

Safety Manual

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| Subject: Machine Guarding | Number: |
| Date: August 1, 2017 | Amends: None |
| Supersedes: | Page 1 of 7 Pages |
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Machine Guarding

Purpose: This policy is to establish requirements for the safety of North Carolina Agricultural and Technical State University employees while working near machinery with hazardous moving parts. The purpose of machine guarding is to protect the machine operator and other employees in the work area from hazards created by ingoing nip points, rotating parts, flying chips and sparks. There are as many hazards created by moving parts as there are types of machines. Safeguards are essential for protecting workers from needless injuries.

Scope: Any machine part, function, or process which may cause an injury must be safeguarded. Hazards must be eliminated or controlled when there is the potential for the operations of a machine or accidental contact with it that can injure the operator or other employees working on, near, or around the machine.

Responsibilities

EHS: EHS is responsible for reviewing hazards associated with machine safeguarding during annual shop inspections. The machine safeguards will be reviewed to make sure they are installed on machines that they are needed, in good working order, suitable for the jobs they are used for, and do not pose a hazard to the operator. EHS is responsible for reviewing and updating the Machine Safeguarding Policy. EHS and Supervisors also work jointly in the development of Job Safety Analysis for machine safeguarding that present a unique hazard to the employee.

Supervisor and Employee: Supervisor-led training is required upon employment for employees who operate machines that are equipped with machine safeguarding equipment. An excellent means of conducting this training is to develop a Job Safety Analysis that covers the pertinent information on how to properly and safely use these types of tools and equipment with machine safeguards.

**If an employee is performing maintenance on a piece of equipment that requires the removal of the machine safeguard, that employee is required to secure the machine safeguard back in place before turning the machine back on.

General

One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying objects/chips/metal, and sparks (i.e. Barrier guards, two-hand tripping devices, electronic safety devices, etc.).

A wide variety of mechanical motions and actions may present hazards to the employee. These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any part that may impact or shear. These different types of hazardous

mechanical motions and actions are basic to nearly all machines, and recognizing them is the first step toward protecting employees from the dangers they present.

General requirements for all machines: Guards shall be affixed to the machine where possible. The guard(s) shall be secured elsewhere if for any reason attachment to the machine is not possible. The guard(s) shall be designed and attached in such a way that it does not present an accident hazard. Where mechanical hazards occur, it is required for areas located on the equipment to have a safeguard.

The point of operation: The point of operation is the point on the machine where work is being performed on materials, such as cutting, shaping, drilling, boring, and/or forming of stock.

- Point of operation guards shall be in conformity with all appropriate standards.
- If specific standards are not available, the machine shall be designed and constructed to prevent the operator from having any part of their body in the danger zone during the operating cycle.
- Examples of Machines that Require Point of Operation Guarding: Portable power tools, powered saws, jointers, drill presses, guillotine cutters, power presses, shears, etc.
- Barrels, Containers, and Drums: Revolving drums, barrels, and containers shall be guarded by an enclosure which is interlocked with the drive mechanism, so that the barrel, drum, or container cannot revolve unless the guard enclosure is in place (i.e. Cement/mortar mixer).

Fan blade exposure: When the periphery of the blades of a fan is less than seven (7) feet above the floor or working level, the blades are required to be guarded. The guard shall have openings no larger than one-half (1/2) inch (i.e. – Exhaust fans, window fans, portable fans, wall-mounted fans, industrial strength fans, etc.).

Anchoring fixed machinery: Machines designed for a fixed location shall be securely anchored to prevent the machine from walking or moving from its designated location when it is in use. Operational controls: These are also called 'Other Moving Parts' which refers to all parts of the machine which move while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Awareness of hazardous motions and actions

Motions:

Rotating Motion

Rotating shafts can grip hair and clothing. Through minor contact rotating shafts can force the hand, arm, or any other body part into a dangerous position. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts. Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms which may be hazardous.

In-Running Nip Points

These hazards are caused by rotating parts on machinery. There are 3 main types of in-running nip points:

- Parts can rotate in opposite directions while their axes are parallel to each other. These parts can either be in contact with one another or within close proximity.

Examples of parts that rotate in opposite directions are gears, rolling mills, and calendars.

- Nip points are also created between rotating and tangentially moving parts. Examples of this type 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 also occur between rotating and fixed parts which create a shearing, crushing, or grinding action. Several examples of this include spoked handwheels or flywheels, screw conveyors, or the periphery of an abrasive wheel and an incorrectly adjusted work rest and tongue.

Reciprocating Motions

Can be hazardous because, during the back-and-forth or up-and-down motion, the employee may be struck by or caught between a moving part and a stationary part. An example of this would be a mechanical or manual break for bending sheet metal.

Transverse Motion

This refers to movement in a straight and continuous line. This type of motion creates a hazard because the employee may be struck or caught in a pinch or shear point by the moving part. An excellent example of a transverse motion would be a stationary belt sander.

Actions:

Cutting Action

This type of 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, face, and eyes. These hazards are present at the point of operation when cutting wood, metal, or other materials. Several examples of mechanisms involving cutting hazards include bandsaws, circular saws, boring and drilling machines, turning machines (lathes), or milling machines.

Punching Action

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

Shearing Action

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

Bending Action

This occurs when power is applied to a slide to draw, turn, or stamp metal or other materials into a specified shape. 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 hydraulic tube benders.

Proper measures to take when implementing safeguards: (All Safeguards Must Meet the Following Requirements).

Prevent Contact

The safeguard must prevent hands, feet, arms, legs, or any other part of the body from contacting dangerous moving parts. A good safeguard system eliminates the possibility of the operator or another employee placing his hands near hazardous moving parts. The best practice is to interlock machine control and guards so the machine is inoperable unless the guards are in place.

Be Secured to the Machine

Employees should not be able to remove or tamper with the safeguard, since a safeguard that can easily be made ineffective is not a safeguard at all. Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must be firmly secured to the machine.

Protect from Falling Objects

The guard should ensure that no objects can fall into moving parts. Example: A small tool which dropped into a machine that is spinning in a cyclical motion could cause the object to easily become a projectile that could strike someone.

Does NOT Create a New Hazard

A safeguard defeats its own purpose if it creates a hazard of its own, such as a shear point, a jagged edge, or an unfinished surface which can cause lacerations. The edges of guards should be rolled or bolted in such a way that they eliminate sharp edges.

Does NOT Create Interference

Any safeguard which impedes the employee from performing the job quickly and comfortably may be used improperly to make the job easier or even discarded while the work is being conducted. Proper safeguarding can actually enhance efficiency by relieving the stresses placed on the employee of thinking about the possibility of an injury when using an unguarded or improperly guarded piece of equipment.

Allows for Safe Lubrication

If possible, the employee should be able to lubricate or service the machine with the safeguard in place. Locating oil reservoirs outside the guards with lines leading to the lubrication points will reduce the need for the operator or maintenance employee to enter the hazardous area.

Other recommended aides:

An **awareness barrier** serves as a reminder to a person that he or she is approaching the danger area. Even though the barrier does not physically prevent an employee from entering the danger area, it calls their attention to it. For an employee to enter the danger area, an overt act must take place, that is, the employee must either reach or step over, under or through the barrier.

An example of an awareness barrier would be a highly visible tape placed on a table saw a few inches away from the point of operation.

**Awareness barriers are not considered an adequate means of prevention when continual exposure to the hazard exists.

Special hand tools for placing and removing material can be used to permit easy handling of material without the operator placing a hand in the danger zone (i.e. – Push stick, push block, etc.). However, these types of tools shall not be used in the place of other required guards, but can only be used to supplement protection provided.

Guard construction: Most manufacturers of today's machinery provide point of operation and power transmission safeguards, but not all machines that are used in the various shops at the University have built in safeguards by the manufacturer. Always check with the manufacturer of the machine to see if they also produce safeguards for that particular machine. Guards designed and installed by the builder/manufacture offer two main advantages:

- 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.

However, user built guards are sometimes necessary since guards may not be produced for a specific piece of machinery or because the machinery may pre-date safeguard use.

Machinery maintenance and repair: Having superior maintenance and repair procedures in place to reduce hazards can contribute significantly to the safety of University maintenance personnel and machine operators. The following 4 things can make safe maintenance and repair work difficult:

- The variety and complexity of machines to be serviced.
- The hazards associated with their power sources.
- The special dangers that may be present during machine breakdown.
- The severe time constraints often placed on maintenance personnel.

If possible, machine design should permit routine lubrication and adjustment WITHOUT removal of safeguards. The Lockout/Tagout procedure of 29 CFR 1910.147 must be adhered to when safeguards must be removed in order to work on mechanical parts or have the machine serviced. Example: If it is necessary to oil machine parts while the machine is running, special safeguarding equipment may be needed solely to protect the oiler from exposure to hazardous moving parts.

Prevent hazards while servicing machines: The maintenance and repair crew must never fail to replace the guards before the job is considered finished and the machine released from Lockout/Tagout. The following safeguarding measures should be taken in order to prevent hazards while servicing machines:

- Notify all affected employees (usually machine or equipment operators or users) that the machine or equipment must be shut down to service the machine or perform maintenance.
- Stop the machine.
- Isolate the machine or piece of equipment from its energy source.
- Lockout/Tagout the energy source.
- Relieve any stored or residual energy.
- Verify that the machine or equipment is isolated from the energy source.

The following list is exceptions to the above general rules regarding safeguarding measures that should be taken in order to prevent hazards:

- When the servicing or maintenance is not hazardous for an employee.
- When the servicing which is conducted is minor in nature.

- Done as an integral part of production.
- The employer utilizes alternative safeguards which provide effective protection as required by 29 CFR 1910.212 or other specific standards.

Return the machine or piece of equipment to service: When the servicing or maintenance is completed, there are specific steps which must be taken to return the machine or piece of equipment to service. These steps include:

- Inspection of the machine or equipment to ensure that all guards and other safety devices are in place and functional,
- Checking the area to ensure that energization and start up of the machine or equipment will not endanger employees,
- Removal of the lockout devices,
- Re-energization of the machine or equipment, and
- Notification of affected employees that the machine or equipment may be returned to service.

******The danger of accident or injury is greatly reduced by shutting off and locking out/tagging out all sources of energy.

Training: Even the most elaborate safeguarding system cannot offer effective protection unless the employee knows how to use it and why. Specific and detailed training is therefore a crucial part in any effort to provide machine safeguarding against machine-related hazards. Thorough employee training should include instructions or hands-on training for the following items:

1. Description and identification of the hazard(s) associated with the machine.
2. The safeguards themselves, how they provide protection, and the hazard(s) for which they are intended to guard.
3. How and under what circumstances safeguards can be removed, and who may remove them. (i.e. – Maintenance personnel ONLY, a qualified employee in the shop, etc.) Also, employees should also be trained in the precautions to take while the system is unguarded (i.e. – Lockout/Tagout, de-energized equipment, etc.).
4. Maintenance personnel must be trained in knowing which machines can be serviced while running and which ones need to be de-energized (lockout/tagout).
5. Employees need to also be trained in the scenarios of what to do if a guard is damaged, missing, or unable to provide adequate protection. (i.e. – Contact the supervisor, place a work order, contact EHS if a guard has never been in place and the employee/supervisor is unsure if one needs to be in place, etc.)
6. Supervisors or the designated employee in charge of administering Machine Guard training must turn in a copy of all training documents and roster sheets to the Department of Environment, Health, and Safety for recordkeeping.

OSHA-specific requirements: OSHA has outlined some specific detailed safe guarding and hazard recognition requirements for the equipment that is listed below. The Supervisor should review the OSHA sections that apply to their specific tools and needs, and prepare a Job Safety Analysis for employees to follow when utilizing or working around the equipment covered in the below sections:

- A. Woodworking Machinery OSHA 1910.213: Provides specific information that pertains to the following wood working items:
 1. General Machine Construction
 2. Machine Controls and Equipment
 3. Hand-fed Ripsaws

4. Hand-fed Crosscut Table Saws
 5. Circular Resaws
 6. Self-feed Circular Saws
 7. Swing Cutoff Saws and Sliding Cutoff Saws
 8. Radial Saws
 9. Bandsaws and Band Resaws
 10. Jointers
 11. Tenoning Machines
 12. Boring and Mortising Machines
 13. Wood Shapers and Equipment Similar to Wood Shapers
 14. Planing, Molding, Sticking, and Matching Machines
 15. Profile and Swing-head lathes and Wood Heel Turning Machines
 16. Sanding Machines
 17. Veneer Cutters and Wringers
 18. Other Types of Wood Working Machines (Miscellaneous)
 19. Inspection and Maintenance of Woodworking Machines
 - a. OSHA Machine Guarding e-Tool for Saws
- B. Abrasive Wheel Machinery OSHA 1910.215: Covered in 'IMAC Hand and Portable Power Tool Safety' Section of EHS Manual (Pages 15 – 16).
- C. Mechanical Power Press OSHA 1910.217: Some of this information is covered in the IMAC Machine Guarding Section of the EHS Manual. However, OSHA 1910.217 provides more in-depth information on the various components/guards for mechanical power presses, machine guards and safeguards for the components of mechanical power presses, and specific types of operating controls that should be in place to ensure the safety of the employee.
 1. OSHA Machine Guarding e-Tool for Presses
- D. Mechanical Power Transmission Apparatus OSHA 1910.219: Some of this information is covered in the IMAC Machine Guarding Section of the EHS Manual. However, OSHA 1910.219 provides more in-depth information on safeguarding the components of the mechanical power transmission system which transmits energy from the prime mover to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.