anchored to prevent walking or moving.

3) Awareness Barriers and Signals

Awareness barriers do not provide physical protection but serve only as reminders to a person that he or she is approaching the danger area. An awareness barrier may move or be adjusted to allow entry of work pieces and personnel, but prevents anyone from reaching the hazard without awareness. In addition, it provides visual boundaries and indicates the hazard zone.

Awareness signals provide a recognizable audible or visual signal of an approaching or present hazard. Indicator lamps, usually white, red and green, may be provided to indicate that the device is functioning. Indicator lights should be labeled or have distinct patterning or flashing.

Audible awareness signals, like annunciators or bells, should have a distinctive sound and intensity such that they will be distinguished from the highest ambient noise level in the hazard zone.

4) Controls

Control systems must be designed to enable the operator to interact safely with the machine. Ideally, a machine will have separate control zones for start-up functions, emergency stopping, stopping as a result of a safeguard device, and isolation or energy dissipation.

Each control must require a deliberate action to initiate operation. In addition, controls must be:

- Permanently and clearly labeled and identified.
- Located, positioned or safeguarded to prevent unintentional activation.
- Designed to accommodate the foreseeable use of personal protective equipment (such as gloves and footwear).
- Located out of reach of the hazard zones (except for emergency stop controls).
- Mounted in a location that affords the operator safe operation and optimum visibility of the machinery.
- Ergonomically designed.
- Functionally grouped (i.e, the start button is located near the stop button) .
- Indicated in a consistent manner.

Where the start/stop function is performed by means of a hold-to-run (jog) control, a separate stop control device must be provided.

5) Emergency Stop Devices

All machines must be equipped with adequate means whereby the operator of the machine or other person can disconnect the power promptly in case of emergency. If the machine's power switch is not located near the operator/point of operations, an emergency stop device must be provided.

Emergency stop devices must be continuously operable, clearly identified, clearly visible and readily accessible.

The device must be actuated by a single human action and initiate an immediate stop command. The emergency stop command must override all other functions and operations in all modes for hazardous motion. These devices must be manually reset to restart the machine.

Examples of emergency stop devices are:

a. **Pushbutton –** Pushbutton-type emergency stop devices must be installed so that it is unobstructed and can be actuated by the palm of the hand. The actuator of a pushbutton-operated device must be of the palm or mushroom-head type.
b. **Foot operated devices –** The base of the foot-operated device must be anti-slip or capable of being permanently mounted. It must not create a trip hazard.
c. **Tripwire, cable, or bar –** A safety tripwire, cable or bar is a device located near the danger area of a machine. When pulled or pressed by the operator, the device deactivates the

machine. The operator must be able to reach the device during emergency situations, so proper position is critical.

All emergency stop devices must be colored red. The background immediately around devices and disconnect switch actuators used as emergency stop devices must be colored yellow. The red/yellow combination is reserved exclusively for the emergency stop and emergency switching off applications.

6) Energy Isolation

When operators are required to place any part of their body into a hazardous zone, procedures for shutdown, energy isolation, and lockout/block out/tag out must be established and followed.

If servicing or adjustment operations must be performed with the power on, separate written procedures must be developed to protect employees during these situations.

7) Feeding and Ejection Methods

Many feeding and ejection methods do not require operators to place their hands in the danger area. In some cases, no operator involvement is necessary after the machine is set up. In other situations, operators can manually feed the stock with the assistance of a feeding mechanism. Properly designed ejection methods do not require operator involvement after the machine starts to function. Using feeding and ejection methods does not eliminate the need for safeguarding. Guards and other devices must be used wherever they are necessary to provide protection from hazards. Feeding and ejection methods can be automatic or semiautomatic.

8) Guarding by Location/Distance

To consider a part of a machine to be safeguarded by location, the dangerous moving part of a machine must be located in areas that are not accessible to operators or personnel and do not present a hazard during the normal operation of the machine.

This may be accomplished by using enclosure walls or fences. Another possible solution is to have dangerous parts located high enough to be out of the normal reach of any worker. Locating a machine in a separate and restricted access area *may* qualify as guarding by location if a proper risk assessment is complete.

9) Hand-Feeding & Retrieval Tools

Hand-feeding and retrieval tools can place or remove stock. Hand-feeding tools are intended for placing and removing materials into the in the danger area of a machine. Hand-feeding tools are not a point-of-operation guard or protection device and shall not be used in lieu of appropriate safeguards, but as a supplement. A typical use would be for reaching in the danger area of a press or press brake. Another example would be a push stick or block used when feeding stock into a saw blade. When it becomes necessary for hands to be in close proximity to the blade, the push stick or block may provide a few inches of safety and prevent a severe injury.

10) Shields

Shields can protect workers from flying particles, chips, sparks, and oils, but do not provide protection from machine hazards. Shields must not interfere with the workers ability to operate the machine or reduce the operator's field of vision.

11) Signs, Labels and Color Coding

Color-coding certain parts of a machine will make the employee aware of potentially hazardous conditions. Orange should be used to identify hazardous parts of the machines, such as exposed edges, pulleys, gears, rollers, cutting devices, power jaws, etc. Yellow should be used to identify physical hazards such as striking against, stumbling, falling, and caught in-between.

Warnings, stickers, labels and safety reminders should be affixed to highlight the dangerous areas.

Equipment-specific operating procedures should be established and posted on/near each machine. If possible, have the equipment's operating manual available to workers.

I. Guard Construction

Guards must be constructed of substantial material so they can withstand the vibration, shock, and wear to which they will be subjected during normal operation. Guards are usually constructed of metal, impact-resistant plastic, woven wire mesh, or wood (good for corrosive environments). One type of material is not necessarily superior to the other, as long as it meets the performance objective of the guard.

To be effective, they must safeguard the employee while allowing the work to continue with minimal disruption to the production process. Guards should be hinged or have sliding or removable sections to allow for the admission of oil and lubricants, change belts, and to make adjustments. Guards should be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible.

A machine guard should not have any shear points, sharp edges, or unfinished surfaces which could cause lacerations. If a machine guard creates a new hazard, it defeats its own purpose.

1) Manufacturer & Aftermarket versus Homebuilt Guards

Manufacturers of many single-purpose machines provide point-of-operation and power-transmission safeguards as standard equipment. Unfortunately, not all machines in use have built-in safeguards provided by the manufacturer. In these cases, it is necessary to purchase aftermarket guards or fabricate them.

The table below discusses the advantages and disadvantages of both manufacturer built and user-built guards.

Guards Designed and Built by The Manufacturer	
Advantages	**Disadvantages**
• They usually conform to the design and function of the machine. • They can be designed to strengthen the machine in some way or to serve some additional functional purposes.	• They can be cost-prohibitive. • They are subject to availability – the manufacturer may no longer be in business or offer guards for older models.

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2) Safeguarding Assessment

When conducting a machine guarding assessment, it is imperative to analyze all potential hazards associated with normal operating procedures: start-up, shutdown, setup, inspection, servicing, maintenance and lockout/tag out. It is also important to consider unusual operations, equipment malfunction, broken tooling, and foreseeable misuse of the equipment.

Similar machines may be used as a starting point when tasks and hazards are comparable. Using this information does not eliminate the need to follow a risk assessment process for the specific conditions of use. For example, when a shear used for cutting plastic is compared with a shear used for cutting metal, the risks associated with the different materials should be assessed.

The extent of safeguarding needs can vary based on numerous factors, such as degree of exposure and the potential for harm. The necessity for guarding equipment used by inexperienced operators exceeds what would typically be required in a professional shop. A basic risk assessment can assist with determining this extent.

The assessment should be conducted using logical deduction and a qualitative assessment of the following:

a) Who is exposed?

Machines used by students should be given the most safeguards, while professional equipment used by seasoned machinist may be outfitted with the minimal amount required for compliance. For example, a lathe used primarily by students should be guarded with a lead screw cover; this is not normally seen or accepted in a professional shop. If the equipment is used by both students and professionals, guard for the riskiest population.

b) How many people use the equipment?

Multiple users increase the chances that equipment could be set-up incorrectly or poorly maintained. The more people who use the equipment, the more the equipment is exposed to a variety of worker behaviors.

c) What is the experience level and knowledge of the average user?

Operators who have little or no prior experience are at a higher risk of injury and would benefit from additional safeguards.

d) What is the frequency and duration of equipment use?

The more a piece of equipment is used, the probability that an accident will occur increases. On the opposite end of the spectrum, operators who rarely use a piece of equipment may be at an increased risk of injury because they may forget the specifics of operation or nuances of the machine.

e) What is the probability that an accident will occur?

Additional safeguarding methods should be applied when the probability of an accident, incident or mishap is imminent or extremely likely.

f) What would be the severity of an accident?

The areas and opportunities to cause serious injuries or illnesses should be given the most consideration.

J. Administrative Procedures

1) Training

Employees/Students who operate machines with hazards due to moving parts must be trained on these hazards and their safeguards. Employees/Students must be trained upon initial assignment or when any new guards are put in place. Training should include the following:

- Identification and description of the hazards associated with the machine;
- The guards, how they provide protection, and the hazard for which they are intended;
- Precautions to take when machine is unguarded during maintenance and repair: and
- What to do and who to contact if a guard is damaged, missing, or defective.

Retraining should be provided whenever:

- There is a change in job assignments.
- A change in machines, equipment, or processes that presents a new hazard.
- An inspection reveals, or whenever the employer/shop manager/PI has reason to believe, that there are deviations from or inadequacies in the employees'/students' knowledge of related procedures.

- An injury or near-miss occurs related to a machine guarding hazard or deficiency which provides a learning opportunity for affected personnel.

6. Incident Reporting and Investigation

A. Reporting of Incidents/Emergencies

All incidents/accidents involving machine/equipment must be reported immediately to the PI/instructor/supervisor/ manager and EHS in accordance with the University process for Incident Reporting and Investigating (EOSM-108). The incidents should be reported using the appropriate incident reporting form available on EHS website.

KSU employees, students and contractors must report:

a. Incidents resulting in injury or illness.

b. Incidents or near misses with no injuries.

c. Incidents resulting in environmental damage (e.g. – chemical released into storm drain, contamination of soil, etc.).

d. Incidents resulting in property damage.

e. Each situation or condition observed on the job which has the potential for injuring or endangering the health of people and/or causing damage to property or environment.

Serious incidents or incidents requiring immediate medical attention should be reported immediately by calling the campus emergency number 470-578-6666 (Ext.6666) or 911. Serious accidents for this purpose are those which result in:

a) Fatality.
b) Hospitalization or medical treatment (beyond first-aid) for both KSU's and non-KSU personnel.
c) Fire.
d) Property damage exceeding $1,000.00.

All other incidents must be reported in writing within 24 hours of becoming aware of the incident, injury or illness.

The PI/supervisor/manager must assist EHS personnel with investigations and reports as required.

B. Minor First Aid

First Aid kits should be available in the shop and stocked with essential supplies. Essential supplies should include at minimum various sizes of adhesive bandages, gauze, sterile pads, forceps, scissors, tape, antiseptic wipes and a cold pack. The following guidelines should be followed when administering minor first aid:

I. Do not dispense or administer any medications, including aspirin.
II. Do not apply any ointments or creams to cuts or wounds. Use cool water.

7. Record Keeping Requirements

Each department is responsible for maintaining their own records.

If modifications are made to the machine, keep all documentation (drawings, specs, receipts, etc.) for as long as the equipment is in service or owned by KSU.

Retain all training records for ten years after the person has retired or left University employment. For students, retain records for ten years after the student’s projected graduation date.