Chapter 25: Machine and Portable Tools

Quick Start Summary

The requirements of Machine and Portable Tools apply to workers, supervisors, machine and shop custodians, and building and area managers. They cover the procurement, safeguarding, use, and maintenance of machine and portable (both power and hand) tools.

1 Who needs to know about these requirements

The requirements of Machine and Portable Tools apply to workers, supervisors, machine and shop custodians, and building and area managers. They cover the procurement, safeguarding, use, and maintenance of machine and portable (both power and hand) tools.

2 Why

Machine and portable tools pose various hazards: striking or contacting part of the body with the tool (including rotating parts, exposed gears, cutting tools and blades, point(s) of operation), the work piece, or projectiles coming off them; exposure to noise, dust, and chemicals; and exposure to hazardous energies.

3 What do I need to know

The federal regulations require that machine and portable tools be provided to workers in safe condition, operated safely, and maintained in a safe condition. In addition, machine guarding and other safeguards must 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.

- Workers must use the right tools for the job; be trained and authorized to use the tools; inspect tools before each use; and follow all requirements when using tools. With machine tools this includes demonstrating machine-specific competency, following shop- and machine-specific safety rules, and not working alone unless specifically allowed by the safety rules.
- Shop custodians must make sure all machine tool users are authorized and follow requirements in their shops; machine custodians must ensure machine tools are properly safeguarded, inspected, and maintained and must communicate requirements to workers.

4 When

These requirements take effect 17 December 2018.

5 Where do I find more information

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 25, “Machine and Portable Tools”

Or contact the program manager.
Chapter 25

Machine and Portable Tools

1 Purpose

The purpose of this program is to ensure the safe use of machine and portable (both power and hand) tools. It covers the procurement, safeguarding, use, and maintenance of such tools. It applies to workers, supervisors, machine and shop custodians, and building and area managers.

2 Roles and Responsibilities

Functional roles and general responsibilities for each are listed below. More detailed responsibilities and when they apply are provided in the procedures and requirements.

The roles may be performed by one or more individuals and one individual may play more than one role, depending on the structure of the organizations involved. Responsibilities may be delegated.

2.1 Worker

As a portable (hand and power) tool user

- Only uses tools for which he or she has the training to use safely, knows their limitations and hazards, and has been properly authorized
- Uses tools according to training and authorization. If using a power tool, makes sure the tool has proper guards.
- Uses the appropriate tool for the task
- Always visually inspects tools before use and removes from service any found to be defective. Tags the tool OUT OF SERVICE and notifies supervisor.
- Stops work immediately if a tool becomes damaged
- Practices good housekeeping
- Maintains tools in his or her care and stores them safely
- Wears personal protective equipment (PPE) as required

As a machine tool user, in addition to the requirements above,

- Completes any required training and/or demonstrates competency in safe machine tool operation before using equipment (see Section 4, “Training”)

Is knowledgeable of safety requirements and machining guidelines and adheres to them, including following shop-specific safety rules and meeting machine-specific competency standards

Works alone only if allowed by shop-specific safety rules or the machine-specific competency standard. If working alone notifies someone (the shop custodian or supervisor, for example).

Understands and practices approved machine safeguarding methods

Does not defeat or remove safety devices or guards or operate machines without safeguards in place and in proper working order

Reports machine safeguarding malfunctions or problems to supervisor and machine custodian immediately

Reports unauthorized or unsafe use of machine tools if observed

2.2 Supervisor and Manager

Authorizes workers to use only the tools that they are qualified to use/operate

Provides personal protective equipment (PPE) as needed

Exercises disciplinary action or restricts access to tools when workers fail to follow safety requirements

2.3 Shop Custodian

Is assigned by line management

Is responsible for the safe operation of assigned shop and the equipment therein

Is responsible for developing shop-specific safety rules

Determines if a machine tool requires a second person, in addition to the operator, to be present while in use. For this purpose, “present” means that the second person would know if the machine operator needs emergency assistance. The determination must be documented in shop-specific safety rules or the machine-specific competency standard.

Ensures machine tool users are qualified and competent in the proper and safe operation of machine tools before authorizing machine access

Secures machining areas and equipment to prevent unauthorized use of machine tools

Ensures authorized machine tool users fulfill their responsibilities

Contacts the machine tool user’s supervisor and restricts access when the user fails to follow safety requirements

Is authorized to exclude workers from the shop who do not follow proper safety and housekeeping practices

2.4 Machine Custodian

Is assigned by line management

Ensures machines are properly safeguarded, guards remain in place, and are functional
Conducts inspections to ensure that hand, power, and machine tools are in safe operating condition. Inspection frequency is determined by the directorate of the machine custodian.

Communicates machine-specific safety practices and rules to authorized personnel

Enforces machine use authorization procedures, rules, and training and competency standards as they apply to safe machine tool use

Corrects machine safeguard deficiencies immediately or prevents access to the machine until repaired

Arranges for maintenance and repair or replacement of machines and tools

2.5 Area / Building Manager

Attends to any facility infrastructure issues in shops

Refers any machine-related issues to the shop or machine custodian

2.6 Machine and Portable Tools Program Manager

Assists in the interpretation of standards in support of compliance and safety improvement efforts, when requested

3 Procedures, Processes, and Requirements

These documents list the core requirements for this program and describe how to implement them:

- **Machine and Portable Tools: Portable Tool Requirements** (SLAC-I-730-0A21S-027). Describes requirements for procuring, safeguarding, using, and maintaining portable tools

- **Machine and Portable Tools: Machine Tool Requirements** (SLAC-I-730-0A21S-056). Describes requirements for procuring, safeguarding, using, and maintaining machine tools

- **Machine and Portable Tools: Machine Safeguarding Requirements** (SLAC-I-730-0A21S-005). Describes requirements for safeguarding machine tools

- **Machine and Portable Tools: Machine Safeguarding Anti-restart Device Requirements** (SLAC-I-730-0A21S-006). Describes requirements for anti-restart devices on electric power tools

These documents provide useful guidance; their use is not mandatory:

4 Training

4.1 Worker

4.1.1 General

The following training requirements are general. Workers will also be required to demonstrate machine-specific competency (see below). Additional training may also be required depending on the task, for example for workers involved in electrical work or dealing with hazardous wastes; these requirements are documented in chapters covering those hazards (see Section 6.2, “Related Documents”).

Workers caring for, inspecting, operating, or maintaining any machinery containing moving parts with rotating, transverse, or reciprocation action will complete

- ESH Course 136, Control of Hazardous Energy - Affected Employee (ESH Course 136)
- ESH Course 198, Machine Guarding Safety Training (ESH Course 198)

4.1.2 Powder-actuated Tools

Workers who use a powder-actuated tool must receive training from someone with both sufficient knowledge regarding the tool and sufficient training ability to successfully convey the information. Completion of such training is recorded using the following course:

- ESH Course 301, Powder-actuated Fastening (ESH Course 301)

4.1.3 Machine-specific Competency

Workers meeting any of the following conditions must demonstrate equipment-specific competency:

- Is required to do so by a supervisor or machine custodian
- Is new to machine shops or machine operation
- Is involved in machine design or maintenance
- Services machine safeguards
- Uses powder-actuated tools

This training is typically not provided by SLAC. However, a practical skill evaluation may be conducted to confirm an individual’s competency. This could involve a machine-specific demonstration of competency by the student, a written test, and/or continued supervisor observation during any probationary period.

Information on competency requirements and qualifications for specific machine tools are available from the ESH Course Catalog (under the hazard category “Industrial Equipment” and prefixed “MCE”).
5 Definitions

custodian, machine. A person who is responsible for a machine or piece of equipment, and who ensures that it is properly maintained. May or may not be the same as the machine shop custodian.

custodian, shop. A person who is responsible for a machine shop, who establishes the shop-specific safety and housekeeping rules for that shop, and who is responsible for ensuring that the shop and its machines are used only by properly qualified and authorized personnel.

guard. A barrier that prevents entry of the operator's hands or fingers into the point of operation, pinch or nip point, or moving parts. May be fixed, interlocked, adjustable, or self-adjusting.

guarded. Shielded, fenced, enclosed, or otherwise protected by means of suitable enclosure guards, covers or casing guards, trough or “U” guards, shield guards, standard railings, or by the nature of the location, so as to remove the hazard of accidental contact.

guard zone. Any place in or about a machine or piece of equipment where a person may be struck by or caught between moving parts, caught between moving and stationary objects or parts of the machine, caught between the material and a moving part of the machine, burned by hot surfaces or exposed to electric shock.

interlock. A device that operates to prevent the operation of a machine while the cover or door of the machine is open or unlocked and which will also hold the cover or door closed and locked while the machine is in motion.

machine shop. An area where multiple types of machine tools may be used, generally in one designated location within a building. Each machine shop area will have a designated machine shop custodian or supervisor. May have dedicated staff or authorized users. A carpentry shop is included in this definition.

mechanical power transmission apparatus. Mechanical component or prime mover that transfers power to a machine tool. May include shafting, flywheels, pulleys, belts, couplings, chain drives, cranks, gears.

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 moving parts, between moving and stationary objects, or between the material and moving parts of a machine tool.

point of operation. The point(s) 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.

positive disconnecting means. A device, or group of devices, or other means by which the conductors of a circuit can be physically disconnected from their source of supply.

prime mover. An engine or motor the main function of which is to drive or operate other mechanical equipment.

tool, machine. A powered mechanical device, typically used to fabricate metal components of machines by the selective removal of metal. The term machine tool is usually reserved for tools that use a power source other than human movement, but can be powered by people if appropriately set up. Machining equipment that cuts, shears, punches, presses, drills, rolls, grinds, sands, or forms metal, plastic, or wood stock.
Examples of machine tools are drills, gear shapers, hones, lathes, milling machines, and grinders. Not included in this definition are hand-held, portable power, or manual tools.

**tool, non-sparking.** A tool made of metals such as brass, bronze, Monel metal (copper-nickel alloy), copper-aluminum alloys (aluminum bronze), copper-beryllium alloys (beryllium bronze), and titanium, intended to minimize sparking.

**tool, portable.** A hand-held tool, either operated by hand or a power source:

- **Tool, hand.** A device for doing a particular job that does not use a motor, but is powered solely by the person using it. Examples range from general tools like the hammer to specific tools like calipers.

- **Tool, power.** A tool with a motor. The addition of the motor reduces the work that the operator has to do and sometimes makes it possible for the operator to do things that are difficult or impossible to do by hand. Common power tools include the drill, various types of saws, the router, the electric sander, and the lathe. All of these tools have manual equivalents.

**tool, powder-actuated.** A hand tool that uses an explosive charge to drive a fastener into a piece of material.

For detailed definitions of machine safeguarding terms, see [29 CFR 1910.211](#).

## 6 References

### 6.1 External Requirements

The following are the external requirements that apply to this program:


6.2 Related Documents

**SLAC Environment, Safety, and Health Manual** (SLAC-I-720-0A29Z-001)
- Chapter 2, “Work Planning and Control”
- Chapter 18, “Hearing Conservation”
- Chapter 19, “Personal Protective Equipment”
- Chapter 29, “Respiratory Protection”
- Chapter 51, “Control of Hazardous Energy”

**Other SLAC Documents**
- ESH Course Catalog
- Building Management Guide (SLAC-I-708-403-005-00)

**Other Documents**
- Stanford University, Office of Environmental Health and Safety. Safe Operation of Shop Machinery
- Occupational Safety and Health Administration (OSHA). Concepts and Techniques of Machine Safeguarding (OSHA Publication 3067)
- Occupational Safety and Health Administration (OSHA). Machine Guarding (OSHA eTool)
Chapter 25: Machine and Portable Tools

Portable Tool Requirements

1 Purpose

The purpose of these requirements is to ensure the safe use of portable tools. They cover the procurement, safeguarding, use, and maintenance of such tools. They apply to workers and supervisors.

2 Requirements

2.1 General

Use of portable tools, both power and hand, must meet the following general requirements. Additional requirements are described by type of tool in the following sections.

2.1.1 Procurement

SLAC will provide portable tools for SLAC employees. Except where approved by line management, SLAC employees must not use their personal tools for work at SLAC. Subcontractors will provide their own equipment. All portable tools must comply with the applicable external requirements (see Chapter 25, "Machine and Portable Tools", Section 6.1, "External Requirements").

2.1.2 Use

- Do not use a tool unless you have been trained to use it safely, know its limitations and hazards, and have been properly authorized.
- Use tools according to training and authorization
- Use the appropriate tool for the task. Notify your supervisor if unsure which tool is appropriate. Select tools that
  - Can be used without the hand or wrist in an awkward position
  - Are well balanced
  - Fit the hand comfortably
  - Are not so heavy that they strain the arm and shoulder
  - Have handles designed to minimize the grip force needed
  - Have soft grips that do not cut into the hand
Are spark-resistant (made from brass, plastic, aluminum, or wood) if working around flammable substances (sparks produced by iron and steel tools can be a dangerous ignition source).

- Always visually inspect tools before use and remove from service any found to be defective. Tag the tool OUT OF SERVICE and notify your supervisor.
- Stop work immediately if a tool becomes damaged.

2.1.3 Housekeeping

- Keep the work area free of clutter and debris that could create tripping or slipping hazards.

2.1.4 Cleaning and Maintenance

- Store tools in a dry, secure location, in their supplied case or holder, or in purpose built storage, when they are not being used.
- Damaged tools may be repaired only in accordance with the manufacturer’s specifications. Only authorized personnel will be permitted to maintain or repair power tools. Tools must not be altered from their original state, painted other than by the manufacturer, or have the manufacturer’s label obscured.

2.1.5 Personal Protective Equipment

- Wear or use personal protective equipment (PPE) or clothing that is appropriate for the work you are doing; this may include items such as safety glasses or goggles, hearing protection, dust mask, gloves, safety boots or shoes, or rubber boots. (See Chapter 19, “Personal Protective Equipment” for general PPE requirements and the following sections for tool-specific requirements.)

2.2 Power Tools

2.2.1 Use

- Make sure the tool has proper guards (see Section 2.2.3, “Guarding”).
- Do not operate tools in an area containing explosive vapors or gases.
- Do not surprise or touch anyone who is operating a tool. Startling a tool operator could end up causing an accident or injury.
- Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.

2.2.2 Switches and Controls

Certain types of power tools are required to have specific switches and controls, as follows.

The following power tools must be equipped with a constant pressure switch or control that will shut off the power when the pressure is released:

- Circular saws with blade diameters over two inches
- Chain saws (electric, hydraulic, pneumatic, or gasoline)
Percussion tools (for example, jackhammers) without positive accessory means

The following power tools must be equipped with a constant pressure switch or control that will shut off the power when the pressure is released but may have a lock-on control provided. The control can be turned off with a single motion:

- Drills
- Tappers
- Fastener drivers (for example, staplers, nailers)
- Grinders with wheel diameters over two inches
- Disc sanders with disc diameters over two inches
- Belt sanders
- Reciprocating, saber, scroll, and jig saws with blade shanks greater than nominal 1/4 inch

All other power tools must be equipped with a momentary contact ON/OFF control or other controls. Operating controls on all power tools must be located to minimize the possibility of accidental operation.

### 2.2.3 Guarding

Any power tool designed to accommodate guarding, such as circular saws, airless spray guns, belt sanding machines, and portable grinders, must be equipped with that guard during use and the guard must not be altered.

In general, guards are provided to protect the user and others from the following hazards:

- Point of operation
- In-running nip points
- Rotating parts
- Flying chips and sparks

Specifically, the moving parts of a power tool that can be hazardous must be guarded. For example, all of the following parts must be guarded:

- Gears, sprockets, and sprocket chain drives
- Belt and pulley drives
- Hazardous revolving or reciprocating parts
- Pulleys and drums
- Exposed shafts
- Projecting shaft ends
- Collars, clutches, and couplings

For example, portable circular saws must be equipped with guards. An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except when it makes contact
with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work.

2.2.3.1 Exclusions

Certain tools are excluded from the guarding requirements due to there being a greater hazard to workers if they are guarded in their working area. These tools include chain and reciprocating saws. These types of tools have other guards to protect workers.

2.2.4 Powering On and Off

- Switch off tools before connecting them to a power supply.
- Disconnect the power supply before making adjustments or changing accessories.
- Do not disconnect the power supply of the tool by pulling or jerking the cord from the outlet.
- Remove any wrenches and adjusting tools before turning on a tool.
- Do not bypass the ON/OFF switch and operate the tools by connecting and disconnecting the power cord.
- Do not walk around with a plugged-in tool with your finger touching the switch.
- Do not bush away sawdust, shavings or turnings while the tool is running.
- Do not leave a running tool unattended. Do not leave it until it has been turned off, has stopped running completely, and has been unplugged.

2.2.5 Housekeeping

- Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.

2.2.6 Cleaning and Maintenance

- Ensure that cutting tools, drill bits, and so on are kept sharp, clean, and well maintained.
- Do not clean tools with flammable or toxic solvents.
- Cleaning surfaces or removing sawdust, metal turnings, and so should be performed by mechanical means (brush, broom) with the use of compressed air as last resort. If compressed air is used for cleaning the pressure at the nozzle tip must be less than 30 pounds per square inch (psi) and all personnel in the area must wear eye protection in keeping with federal regulations (29 CFR 1910.133).

2.2.7 Personal Protective Equipment

- Do not wear loose clothing or jewelry while using revolving power tools. Tie back long hair or wear appropriate hair protection to prevent hair from getting caught in moving parts of equipment. When using revolving power tools, wear gloves when the tool is taken to the work; do not wear them when the work is taken to the tool.
2.3 Electric Power Tools

2.3.1 General

2.3.1.1 Use

- In areas that are wet or in where flammable vapors may be present, use only electrical tools designed specifically for that purpose.
- Use only tools that are of an approved, double-insulated type and/or grounded to conform to federal Occupational Safety and Health Administration (OSHA) electrical standards (see Chapter 8, “Electrical Safety”).
- On construction sites, on temporary wired circuits, or in wet environments, use tools only in conjunction with an approved ground fault circuit interrupter (GFCI).
- Do not power on tools until just before use and power them off immediately afterwards or before changing accessories.
- Do not get near the moving parts of an electrical tool unless the power is off.
- Avoid body contact with grounded surfaces like refrigerators, pipes, and radiators.
- Do not use any tool that is sparking or appears to have an electrical short.
- Do not use an electric grinding wheel, buffer, or wire brush that wobbles or vibrates excessively.
- Do not use excessive force on saws or drills.

2.3.1.2 Electric Cords

- Use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool that being used. This will prevent the cord from overheating.
- For outdoor work, use outdoor extension cords marked W-A or W.
- Do not use light-duty power cords.
- Do not use any tool with a damaged or exposed cord or exposed wiring.
- Check cords regularly for fraying, insulation damage, and crushing or cutting.
- If a power cord feels more than comfortably warm, remove it from service and have it checked by an electrician or other qualified person.
- Do not lay power cords over sharp edges or through doorways or holes in walls.
- Keep power cords away from heat, water, oil, and moving parts. They can damage the insulation and cause a shock.
- Keep power cords clear of tools and the path that the tool will take.
- Protect cords from damage by vehicles, being walked on, and so on. Cords should be put in conduits, placed under a cord cover or protected by placing planks on each side of them.
- Do not lift, lower, or carry tools by their cords.
- When unplugging a tool, pull the plug, not the cord. Pulling the cord causes wear and may adversely affect the wiring to the plug.
Do not plug several power cords into one outlet by using single-to-multiple outlet adapters or converters (*cube taps*).

Eliminate *octopus connections*: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in over-current protection.

Do not connect or splice extension cords together to make a longer connection: the resulting extension cord may not be able to provide sufficient current or power safely.

Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

Do not break off the third prong (ground prong) on a plug: replace broken three-prong plugs and make sure the third prong is properly grounded.

Do not use extension cords as permanent wiring: use extension cords only as a temporary (for example 30 days) power supply to an area that does not have a power outlet.

### 2.3.2 Belt Sanders

#### 2.3.2.1 Use

- Inspect sanding belts before using them. Replace belts that are worn or frayed.
- Install sanding belts that are the same width as the pulley drum.
- Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.
- Secure the sanding belt in the direction shown on the belt and the machine.
- Keep hands away from a sanding belt.
- Use two hands to operate sanders: one on a trigger switch and the other on the manufacturer-supplied hand-hold.
- Keep all cords clear of sanding area during use.

#### 2.3.2.2 Powering On and Off

- Make sure the sander is switched to OFF before connecting the power supply.
- Disconnect power supply or unplug the sander before changing a sanding belt, making adjustments, or emptying dust collector.

#### 2.3.2.3 Cleaning and Maintenance

- Clean dust from the motor and vents at regular intervals.

#### 2.3.2.4 Personal Protective Equipment

- Wear safety glasses and/or a face shield.
- Wear a dust respirator for dusty operations.

### 2.3.3 Circular Saws

#### 2.3.3.1 Use

- Select the correct blade for stock being cut and allow it to cut steadily. Do not force it.
Ensure that the blade that you have selected is sharp enough to do the job. Sharp blades work better and are safer.

Set the depth of the blade, while the saw is unplugged, and lock it at a depth so that the lowest tooth does not extend more than about 0.3 centimeter or 1/8 inch beneath the wood.

Check the retracting lower blade guard to make certain it works freely. It should enclose the teeth as completely as possible, and cover the unused portion of the blade when cutting.

Check that the retracting lower blade guard has returned to its starting position before laying down the saw.

Keep upper and retracting lower blade guard clean and free of sawdust.

Check the saw for proper blade rotation.

Secure work being cut to avoid movement.

Use two hands to operate saws - one on a trigger switch and on the manufacturer-supplied hand-hold.

Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.

Do Not

Carry the saw with a finger on the trigger switch.

Hold or force the retracting lower guard in the open position.

Place hand under the shoe or guard of the saw.

Over tighten the blade-locking nut.

Twist the saw to change, cut, or check alignment.

Use a saw that vibrates or appears unsafe in any way.

Force the saw during cutting.

Cut materials without first checking for obstructions or other objects such as nails and screws.

Overreach. Keep proper footing and balance.

Rip stock without using a wedge or guide clamped or nailed to the stock.

2.3.3.2 Powering On and Off

Disconnect power supply or unplug the saw before adjusting or changing the blade.

Allow the saw to reach full power before starting to cut.

2.3.3.3 Cleaning and Maintenance

Keep the motor free from accumulation of dust and chips.

2.3.3.4 Personal Protective Equipment

Wear safety glasses or a face shield.

Wear an approved respirator or dust mask when exposed to harmful or nuisance dusts.
2.4 Fuel Power Tools

2.4.1 General

- All fuel power tools must be stopped and shut down for refueling, servicing, or maintenance. Fire extinguishers must be available in the immediate area. All fuel power tools must meet the requirements of Chapter 12, “Fire and Life Safety”, for combustible materials.
- Fuel power tools must not be used inside of any building. An alternative tool must be used.

2.4.2 Gasoline Power Tools

- Gasoline must be stored in approved containers or portable tanks per Department of Transportation (DOT) regulations.
- Fire extinguishers of the correct type must be available where gasoline is stored.
- An additional extinguisher must be located outside of the room or immediate area where the gasoline is stored.
- When tools are filled, or when gasoline is transferred between containers, proper grounding and bonding procedures must be used.

2.4.3 Gasoline Power Saws

- The saw must have a control that returns to idle when released.
- The clutch must be adjusted to prevent the chain drive from engaging at idle speed.
- The operator must be positioned properly to avoid injury in case of kick back.
- The engine must be stopped when the saw is carried over 100 feet, or when it is being cleaned, refueled, adjusted, or repaired.

2.5 Hydraulic Power Tools

- The fluid used in hydraulic power tools must be fire-resistant and retain its operating characteristics at the most extreme working temperatures to which it will be exposed.
- Users must refer to the manufacturer’s manual for the safe operating pressure of tools hoses, pipes, valves, filters, and fittings.
- Hydraulic power tools should have a non-leak feature on the disconnect fittings.

2.6 Pneumatic Power Tools

There are several dangers encountered in the use of pneumatic tools, which are powered by compressed air. The main one is the danger of getting hit by one of the tool’s attachments or by some kind of fastener the worker is using with the tool.
2.6.1 General

2.6.1.1 Use
- Check to see that pneumatic tools are fastened securely to the hose to prevent them from becoming disconnected. All pneumatic tools must be secured to the hose or whip by some positive means to prevent the tool from accidentally disconnecting.
- Do not hoist or lower tools by the hose.
- Do not exceed the manufacturer’s safe operating pressure for hose, pipe, valves, filters, and fittings.

2.6.1.2 Switches and Controls
- All hoses over 1.27 centimeters (0.5 inch) in diameter must have a safety device (pressure regulator) at the source of supply or branch line to reduce pressure if the hose fails. All connections must be provided with a device to prevent whipping.

2.6.1.3 Guarding
- A safety clip or retainer must be installed to prevent attachments, such as chisels on a chipping hammer, from being unintentionally shot from the barrel.

2.6.1.4 Powering On and Off
- Disconnect from the source and release any pressure in lines before making any adjustments or repairs.

2.6.1.5 Personal Protective Equipment
- Eye protection is required and face protection is recommended for workers using pneumatic tools.
- Protective screens should be used to protect nearby workers from being struck by flying fragments generated by the use of pneumatic tools.

2.6.2 Compressed Air Guns

2.6.2.1 Use
- Compressed air nozzles should not be aimed or pointed at other workers unless the specific operation requires this action. Users should never dead-end a compressed air gun against themselves or anyone else.
- Never use compressed air over 30 pounds per square inch gauge (psig) to blow dirt, chips, or dust from clothing while it is being worn.
- Secure the air hose for a pneumatic nailer or stapler at roof level to provide ample, but not excessive, amounts of hose on roofs of 1:4 pitch or greater.

2.6.2.2 Switches and Controls
- Pneumatic nailers and staplers operating at more than 100 psi must have a safety device to prevent operation when the muzzle is not in contact with the surface.
2.6.2.3 Guarding

2.6.2.4 Powering On and Off

- Disconnect pneumatic nailers and staplers at the tool from the air supply when not in use.

2.6.2.5 Personal Protective Equipment

- Always wear a securely fastened safety belt and lanyard when using pneumatic nailers and staplers on steep roofs (1:3 pitch or greater).

2.6.3 Portable Compressors

- Wheels must be fixed, locked, or blocked to prevent rolling.
- Fans must be guarded with a shroud or side screens.
- Air tanks must be drained of liquid according to the manufacturer’s specifications.
- Air receivers must comply with federal (29 CFR 1910.169) and state regulations (8 CCR 461–466).

2.7 Powder-actuated Tools

Powder-actuated tools operate like a loaded gun and should be treated with the same respect and precautions. All powder-actuated tools must comply with American National Standards Institute (ANSI) A10.3-2006, “Safety Requirements for Powder-actuated Fastening Systems” (ANSI A10.3-2006), or have a California approval number. (If the tool manufacturer cannot say it meets the ANSI standard then it can request approval for the tool from the California Division of Occupational Safety and Health.)

2.7.1 Use

- Only workers who have been trained in the operation of the particular tool in use are allowed to operate a powder-actuated tool. Training must be provided by someone with both sufficient knowledge regarding the tool and sufficient training ability to successfully convey the information to the worker. The training should include review of the instruction manual for each specific make and model of powder-actuated tool. Completion of such training is recorded using ESH Course 301.
- All tools must be tested according to the manufacturer’s recommendations before loading to see that the safety devices are working properly. If the tool develops a defect during use it should be tagged and taken out of service immediately until it is properly repaired.
- Inspect the tool before use to determine that it is clean, that all moving parts operate freely, and that the barrel is free from obstructions.
- Do not point tools, whether loaded or empty, at any person.
- Keep hands clear of the barrel end.
- Bystanders are not permitted near the work. Shields for protecting workers against a possible ricochet may be necessary in the working area.

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Warning signs must be conspicuously posted within 50 feet of the area where powder-actuated tools are being used and be removed promptly when no longer applicable.

Do not use tools in explosive or flammable atmospheres.

Adequate ventilation must be provided in confined spaces where powder-actuated tools are used.

Be careful when using tools near live electrical circuits and make sure that projectiles do not enter live circuits buried or hidden in the base material.

Use tools at right angles to the work surface.

Make sure the base material has no holes or openings and is of sufficient consistency to prevent a projectile from passing right through.

Do not force a projectile into a working surface that is harder than the projectile being used. If the base material is unknown, use a hand hammer to drive the projectile, using it as a drift punch.

2.7.2 Switches and Controls

To prevent the tool from firing accidentally, two separate motions are required for firing: one to bring the tool into position, and another to pull the trigger. The tools must not be able to operate until they are pressed against the work surface with a force of at least five pounds greater than the total weight of the tool.

All tools must be designed for varying powder charges so that the user can select a powder level necessary to do the work without excessive force.

2.7.3 Guarding

All tools must be used with the correct shield, guard, or attachment supplied by the manufacturer. The muzzle end of the tool must have a protective shield or guard centered perpendicularly on the barrel to confine any flying fragments or particles that might otherwise create a hazard when the tool is fired. The tool must be designed so that it will not fire unless it has this kind of safety device.

2.7.4 Powering On and Off

Do not load until immediately before the intended firing time, and do not leave loaded tools unattended.

2.7.5 Cleaning and Maintenance

Store tools and cartridges when not in use in lockable containers and that have required warning labels on the inside and outside of the container.

Unload tools before storing.

Clean and maintain tools according to manufacturers' instructions.

2.7.6 Personal Protective Equipment

Personal protective equipment will be used: safety glasses or a face shield, hearing protection, and a hard hat.
2.7.7 Cartridges

- Use only cartridges recommended by the tool manufacturer.
- Check the color of the cartridge to make sure it is appropriate for work being done. Charge cartridges are color-coded to show their strength.
- Check cartridges by conducting a first trial using the weakest or lowest strength charge cartridge.
- Cartridges must not be carried loose or in a pocket, but in the manufacturer’s package.
- Do not force cartridges into a tool.
- Keep cartridges in a lock up when not in use.
- Do not discard unfired cartridges carelessly.

2.7.7.1 Misfires

If a powder-actuated tool misfires

1. Wait at least 30 seconds then try firing it again.
2. If it still will not fire, wait another 30 seconds so that the faulty cartridge is less likely to explode, then carefully remove the load.
3. Place the bad cartridge in a bucket of water.
4. Notify your supervisor that a misfire has occurred.
5. Contact the Waste Management Group (WM) for assistance in disposing of the misfired cartridge.

Note Subcontractors will advise their SLAC contact that a misfire has occurred and will make arrangements for removing the faulty cartridge from SLAC, following all required laws and regulations.

3 Forms

The following are forms required by these requirements:
- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:
- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 25, “Machine and Portable Tools”
– **Machine and Portable Tools: Machine Tool Requirements** (SLAC-I-730-0A21S-056)

- **Chapter 2, “Work Planning and Control”**
- **Chapter 8, “Electrical Safety”**
- **Chapter 12, “Fire and Life Safety”**
- **Chapter 19, “Personal Protective Equipment”**

Other SLAC Documents

- ESH Course 301, Powder-actuated Fastening (**ESH Course 301**)

Other Documents


1 Purpose

The purpose of these requirements is to ensure the safe use of machine tools. They cover the procurement, safeguarding, use, and maintenance of such tools. They apply to workers, supervisors, machine and shop custodians, and building and area managers.

2 Requirements

Use of machine tools must meet the following general requirements.

2.1 Procurement

All machine tools must comply with the applicable external requirements (see Chapter 25, “Machine and Portable Tools”, Section 6.1, “External Requirements”).

2.2 Authorization

- Only authorized workers will be permitted to operate machine tools. Machine tool use is authorized through a machine-specific competency evaluation, as described in Chapter 25, “Machine and Portable Tools”, Section 4, “Training”, for each machine to be operated.

2.2.1 Working Alone

The shop custodian will determine if a machine tool requires a second person, in addition to the operator, to be present while it is in use. For this purpose, “present” means that the second person would know if the machine operator needs emergency assistance. This determination must be documented in shop-specific safety rules or the machine-specific competency standard. That second person must, at a minimum, be able to shut the machine off and contact emergency services.

2.3 Use

All tools will be restricted to the use for which they are intended and will be used properly, according to the manufacturer’s instructions, the requirements of this program, and any tool- or shop-specific requirements and procedures.
Workers will visually inspect all tools before each use. Malfunctioning machinery or safeguards must be reported immediately to the shop or machine custodian. If the malfunction presents a safety hazard, the machine must be taken out of service by disconnecting and locking out the power source(s). A warning sign indicating the problem should be placed on the machine to communicate its status to affected personnel.

### 2.3.1 Safety Rules

Machine users will follow shop-specific safety rules and meet machine-specific competency standards. Safety rules should cover:

- Personal protective equipment
- Apparel
- Actions/behaviors
- Equipment use
- Housekeeping
- Cleanup

The shop custodian is responsible for developing shop-specific safety rules and ensuring they are followed, and contacts the machine tool user’s supervisor and restricts access if the user fails to follow safety requirements.

### 2.4 Guarding

Any tool designed to accommodate guarding must be equipped with that guard during use and the guard must not be altered.

Safeguards must be provided at three basic locations:

1. At the point of operation
2. On or at the mechanical power transmission apparatus
3. At other moving parts which could potentially create a hazard

Machinery containing moving parts with rotating, transverse, or reciprocating action will be effectively guarded according to federal Occupation Safety and Health Administration (OSHA) regulations. One or more methods of machine safeguarding must be provided to protect from hazards such as those created by point of operation, nip points, rotating parts, flying chips, sparks and so on. Safeguards must conform to OSHA and American National Standards Institute (ANSI) B11 series (ANSI B11) standards.

Note: **OSHA does not grant a grandfather clause for old equipment. All equipment must be safeguarded. Equipment must also be installed in conformance to applicable facility standards, such as electrical and seismic.**

For requirements on using safeguards on common machine tools, see [Machine and Portable Tools: Machine Safeguarding Requirements](#).
2.4.1 Selecting Guarding Methods

Neither OSHA regulations nor third-party standards offer guarding requirements for every possible machine configuration; therefore each machine must be evaluated by a knowledgeable, trained person and compared to the appropriate machine safeguarding standard.

A uniform process should be applied and used to evaluate each of the hazards on a machine to develop the required level of safeguarding. The evaluation may be performed by a knowledgeable and experienced person internal to SLAC, or for more complicated machine designs and safeguarding issues, by a qualified third party.

The OSHA/ANSI hierarchy for controlling machine hazards is as follows:

1. Eliminate the hazard by design
2. Control the hazard by guarding or devices
3. Warnings
4. Personal protective equipment
5. Training

If the results of the hazard evaluation show the equipment to be safe (that is, poses no hazard to the employee), changes to the equipment may not be necessary. This may be true for manually powered equipment.

The standards agree that the first step to safeguarding must be to attempt to eliminate the hazard completely. To eliminate the hazard totally or enclose the exposure on a machine such that the employee has almost zero exposure may not be practical. However, it can be approached very closely to minimize employee exposure to injury.

The second step in determining what level of protection is necessary is often driven by specific regulatory requirements and hazard identification. OSHA regulations point to the need to reduce, through the use of physical safeguarding, the employee’s exposure to the identified hazards. This approach is where safeguarding may be applied through proven concepts and designs such as distance and time, barriers, interlocked guards, presence sensing devices such as light curtains, enclosures, and various other guarding combinations.

Once hazards have been identified and prioritized, the third step is to determine what level of protection is necessary. Perform a risk assessment, an evaluation procedure to verify the level of safeguarding needed. In simple terms, there are only two significant factors that must be considered when evaluating the associated risk in a danger zone or at a point of operation:

1. The severity of foreseeable injuries which could occur at a location. The severity of possible injury can vary tremendously from minor cuts to fatality. Most injuries happen immediately but some injuries are chronic in nature and may not manifest themselves until years later.
2. The probability of injuries occurring while the employee is working with the machine. The following should be considered in the evaluation of injury probability:
   1. Machine operation, all phases (operating and maintenance, including set-up, start-up, service adjustments, lubrication, clearing jams or malfunctions, loading and unloading, cleaning, shutting down, preventive maintenance)
2. Foreseeable misuse of the machinery and equipment
3. Evaluating human response to determine the frequency of exposure to danger points

One thing that should be clearly understood is that the absence of an injury from a particular exposure or hazard should not be taken to mean that the injury will never occur or the machine is completely safe. Accidents occur more or less randomly and usually result in pain and suffering in addition to the loss of productivity.

Some of the issues to address when determining the potential degree of injury are as follows:

1. What types of physical or mechanical hazards are involved?
2. What types of injuries can be foreseen?
3. Given the conditions under which access to the danger zone or point of operation occurs, what is the probability of each possible severity of injury?
4. What potential loss to the employee as well as to production does each possible severity of injury represent?

For guidance on selecting safeguarding methods, see Machine and Portable Tools: Machine Safeguarding Guideline.

2.5 Housekeeping

The work area must be kept free of clutter and debris that could create tripping or slipping hazards.

2.6 Cleaning and Maintenance

Machine custodians will establish and follow a program of periodic and regular inspections and maintenance of their equipment to ensure that machines, parts, and auxiliary equipment are in a safe operating condition and necessary safeguards are present. Records of these inspections should be maintained and made available for inspection upon request.

Only authorized personnel will be permitted to maintain or repair machine tools. When service occurs that requires entry of any body part into a danger zone within the equipment, or unexpected startup or energizing of the machine could cause injury, maintenance personnel will first isolate hazardous energies as required by Chapter 51, “Control of Hazardous Energy”.

2.7 Personal Protective Equipment

Workers must wear attire and personal protective equipment (PPE) appropriate for the tool they are using and the work they are performing. (See Chapter 19, “Personal Protective Equipment” for general PPE requirements.)

- Long pants and closed-toed shoes are required when entering an area with operating machine tools.
- Long sleeves, gloves, neckties, or other loose-fitting clothing must not be worn when operating machine tools.
Long hair or beards must be suitably secured or covered to prevent entanglement with revolving or moving machinery.

Jewelry or other items that could catch on or be grabbed by moving parts must not be worn.

Safety glasses with side shields or goggles are required entering an area with operating machine tools.

Face shields are required if flying fragments/particles are likely to be generated.

Properly selected gloves, as well as protective sleeves, aprons, and so on, are required when using hazardous chemicals and handling scrap metal or wood, sharp-edged stock, and unfinished lumber.

**Important** Gloves must not be worn while machining, as they can get caught in moving equipment.

Safety-toed boots may be required where potential dropping of heavy objects exists.

For loud work or operations with respiratory hazards, contact ESH for assessment and recommendations. (See Chapter 18, “Hearing Conservation” and Chapter 29, “Respiratory Protection”.)

### 2.7.1 Other Requirements

#### 2.7.1.1 Positive Disconnecting Means

To enable proper isolation of hazardous energies before and during equipment maintenance and repair, machines and equipment operated by electric motors or other hazardous energy will be provided with a positive disconnecting means. Examples of positive disconnecting means include service disconnects, circuit breakers, valves, and power cords and plugs. Push buttons, selector switches, software interlocks, control circuit type devices, and computer controlled software cannot be used to isolate hazardous energy.

#### 2.7.1.2 Stop Buttons and Power Controls

Machines should have an EMERGENCY POWER OFF or STOP button or other readily accessible and clearly designated power switch within easy reach of the operator to cut off the power to each machine, rendering it unable to injure personnel. The power controls must be located so as to make it unnecessary to reach over or near the hazard to make adjustments. For larger machines, power switches should be located in multiple locations on various sides so that power can be easily deactivated by bystanders in case of emergency.

#### 2.7.1.3 Machine Anchoring

Machines designed for a fixed location will be securely anchored per SLAC seismic requirements, to prevent walking or moving due to vibration, rotation, or seismic activity.

#### 2.7.1.4 Manual Reset

Proper restart systems must be installed on all powered equipment and tools so that manual reset is required to restart the tool after it has been stopped by any safety device or mechanism. For example, if an interlocked guard stops tool operation when the guard is removed; manual reset is required to restart the tool after the guard is replaced. Replacing the guard alone must not allow the tool to restart.
2.7.1.5 Anti-restart Devices

Anti-restart devices (ARDs) or other effective provisions must be present on all machines, presses, and power tools that could create hazardous conditions to workers if motors were to restart suddenly after a restoration of voltage conditions following a power failure. It is strongly recommended that any machine that could pose a hazard to workers upon restoration of power also be provided with an ARD.

In addition, the machine should be evaluated (see Section 2.4, “Guarding”) to determine the risk to employees if an ARD is not present. A sudden restoration of power following an interruption should not create hazardous conditions to workers. (See Machine and Portable Tools: Machine Safeguarding Anti-restart Device Requirements, for more information.)

3 Forms

The following are forms required by these requirements:
- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:
- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 25, “Machine and Portable Tools”
  - Machine and Portable Tools: Portable Tool Requirements (SLAC-I-730-0A21S-027)
  - Machine and Portable Tools: Machine Safeguarding Requirements (SLAC-I-730-0A21S-005)
- Chapter 2, “Work Planning and Control”
- Chapter 18, “Hearing Conservation”
- Chapter 19, “Personal Protective Equipment”
- Chapter 29, “Respiratory Protection”
- Chapter 51, “Control of Hazardous Energy”

Other SLAC Documents
- None
Other Documents

- Stanford University, Office of Environmental Health and Safety. Safe Operation of Shop Machinery
Chapter 25: Machine and Portable Tools

Machine Safeguarding Requirements

1 Purpose

The purpose of these requirements is to ensure effective safeguarding of common types of machine tools. They cover the use of safeguards associated with such tools. They apply to workers, supervisors, and machine and shop custodians.

2 Requirements

The information below covers safeguarding on common machine tools. It is not a replacement for a thorough machine-specific safeguarding evaluation and shop- and machine-specific procedures and training.

2.1 Power Saw

- Hood guard over blade
- Spreader fingers for rip sawing
- Electrical disconnect switch readily available and lockable
2.2 Radial Arm Saw

- Backrail in place to hold wood
- Hooded guard to cover top of blade
- Retractable guard on each side of saw blade
- Non-kickback fingers for use when ripping
- Stop to prevent forward travel past table edge
- Head returns automatically to rear when released by operator
- Electrical disconnect switch readily available and lockable
- Electrical disconnect properly identified and located on or near machine
2.3 Band Saw

- All belts must be guarded
- Electrical disconnect properly identified and located on or near machine
- Disconnect switch must be lockable and properly identified
- Adjustable blade guard to enclose entire blade except for material being cut
2.4 Drill Press

- Power transmission system guarded
- Electrical disconnect switch readily available and lockable
- Electrical disconnect properly identified and located on or near machine
- The work must be restrained or secured to prevent material rotation
2.5 Grinder

- Spindle nuts guarded
- Lockable disconnect switch
- Tongue guard not to exceed 1/4 inch gap
- Shield glass to be clean and free of cracks
- Wheel guard to cover 210 degrees of wheel
- Tool rest adjustment not to exceed 1/8 inch gap
- Wheel blotters to be used between wheel and flanges
- Flanges and/or special nut and flange combinations as designed for the grinder will be used
- Ring test required on wheels prior to mounting
2.6 Cut Off Saw

- Stock fastening chuck secure
- Power transmission system guarded
- Unused portion of blade guarded
2.7 Vertical Milling Machine

- Power transmission system guarded
- Electrical disconnect switch readily available and lockable
- Electrical disconnect properly identified and located on or near machine
- Feed rods and lead screws within envelope of machine
- No protrusions on chuck or faceplate beyond its periphery unless guarded
2.8 Lathe

- Power transmission system must be guarded
- Electrical disconnect switch must be readily available and lockable
- Electrical disconnect properly identified and located on or near machine
- Feed rods and lead screws of lathe must be guarded if they present a hazard
- No protrusions on chuck or faceplate beyond the periphery unless guarded
2.9 Surface Grinder

- Table shields in place
- Match spindle and wheel speeds
- Power transmission system guarded
- Wheel guarded covered a minimum of 210 degrees of wheel
- Electrical disconnect switch readily available and lockable
- Electrical disconnect properly identified and located on or near machine

3 Forms

The following are forms required by these requirements:
- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:
- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
Chapter 25, “Machine and Portable Tools”

- Machine and Portable Tools: Machine Tool Requirements (SLAC-I-730-0A21S-056)

Other SLAC Documents
- None

Other Documents
- Stanford University, Office of Environmental Health and Safety. Safe Operation of Shop Machinery
- Occupational Safety and Health Administration (OSHA). Concepts and Techniques of Machine Safeguarding (OSHA Publication 3067)
- Occupational Safety and Health Administration (OSHA). Machine Guarding (OSHA eTool)
Chapter 25: Machine and Portable Tools

Machine Safeguarding Anti-restart Device Requirements

1 Purpose

The purpose of these requirements is to prevent electric-powered machine tools from restarting automatically. They cover the selection and installation anti-restart devices on machine tools. They apply to workers, supervisors, and machine and shop custodians.

1.1 Background

Equipment that is dependent upon electricity for its power source will stop working when the electrical power is interrupted. Once power is restored, some equipment may restart automatically, which could present a significant hazard to workers.

Equipment may 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, that 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.)

2 Requirements

To protect workers, machine tools that have the capability of restarting automatically must

1. Be fully guarded or
2. Be provided with an anti-restart device (ARD)

An ARD is not required for machines that meet any of these conditions:

1. Machines whose moving parts are fully guarded.
2. Machines that have a magnetic starter and
1. Do not have a computerized auto start feature
2. Do not have automatic re-setting instrumentation such as a level switch
3. Do not have a separate power source for the control circuit

3. Machines that meet the requirements of the applicable standard in the American National Standard Institute (ANSI) B11 series

4. Machines that are listed and labeled by a nationally recognized testing laboratory (NRTL) and are used in accordance with the instructions included in the listing

**Important** ARDs must not be installed on equipment that is required to be on line constantly, such as HVAC, sump pumps, and refrigerators. This type of equipment must be fully guarded.

## 2.1 Installing ARDs

Depending upon the wiring configuration, there are several methods available to install ARDs.

### 2.1.1 Cord-connected machines (120 volts)

Use method A or B below.

#### 2.1.1.1 Method A, Plug-in Adapters

Adapters are the easiest and least expensive way to apply an ARD. To install, plug an adapter into the electrical outlet for the machine, then plug the machine cord into the adapter. When power is lost, the adapter will remain de-energized until it is manually reset.

The following adapters are recommended:
- Shock Shield, Model 14000 (wall mounted, three outlets, comes with anti-theft screw).
- Shock Shield, Model 14650 (portable)

#### 2.1.1.2 Method B, User-attachable Plug

This has an ARD device built in to the plug. To install, replace the regular plug on the cord with the attachable plug. The following plug is recommended:
- Shock Shield, Model 14880 (for cord attachment)

The adapters and plugs may only be used if:
- The machine is connected with a cord
- The load requirement does not exceed 15 amperes at 120 volts

**Note** The adapters and plug listed above have ground fault circuit interrupters (GFCIs). Not all plugs and adapters have GFCI protection.
2.1.2 Hard-wired Machines (120 volts)

This ARD is a panel-mounted device consisting of a compact molded case that must be mounted in a box. It is connected between the source of power and the machine and will work even without a starter or contactor. When power is lost, the device trips out and cannot restart until it is manually reset after power is restored. The following ARD is recommended:

- Shock Shield, Model 14060 (20 ampere, 120 volts AC)

2.1.3 Three-phase Machines (208 or 480 volts)

Most machines are wired through a starter or contactor, providing anti-restart protection. If, however, a machine has an automatic start or if the control power comes from a different source, the built-in anti-restart feature is defeated. In this event, there are two ways to create an anti-restart feature depending upon the wiring configuration:

1. Install an under-voltage relay with the coil in the main circuit and the contact in the control circuit. (This prevents the contactor from re-closing without a manual reset.)
2. Install two under-voltage relays with one coil in the main circuit and another in the control circuit. Contacts of both relays should be wired in series in the control circuit.

3 Forms

The following are forms required by these requirements:

- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 25, “Machine and Portable Tools”
  - Machine and Portable Tools: Machine Safeguarding Requirements (SLAC-I-730-0A21S-005)

Other SLAC Documents

- None

Other Documents

Chapter 25: Machine and Portable Tools

Machine Safeguarding Guideline

Product ID: 271 | Revision ID: 2072 | Date published: 17 December 2018 | Date effective: 17 December 2018

1 Purpose

The purpose of these guidelines is to provide effective safeguards. They cover the selection of safeguarding methods. They apply to machine and shop custodians.

2 Guidelines

If a machine-specific evaluation or other inspection reveals areas of the machine whose moving parts pose a potential hazard to operators or others nearby, guarding can be accomplished by one or a combination of the methods below.¹

Whichever safeguard or combination of safeguards is chosen, it must

1. Prevent the worker’s body or clothing from contacting hazardous moving parts
2. Be firmly secured to machine and not easily removed
3. Not allow falling objects to enter moving parts
4. Create no new hazards (must not have shear points, jagged edges or unfinished surfaces)
5. Create no interference (must not prevent worker from performing the job quickly and comfortably)
6. Allow safe lubrication (the person should be able to lubricate the machine without removing the safeguard)

¹ Content based on Occupational Safety and Health Administration (OSHA), Concepts and Techniques of Machine Safeguarding (OSHA Publication 3067) and Lawrence Berkeley National Laboratory, Health and Safety Manual, Chapter 25, “Machine Guarding - Shop and Lab Machine Safety”
2.1 Guards

2.1.1 Fixed

A fixed guard provides a barrier, a permanent part of the machine, preferable to all other types of guards.

2.1.2 Interlocked

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.
2.1.3 Adjustable

An adjustable guard provides a barrier that may be adjusted to facilitate a variety of production operations. Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock, but, because they require adjusting, they are subject to human error.

2.1.4 Self-adjusting

A self-adjusting guard provides a barrier that moves according to the size of the stock entering the danger area. Self-adjusting guards avoid the potential for human error associated with adjustable guards.
2.2 Safety Devices

A safety device may perform one of several functions:

- It may stop the machine if a hand or any part of the body is inadvertently placed in the danger area.
- It may restrain or withdraw the operator's hands from the danger area during operation.
- It may require the operator to use both hands on machine controls, thus keeping both hands and body out of danger.
- It may provide a barrier that is synchronized with the operating cycle of the machine in order to prevent entry to the danger area during the hazardous part of the cycle.

2.2.1 Presence Sensing

A presence-sensing device uses a system of light or radio beam (capacitance) sources and controls 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. The design and placement of the guard depends upon the time it takes to stop the mechanism and the speed at which the person’s hand can reach across the distance from the guard to the danger zone.
2.2.1.1 Electromechanical Sensing Device

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 control unit does not actuate the machine cycle.

2.2.2 Pullback

A pullback utilizes a series of cables attached to the operator’s hands, wrists, or arms which withdraws hands when the slide/ram begins to descend. It is primarily used on machines with full-revolution stroking action and allows access to the point of operation when the slide/ram is up.
2.2.3 Restraint

A restraint uses cables or straps attached to the operator’s hands and a fixed point. It must be adjusted to let the operator’s hands travel within a predetermined safe area.

2.3 Safety Controls

2.3.1 Pressure-sensitive Body Bar

When depressed, a pressure-sensitive body bar will deactivate the machine. If the operator or anyone trips, loses balance, or is drawn into the machine, applying pressure to the bar will stop the operation.
2.3.2 Safety Tripod

When pressed by the operator's hand, a safety tripod deactivates the machine. Because it has to be actuated by the operator during emergency situations, proper position is critical.

2.3.3 Safety Tripwire Cable

A safety tripwire cable is a device located around the perimeter of or near the danger area. Operator must be able to reach the cable to stop the machine. Tripwire cables must be manually reset to restart the machine.
2.3.4 Two-hand Control

A two-hand control requires constant, concurrent pressure to activate the machine. This kind of control requires a part-revolution clutch, brake, and a brake monitor if used on a power press. 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.

2.3.5 Two-hand Trip

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.
2.3.6 Gate

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

2.4 Guarding by Location / Distance

Locate the machine and its dangerous moving parts so that they are not accessible or do not present a hazard to a worker during normal operation. Maintain a safe distance from the danger area. To consider a part of a machine to be safeguarded by location, the dangerous moving part of a machine must be so positioned that those areas are not accessible or do not present a hazard to a worker during the normal operation of the machine. This may be accomplished by locating a machine so that the hazardous parts of the machine are located away from operator work stations or other areas where employees walk or work. Additionally, enclosure walls or fences can restrict access to machines. Another possible solution is to have dangerous parts located high enough to be out of the normal reach of any worker.

2.5 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. Automatic feeds reduce the operator exposure during the work process, and sometimes do not require any effort by the operator after the machine is set up and running.

2.6 Miscellaneous Aids

Although these aids do not give complete protection from machine hazards, they may provide the operator with an extra margin of safety. Sound judgment is needed in their use.
2.6.1 Awareness Barriers

Awareness barriers do not provide physical protection but serve only as reminders to a person that he or she is approaching the danger area. Generally, awareness barriers are not considered adequate where continual exposure to the hazard exists.

2.6.2 Protective Shields

Aids such as clear protective shields do not give complete protection from machine hazards, but do provide some protection from flying particles, splashing cutting oils, and coolants. They provide the operator with an extra margin of safety.
2.6.3 Hand-feeding or retrieving Tools

Hand-feeding or retrieving tools can place or remove stock. Hand-feeding tools are intended for placing and removing materials into 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.

2.7 Guard Construction

Builders 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.

Guards designed and built by the manufacturer offer two main advantages:

7. They usually conform to the design and function of the machine.
8. They can be designed to strengthen the machine in some way or to serve some additional functional purposes.

Guards fabricated by the machine tool user are sometimes necessary for a variety of reasons, and offer these advantages:

- Often, with older machinery, they are the only practical solution.
In older plants, they may be the only choice for mechanical power transmission apparatus, where machinery is not powered by individual motor drives.

- They permit options for point-of-operation safeguards when skilled personnel and machinery are available to make them.
- They can be designed and built to fit unique and even changing situations.
- They can be installed on individual dies and feeding mechanisms.

User-fabricated guards also have disadvantages. They may

- Not conform well to the configuration and function of the machine
- Be poorly designed or built
- Not comply with regulatory requirements

3 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 25, “Machine and Portable Tools”
  - Machine and Portable Tools: Machine Tool Requirements (SLAC-I-730-0A21S-056)
  - Machine and Portable Tools: Machine Safeguarding Requirements (SLAC-I-730-0A21S-005)

Other SLAC Documents
- None

Other Documents
- Occupational Safety and Health Administration (OSHA). Concepts and Techniques of Machine Safeguarding (OSHA Publication 3067)