TEAMSTERS Safety & Health FACTS
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MACHINE GUARDING

Hazards of Unguarded Machines

Workers are exposed to unguarded or inadequately guarded machines in many workplaces. According to OSHA, workers who operate and maintain machinery suffer approximately 18,000 amputations, lacerations, crushing injuries, abrasions, and over 800 deaths per year. Amputation is one of the most severe and crippling types of injuries in the occupational workplace, and often results in permanent disability. Machine guarding and related violations continuously rank among the top ten OSHA citations. The purpose of machine guarding is to protect the machine operator and other workers in the work area from hazards created by ingoing nip points, rotating parts, flying chips and sparks.

Occupational Safety and Health Regulations (OSHA)

The employer is responsible for protecting workers from any machine part, function, or process, which may cause injury and should consider this need when purchasing machinery. New machinery is usually available with safeguards installed by the manufacturer. Appropriate safeguards can also be purchased separately or built in-house.

The Occupational Safety and Health Administration (OSHA) requires that machine guarding be provided and maintained in a manner sufficient to protect machine operators and other persons present in machine areas from hazards associated with the operation of machines. Such hazards include those created by points of operation, in-going nip points, rotating parts, flying chips and sparks.

OSHA has established requirements for guarding fixed machinery and portable tools in several standards in Title 29 of the Code of Federal Regulations (CFR):

- 29 CFR Part 1910 Subpart O covers machinery and machine guarding, including general requirements for all machines, and specific requirements for woodworking machinery; abrasive wheel machinery; mills and calendars in rubber and plastics industries; mechanical power presses; forging machines; and mechanical power-transmission apparatus. 29 CFR Subpart P addresses hand and portable powered tolls and other hand-held equipment guarding of portable powered tools;

- 29 CFR 1926 Subpart I covers hand and powered tools in the construction industry.
- 29 CFR Part 1928 Subpart D covers agricultural equipment;
- 29 CFR Part 1915 Subparts C, H, and J; 29 CFR Part 1917 Subparts B, C, and G; and
- 29 CFR Part 1918 Subparts F, G, and H cover maritime operations.

Hazardous Machine Parts

All machines consist of three fundamental areas; the point of operation, the power transmission device, and other moving parts. Each of these components can present hazards that require safeguarding:

- **The point of operation:** The point on the machine where work is performed on the material, such as cutting, shaping, boring, or forming of stock.
- **Power transmission apparatus:** 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, cranks, and gears.
- **Other moving parts:** 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.

Besides normal operation, the following activities involving stationary machines also expose workers to potential amputation hazards: setting-up, threading, preparing, adjusting, cleaning, lubricating, and maintaining machines as well as clearing jams.

Machine Guarding Requirements

Safeguards must be installed and maintained so that they meet these minimum general requirements:

- **Prevent contact:** A good safeguarding system eliminates the possibility of the operator or another worker making contact with dangerous moving parts.
- **Secure:** Operators should not be able to easily remove or tamper with the safeguard, because a safeguard that can easily be made ineffective is no 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 safeguard should ensure that no objects could fall into moving parts. A small tool dropped into a cycling machine could easily become a projectile that could strike and injure someone.
- **Create no new hazards:** A safeguard defeats its purpose if it creates a hazard such as a shear point, a jagged edge, or an unfinished surface that could cause a laceration. The edges of guards, for instance, should be rolled or bolted in such a way to eliminate sharp edges.
- **Create no interference:** Any safeguard that impedes an operator from performing the job quickly and comfortably might soon be overridden or disregarded. Proper

safeguarding may actually enhance efficiency since it relieves the operator's apprehensions about injury.

- **Allow safe lubrication:** If possible, workers should be able to lubricate the machine without removing the safeguards. Locating oil reservoirs outside the guard, with a line leading to the lubrication point, will reduce the need for the operator or maintenance operator to enter the hazardous area.

Types of Machine Guards

The OSHA standard (29 CFR 1910.212) requires that "One or more methods of machine guarding shall be provided to protect the operator and other workers in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips and sparks…."

Despite all machines having the same basic components, their safeguarding needs widely differ due to varying physical characteristics and operator involvement. The following equipment and devices are examples of how workers who operate and maintain machinery may be protected:

(1) Guards are physical barriers which prevent access to dangerous areas. There are four general types of guards:

- **Fixed:** A guard that is secured to the machine, where possible, and prevents entry of operator's hands or fingers into the point of operation. The guard is usually preferable to all other types because of its relative simplicity.
- **Interlocked:** When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, the moving parts of the machine are stopped, and the machine cannot cycle or be started until the guard is back in place.
- **Adjustable:** Provides a barrier that may be adjusted to facilitate a variety of production operations.
- **Self-adjusting:** Provides a barrier that moves according to the size of the stock entering the danger area.

(2) Safety Devices help prevent contact with points of operation and may replace or supplement guards. Devices can interrupt the normal cycle of the machine when the operator’s hands are at the point of operation, prevent the operator from reaching into the point of operation, or withdraw the operator’s hands if they approach the point of operation when the machine cycles:

- **Photoelectric (optical), Radiofrequency (capacitance), or Electromechanical Sensing** devices use light, radio beam, and probe or contact bar to interrupt the machine’s operating cycle prevent or stop operation of the machine if a hand or any part of the body is in the danger area.
- **Pullback** devices utilize a series of cables attached to the operator's hands, wrists, and/or arms that assure withdrawal of the hands from the point of operation.
- **Restraint (holdout)** devices utilize cables or straps that are attached to the operator's hands at a fixed point. The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area.

- **Safety Trip Controls** rely on a pressure-sensitive body bar to provide a quick means for deactivating the machine in an emergency situation. If the operator or anyone trips, loses balance, or is drawn toward the machine, applying pressure to the bar will stop the operation.
- **Two-Hand Trip and Two-Hand Controls** require concurrent use of both of the operator's hands on control buttons to activate the machine, thus preventing the hands from being in danger area when machine cycle starts.
- **Gates** are moveable barriers that protect the operator at the point of operation before the machine cycle can be started. To be effective, the gate must be interlocked so that the machine will not begin a cycle unless the gate guard is in place.

(3) Automatic or Semi-automatic Feeding and Ejection Methods eliminate the need for the operator to place his or her hands in the danger area. Using these feeding and ejection methods does not eliminate the need for guards and devices.

(4) Miscellaneous Aids do not give complete protection from machine hazards but they may provide the operator with an extra margin of safety. Sound judgment is needed in their application and usage:

- **Special hand tools** may be used to place or remove stock, particularly from or into the point of operation of a machine.
- **Awareness sign or barrier** serves as a reminder to a person that he or she is approaching the danger area but it does not physically prevent a person from entering the danger area.

Training

Even the most elaborate safeguarding system cannot offer effective protection unless the operator knows how to use it and why. Specific and detailed training is therefore a crucial part of any effort to provide safeguarding against machine-related hazards. This kind of safety training is necessary for new operators and maintenance or setup personnel, when any new or altered safeguards are put in service, or when operators are assigned to a new machine or operation. One of the most effective ways to communicate machine safety is to use examples of accidents of near misses involving machines that are located at the workplace.

Thorough operator training should involve instruction or hands-on training in the following areas:

- A description and identification of the hazards associated with the machine(s);
- A description of the safeguards, the hazards for which they are intended, and how they provide protection;
- Instruction on how to use the safeguards and why;
- Instruction on how and under what circumstances safeguards may be removed, and by whom (in most cases, repair or maintenance personnel only);
- When a lockout/tagout program is required; and
- Instruction on what to do (e.g., contact the supervisor) if a safeguard is missing, damaged, or unable to provide adequate protection.

Protective Clothing and Personal Protective Equipment

Engineering controls, such as the guards and devices described above, are the first choice for eliminating machine hazards because they eliminate the hazard at the source and do not rely on the operator's behavior for their effectiveness. But whenever engineering controls are not available or are not fully capable of protecting the operator, operators must wear protective clothing or personal protective equipment (See IBT Safety and Health Fact Sheet on *Protect Yourself with Personal Protective Equipment*). Certain protective coveralls, jackets, vests, aprons, and full-body suits can guard the trunk of the body from cuts or impacts from heavy or rough-edged stock. Operators can also protect their hands and arms from the same kinds of injury with special sleeves and gloves.

It is important to note that protective clothing and equipment may create hazards. A protective glove that can become caught between rotating parts, or a respirator facepiece that hinders the wearer's vision, for example, require alertness and continued attentiveness whenever they are used.

The operator's clothing may present additional safety hazards. For example, loose-fitting shirts might become entangled in rotating spindles or other kinds of moving machinery. Jewelry, such as bracelets and rings, can catch on machine parts or stock and lead to serious injury by pulling a hand into the danger area.

Machinery Maintenance and Repair

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, and the severe time constraints often placed on maintenance personnel all make safe maintenance and repair work difficult. If possible, machine design should permit routine lubrication and adjustment without removal of safeguards. But when safeguards must be removed, and the machine serviced, the lockout procedures mandated by OSHA in 29 CFR 1910.147 must be adhered to (See IBT Safety and Health Fact Sheet on *Control of Hazardous Energy Sources, Lockout/Tagout*). While this is the general rule, there are exceptions when the servicing or maintenance is not hazardous for a worker, or when the servicing which is conducted is minor in nature, is done as an integral part of production, and the employer utilizes alternative safeguards which provide effective protection.

The maintenance and repair crew must never fail to replace the guards before the job is considered finished and the machine released from lockout. In order to prevent hazards while servicing machines, each machine or piece of equipment should be safeguarded during the conduct of servicing or maintenance by:

1. Notifying all affected workers (usually machine or equipment operators or users) that the machine or equipment must be shut down to perform some maintenance or servicing;
2. Stopping the machine;
3. Isolating the machine or piece of equipment from its energy source;

4. Locking out or tagging out the energy source;
5. Relieving any stored or residual energy; and
6. Verifying that the machine or equipment is isolated from the energy source.

For More Information:

For more information, please contact the Safety and Health Department at (202) 624-6960, or see OSHA publications: *Concepts and Techniques of Machine Safeguarding* (OSHA 3067), and *Safeguarding Equipment and Protecting Workers from Amputations* (OSHA 3170), *A Guide for Protecting Workers from Woodworking Hazards* (OSHA 3157), and *Amputation* Fact Sheet.
A checklist on machine guarding may be found in *Concepts and Techniques of Machine Safeguarding* (OSHA 3067), http://www.osha.gov/Publications/Mach_SafeGuard/checklist.html.