Methods of Machine Safeguarding

There are five general methods of safeguarding machinery and equipment: guards, devices, location, feeding/ejection methods, and miscellaneous aids. Always choose the most effective and practical means available.

1. Guards

Guards prevent the operator from physically reaching around, under, or through the danger area. In general, there are four different types of guards.

**Fixed Guards** are a permanent part of the machine that does not depend on moving parts to perform its function. This guard is usually preferable to other types of guards because it is relatively simple, yet difficult to remove. Fixed guards are best used to protect workers from the power transmission apparatuses.

![Fixed Guard Enclosing a Belt and Pulleys](image)

**Interlocked Guards** are a type of guard that if opened or removed, will automatically shut off or disengage the machine. The machine cannot cycle or be powered until the guard is back in place, but replacing the guard will not automatically restart the machine.

**Adjustable Guards** are useful because they allow flexibility in accommodating various sizes of material. However because they require adjusting, they are subject to human error.
**Self-Adjusting Guards** allow the barrier to open and close depending on the size and movement of the material. As the material is moved into the danger area, the guard is pushed away, which provides an opening only large enough to accommodate the material. When the material is removed, the guard returns back to the rest position.

**Guard Construction**

Many machine builders (manufacturers) provide point of operation and power transmission safeguards as standard equipment. Guards designed and installed by the builder are preferred because they usually conform to the design and purpose of the machine. However, when this is not possible, user-built guards may be necessary. Although that is not the preferred way of guarding, it does have its advantages.
User-built guards may be the only option for older machines that never had guard specifications. These guards can be designed to fit unique situations such as older or specially made machines. Also, the design and installation of user-built guards by workplace personnel can help promote safety awareness among workers.

Although there are many advantages to user-built guards, they do come with some disadvantages. The main problem is the risk of poor design and execution. These guards may not conform to the machine making operations impractical. Also, altering the machine to accommodate guards may harm the integrity of the machine causing new hazards. Always make sure user-built guards are only made and installed by a professional who has done a thorough hazard analysis.

**Power Transmission Apparatus Guards** need no opening for feeding material, unlike point of operations guards. Because of this, power transmission guards should cover all moving parts in such a way that no part of the operator’s body can come in contact with them. The only openings necessary for these guards are those for lubrication, adjustment, repair, or inspection. These openings are covered and fastened in a way that they can only be removed using tools.

**Point of Operation Guarding** may call for more user-built guards because of the complexity and different uses these machines have. For these reasons, not all machine builders provide point of operation guards for their products.

### Distance of Guards from Point of Operation

The diagram below shows the accepted safe openings between the bottom edge of the guard and the feed table at varying distances from the point of operation (danger line).
Danger line is the point of operation and location of moving parts.

Clearance line marks the distance needed to avoid contact between the guard and moving parts at the danger line.

Minimum guard line is the distance between the opening of the guard in order to feed material and danger line (1/2 inch).

The various openings are such that an operator’s fingers (average hand size) will not reach the point of operation.

2. Devices

Devices are used when barrier guards are not practical. For example, when access to feed points or ejection of parts is required, a barrier guard would not be used because nothing would be able to pass through it. Safeguard devices may operate through the following ways:

Presence Sensing devices may use different methods of light, radio frequency, or electromechanical systems to shut off a machine if a worker enters the danger area. These devices are only to be used if the machine can be stopped before the worker enters the danger area.

Physical Restraint devices keep the operator from reaching or walking into the danger area. This is done by attaching a cable or strap to the operator’s hand or body allowing only a certain range of motion. If the operation involves placing material into the danger area, hand-feeding tools are often necessary.

Pullback devices are similar to restraint devices in that they use a series of cables attached to the operator’s hands, wrists, or arms. When the machine’s slide or ram is up and not in the danger area, there is slack in the cable allowing the operator to access the point of operation. When the
slide or ram begins to descend, the cables tighten, which withdraws the operator's hands from the danger area at the point of operation.

**Safety Control devices** provide a quick means for shutting down a machine in an emergency situation. Common safety controls include trip devices such as pressure-sensitive body bars, tripods/tripwires, and two-hand controls.

*Pressure Sensitive Body Bars* will deactivate a machine when pressure is applied. If the operator trips, loses balance, or falls toward the machine, the body will apply pressure to the bar and the machine will stop. Because of this, the position of the bar is very important.

*Safety Tripods and Wires* will deactivate a machine when pressed or pulled by hand. Because these are used in an emergency situation, they must be within reach of the operator around the perimeter of the danger area.

*Two-hand Controls* require constant, simultaneous pressure by both of the operator's hands for the machine to run. With the operator's hands on the control buttons, they are a safe distance from the danger area and when one of the hands eases pressure, the machine will shut down.

*Gates* are movable barriers that protect the operator at the point of operation before the machine can be started. If the gate is not permitted to fully close, the machine will not be able to function.

### 3. Location

Location is a method of safeguarding that involves locating the machine or the dangerous components of the machine so they are not accessible to the operator or other workers. By doing this, the worker can maintain a safe distance from the danger area while still operating the machine. This can be done by placing the dangerous moving parts against a wall or fence so the worker cannot enter the danger area.

### 4. Feeding and Ejection Methods

Many feed and ejection methods do not require the operator to place their hands in the danger area. Once the machine is set up and the material is loaded, there may be no operator involvement at all. In other instances where a manual feed is necessary, a feeding mechanism can assist the operator to ensure distance from the danger area. Please note that using feed and ejection methods do not eliminate the need for guards and devices. Guards and devices must be used whenever they are necessary.

### 5. Miscellaneous Aids

Machine safeguards and devices are the best way to protect workers from mechanical hazards, which could result in severe injury or death. However, there are some devices and strategies that, although not providing complete protection, may provide an extra margin of safety to the operator.
Awareness Barriers do not provide any physical protection, but act as a reminder to a worker that they are approaching a danger area. An awareness barrier such as a rope with a caution sign is generally not as effective in areas where continual exposure to hazards exist.

Protective Shields in a simple form are transparent barriers attached to a machine that are mainly used to provide protection from flying debris, splashing oils, and coolants.

Hand-Feeding Tools can be used when it is necessary for an operator to feed or remove a material without the use of a feed or ejection mechanism. For example, using a push stick or block to feed wood into a saw blade is much safer than using one’s hands.

Administrative Controls include training, supervision, and procedural measures to safeguard individuals from mechanical hazards. Even the best safeguarding system cannot work effectively unless the worker knows how and why to use it. Specific and detailed training is an essential part of the safeguarding process. Training programs should include:

- Identification of hazards associated with individual machines
- The safeguards and how they provide protection from hazards
- How the safeguards are to be used
- When the safeguards should be removed
- What to do if a safeguard is missing, damaged, or inadequate

Personal Protective Equipment (PPE) should be worn whenever possible to provide an extra measure of protection to the worker, even though engineering controls (guards and devices) take precedence in protecting workers from injury. In order to provide adequate protection, PPE should
be chosen and worn according to a particular hazard. It should also be stored properly to be kept clean and in good condition.

Although PPE is intended to provide extra protection to the worker, it can create hazards of its own. For example, protective gloves and sleeves may get caught in rotating parts causing injury to the worker. Consult with your supervisor when selecting PPE for specific operations.

Non-mechanical Hazards

This site concentrates on safeguarding mechanical motions and the hazards they present; however, there are other hazards that should not be ignored. These hazards include:

*Electrical hazards* are present when using electrically powered or controlled machines. The electrical systems should be properly grounded and damaged or exposed wires should be replaced to protect the operator from electric shocks.

*Noise* can create numerous hazards including hearing loss, pain, nausea, fatigue, and emotional distress. Engineering controls like sound reducing material should be used if practical. Also, hearing protection such as ear plugs or muffs should be used if engineering controls are not an option.

*Hazardous Materials* may be required for machines to operate properly or to complete a process. Materials such as cutting fluids, coolants, and lubricants may cause skin irritation, blindness, or serious illness. Some materials may give off harmful fumes when heated. Workers should always wear appropriate PPE when dealing with hazardous materials. Machines that give off fumes should be used in a vented area. Also, material safety data sheets (MSDSs) must be available in an emergency situation.

Specific Machine Guarding

The following link provides a guide from the Oregon Occupational Safety and Health Administration for machine-specific hazards and guards.


Acknowledgments:

Special thanks to the North Carolina Department of Labor. Much of the information, images, and charts were obtained through their manual, *A Guide to Machine Safeguarding*. This manual can be found by clicking [here](http://www.orosha.org/pdf/pubs/2980.pdf).