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Machine Guarding Safety w/ANSI B11.0 Standards at S&H25



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CSP, ASP, CHST
Shield Of Armor Safety

Why do we need a Standard

NSC Safety & Health Magazine

- *18,000 amputations on average per year*
- *750 deaths per year*

It is believed that roughly 50% of machinery in the US does not comply.



How do these injuries happen??

NSC Injury Types

- *Moving object strikes worker*
- *Worker striking against an object or equipment, including bumping into stepping on, kicking, or being pushed to thrown into an object*
- *Workers body being squeezed, pinched or compressed, crushed in equipment*
- *Worker being struck, caught or crushed in collapsing structure, equipment or material.*
- *Worker being injured as a result of friction or pressure between the person and the source or injury.*
- *A worker being injured from vibration.*
- *Slips trips and falls from equipment or machinery.*



ANSI B11 Standards For Ensuring Machinery Safety

What is ANSI?

American National Standards Institute (ANSI) is responsible for overseeing the development of voluntary consensus standards for products, services, processes, and systems in the US.

Latest Revision: June 27th 2023 (not available for purchase)

ANSI B11 Standards Affecting Mechanical Contractors

B11.0 :Safety of Machinery

B11.19: Performance Requirements for Risk Reduction

ANSI B11 Standards For SMACNA Contractors

Simplified B11 Requirements

1. The user shall be responsible for ensuring that risk reduction measures are provided, integrated, installed, maintained, and used in accordance with the requirements of this standard.
2. The user shall be responsible for ensuring that supervisors, operators, maintenance, and service personnel are trained in the proper installation, adjustment, operation and maintenance of the risk reduction measures, within the scope of their work activity.
3. The user shall ensure that when any change of the tooling, process or procedures occurs, the risk reduction measure(s) continue to meet the requirements

Where Dangerous Mechanical Hazards Occur

Dangerous moving parts in these basic areas require safeguarding:

1. *Point of operation*
2. *In running nip points*
3. *Pinch points*
4. *Power transmission*
5. *Other moving parts*
6. *Working at heights*



Where Dangerous Mechanical Hazards Occur

1. Are all machine guards firmly secured and not easily removable? (ANSI B11.19) 2.
2. Do guards permit safe, comfortable, and relatively easy operation of the machine? (ANSI B11.0) 3.
3. Are procedures established to ensure the machine is shut down before guards are removed (Authorized LOTO)? (ANSI B11.19)
4. Is a point-of-operation guard provided for the machine? (ANSI B11.19)



Safeguarding can be accomplished by either machine guards or machine devices.

Steps of Machine Guarding

1. Recognize the hazards by identifying hazardous actions and motions.
2. Analyze the workplace and prioritize safeguarding efforts based on the most predictable injury, the probability of occurrence and available resources.
3. Develop and implement a systematic safeguarding program which includes identifying safeguarding methods, selection and installation.
4. Ensure use of safeguarding and reinforce program by training, education and enforcement.

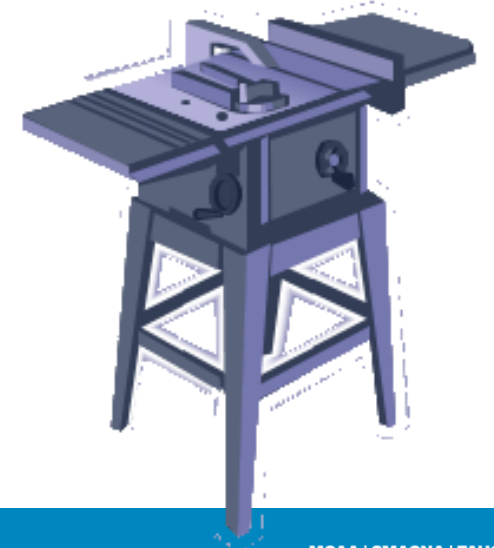
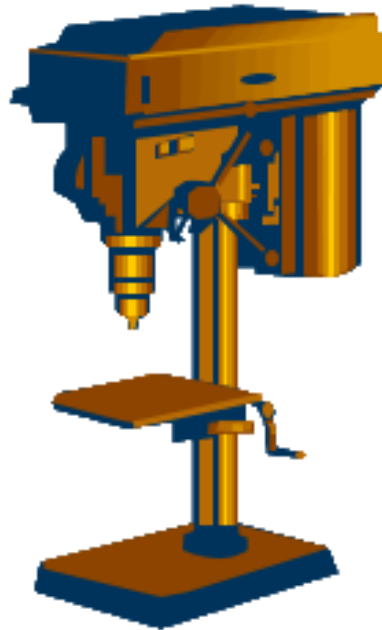
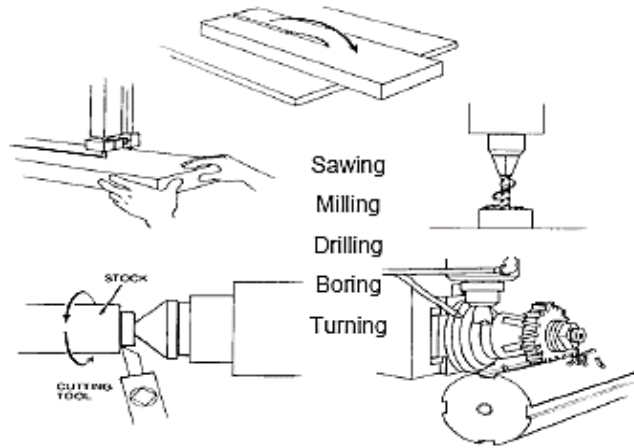
Safety Through Risk Assessment

1. *A company must complete a thorough Risk Assessment to identify hazards and evaluate risks before implementing controls.*
2. *Risk Reduction Measures must be established and documented.*
 - *Hazard identification for each machine (OEM guidelines if possible)*
 - *Risk Estimation which determines the likelihood of an occurrence and the potential severity of harm to an individual*
 - *Risk Evaluation compares the estimate risk against predefined criteria to determine whether risks are acceptable*
 - *Risk Reduction Measures put in place based off of the hierarchy of hazard control.*



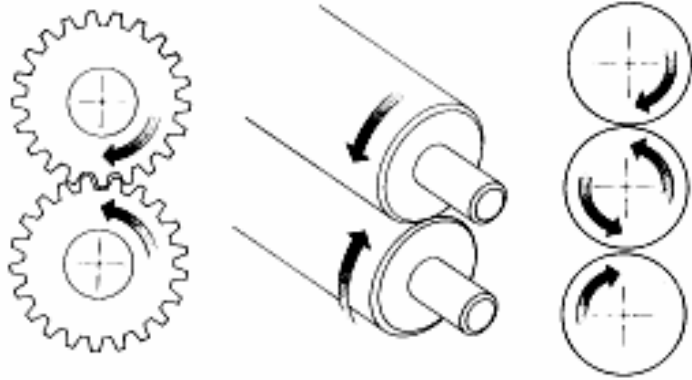
Hazardous Machine Actions - Cutting

Cutting action



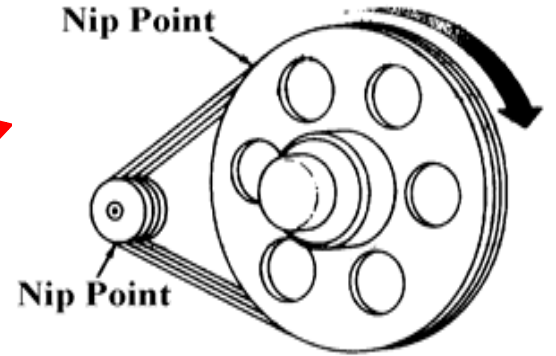
Hazardous Machine Actions – Rotating Parts

In-running nip point hazards

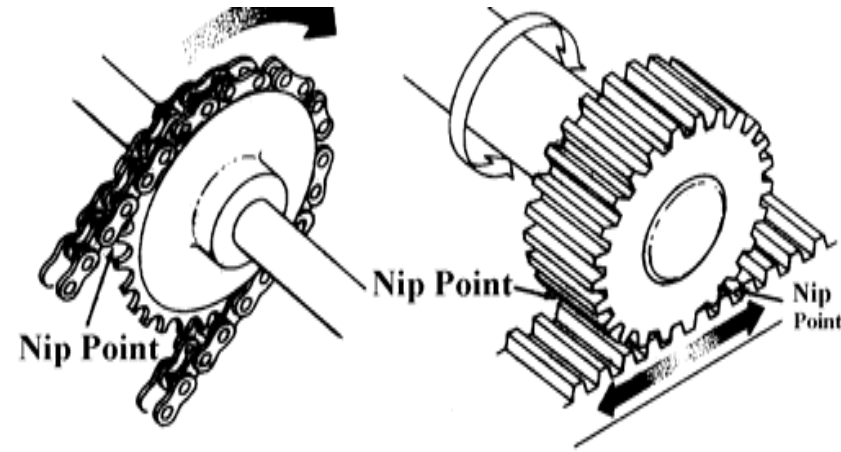


Parts rotating in opposite direction

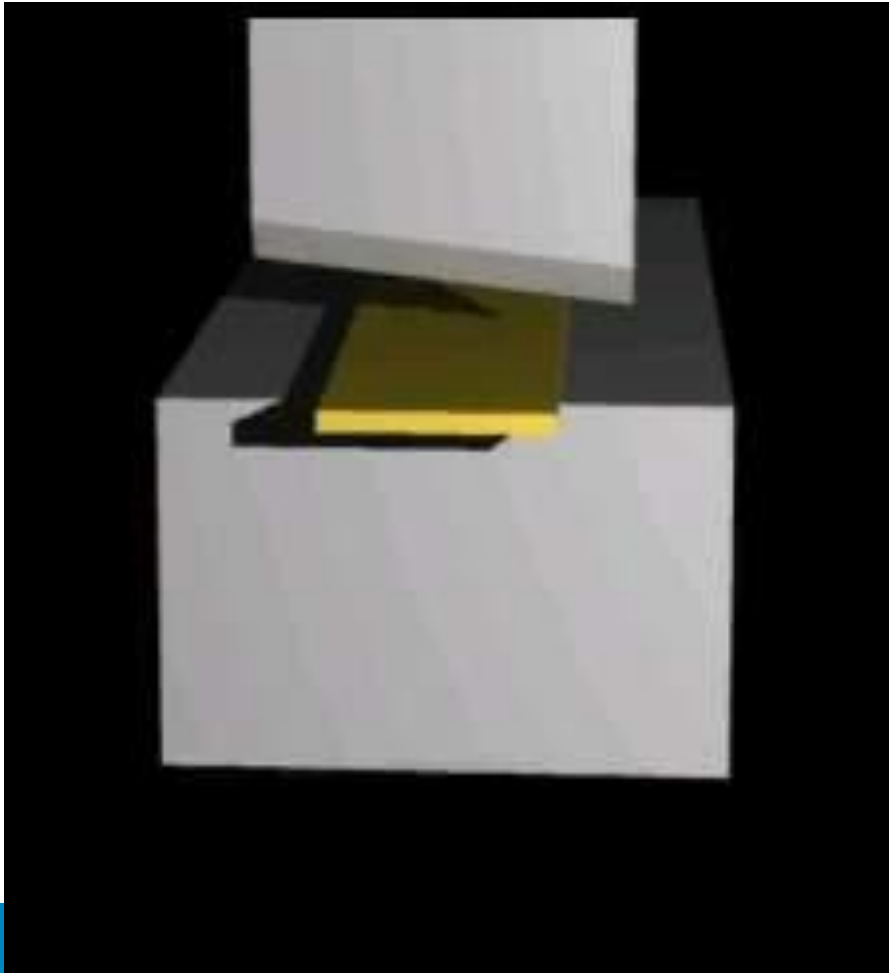
Rotating and tangentially moving parts



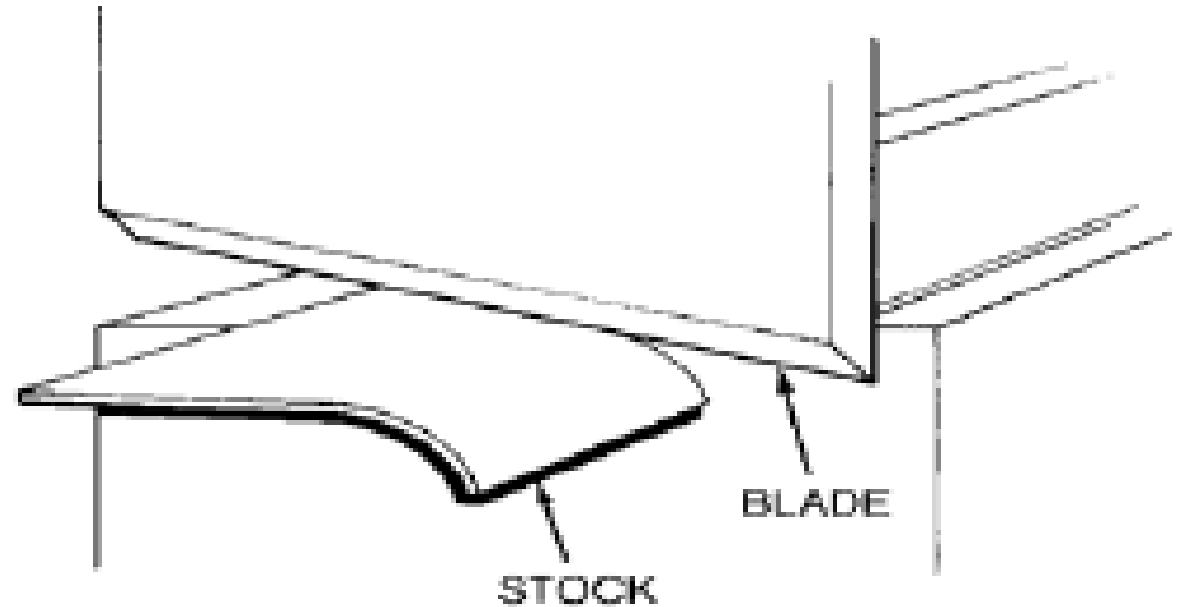
Point of contact between a chain and a sprocket



Hazardous Machine Actions – Shearing

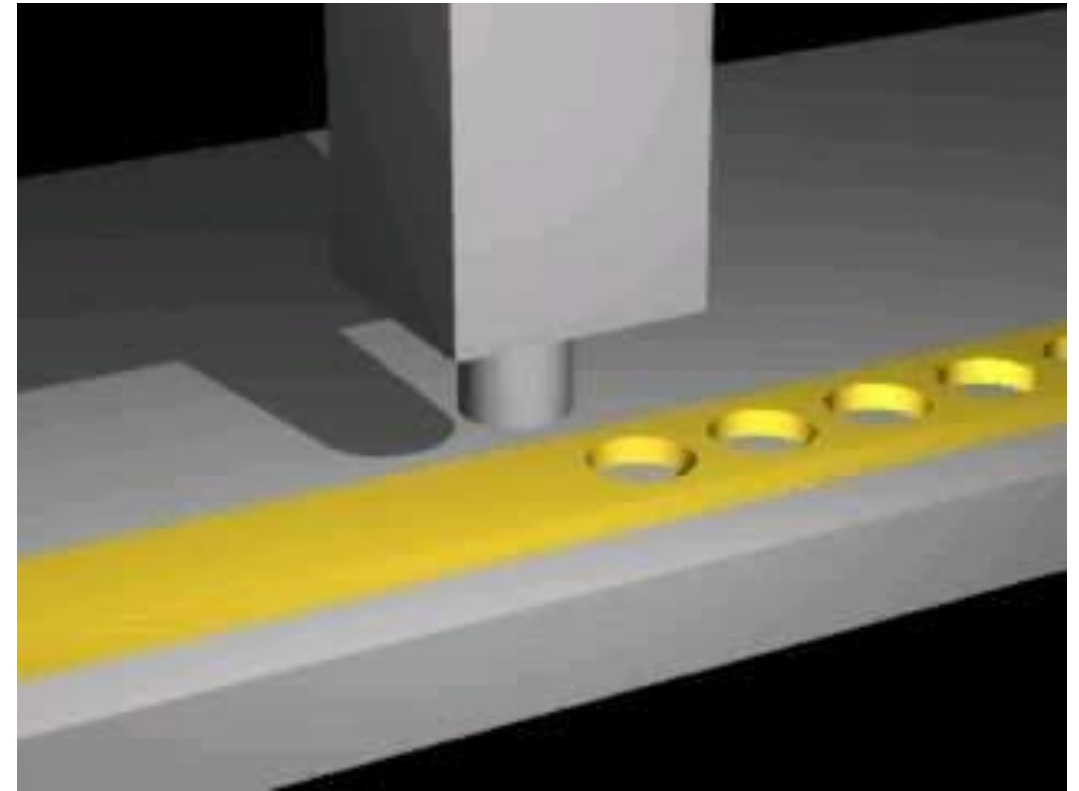
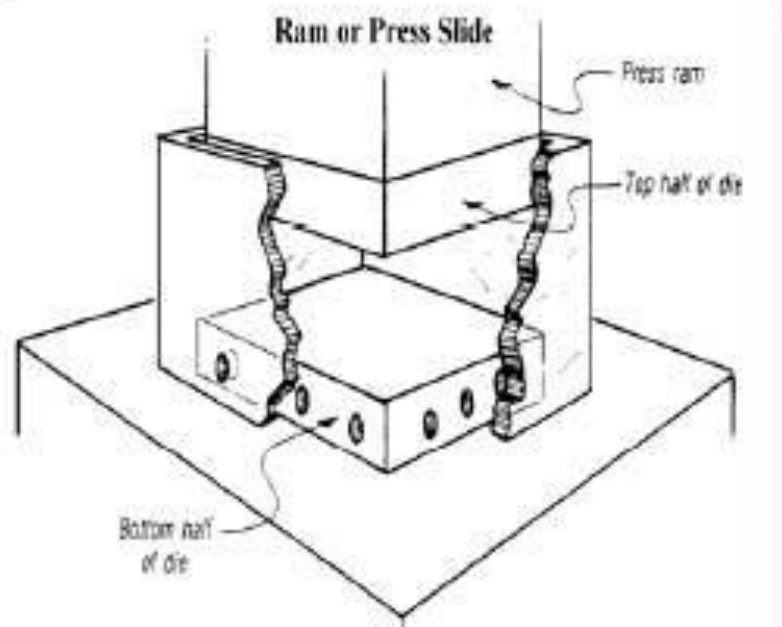


Shearing action

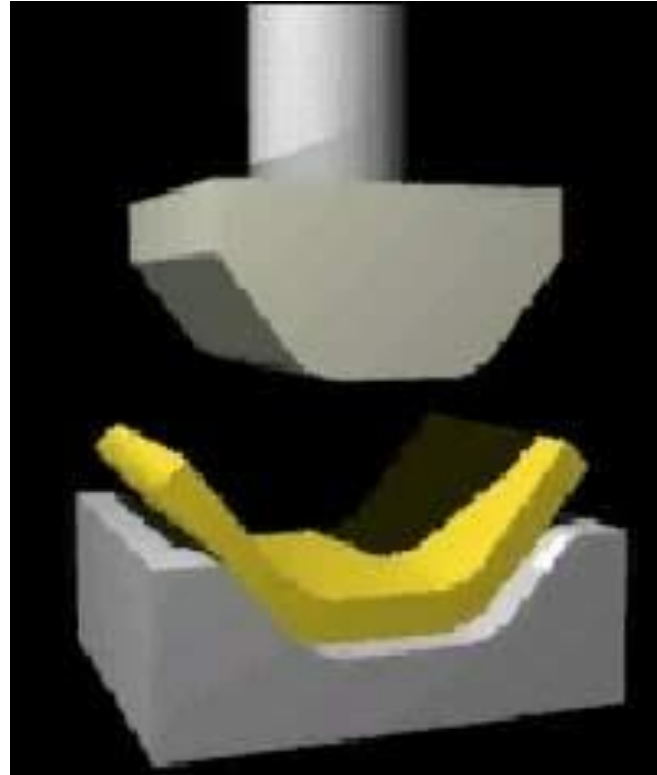


Hazardous Machine Actions – Punching

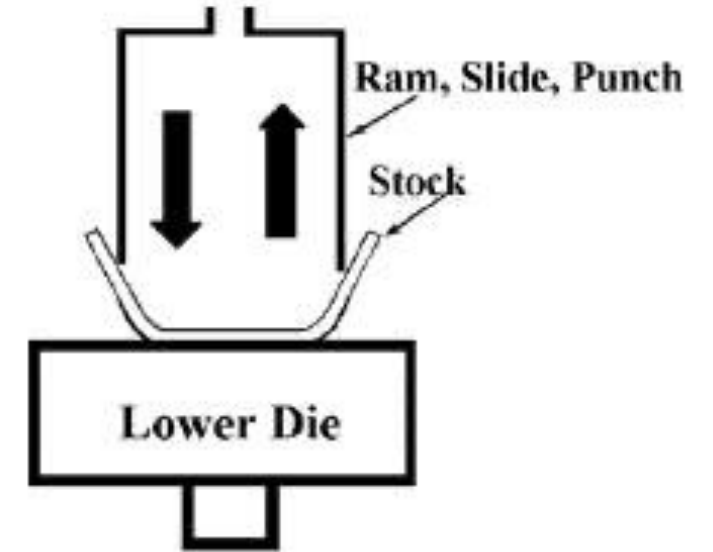
Punching action



Hazardous Machine Actions – Bending

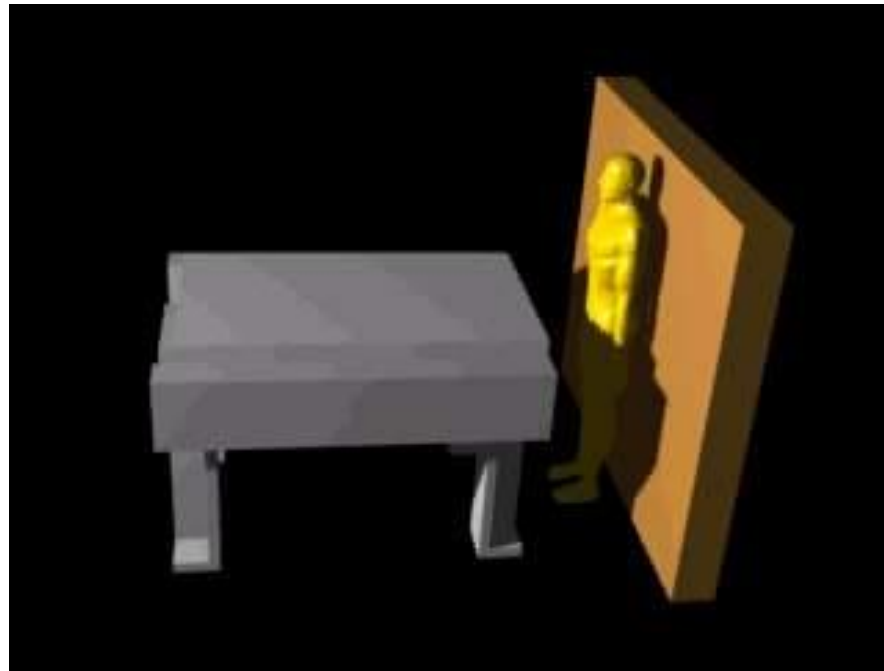
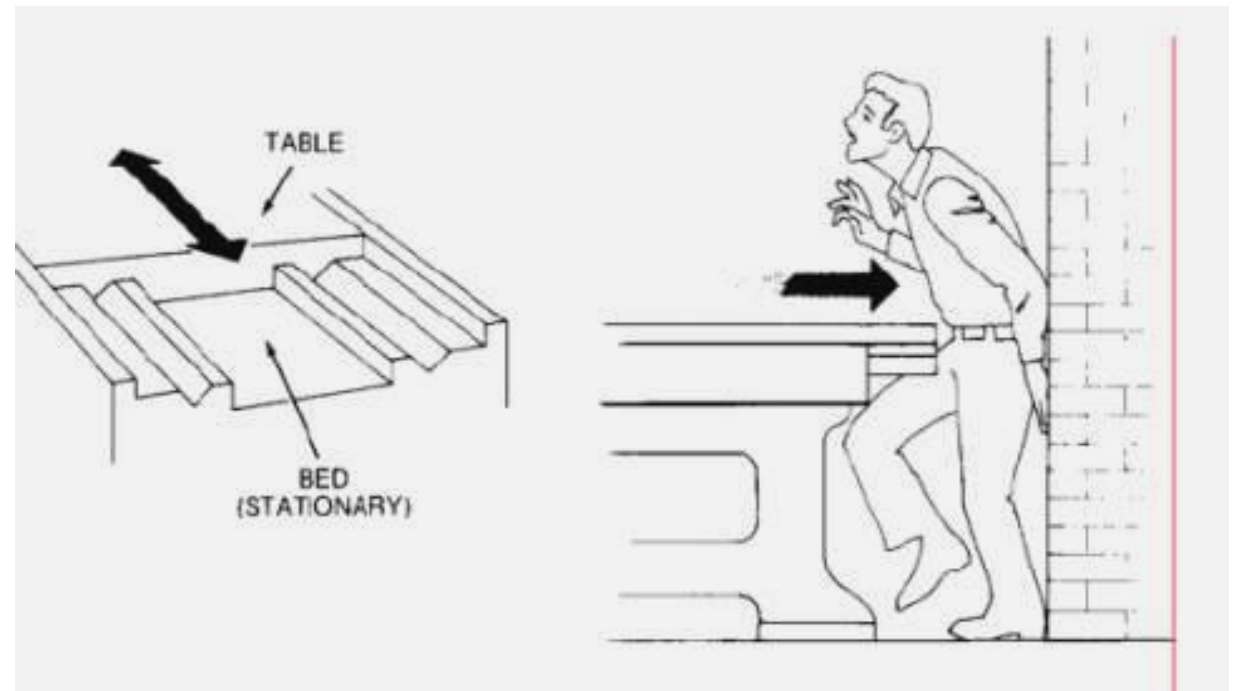


Bending action



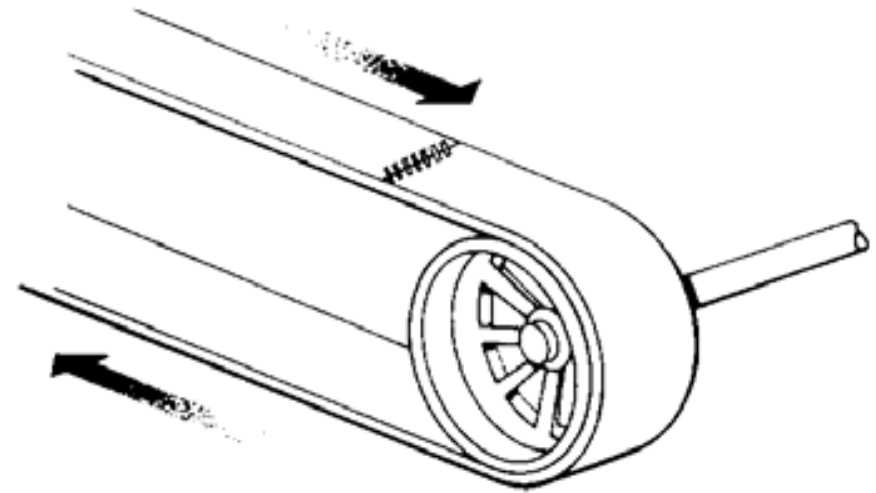
Reciprocating Motions

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



Transverse Motion

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



Transverse Motion of Belt



Methods Of Safeguarding

There are many ways to safeguard machinery, and that means any method of preventing employee contact with the moving part. Conducting a proper Risk Assessment will identify these areas.

To help determine if a piece of equipment or machinery needs guarding use “OUTA”

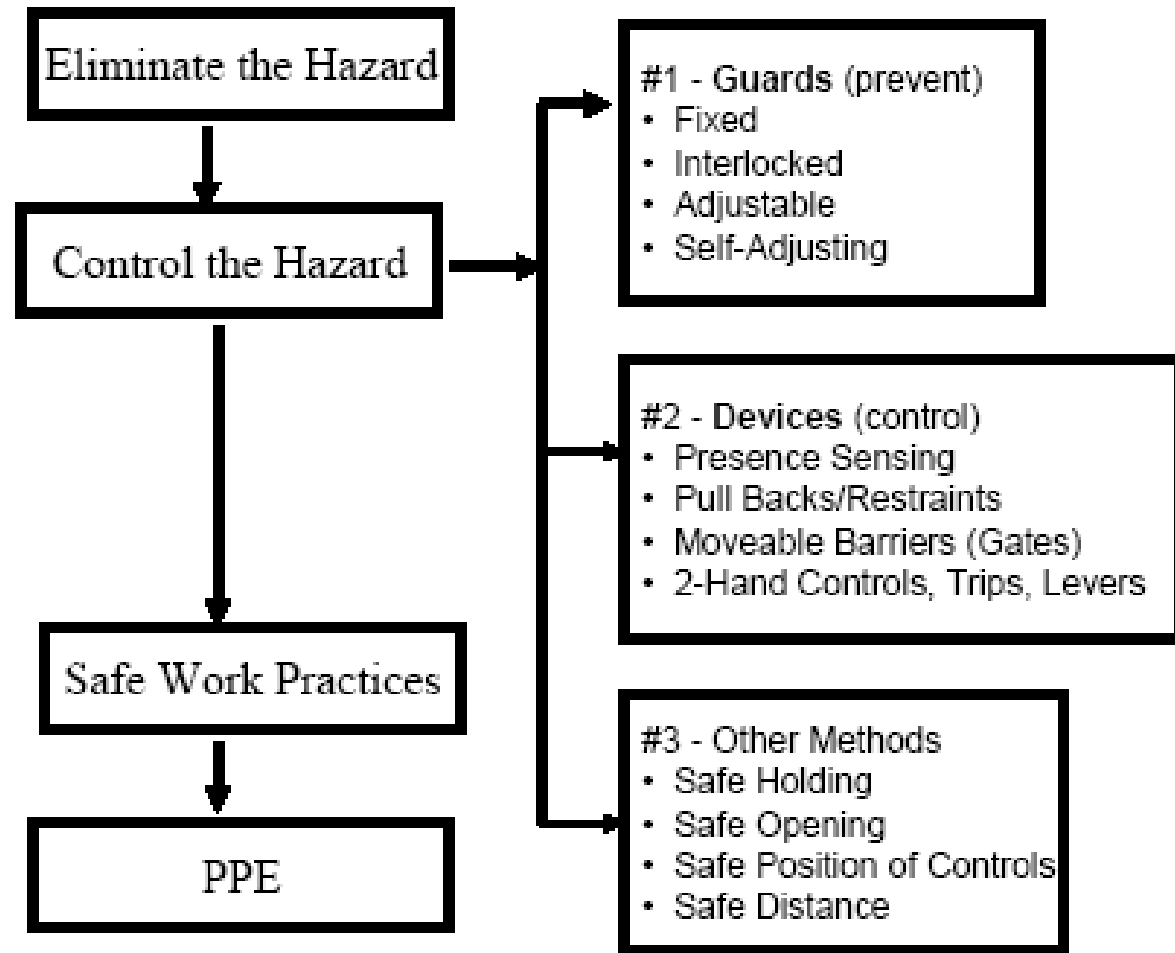
- Can I reach OVER
- Can I reach UNDER
- Can I reach Through
- Can I reach Around

If you can encounter the hazard by these means then it will need some type of safeguarding.

Develop & Implement Program

Safeguarding strategies are grouped under these general classifications:

Safeguarding



Effective Guards

An effective guard must . . .

1. Prevent contact
2. Secured and well constructed
3. Protect from falling objects/contain the hazard
4. Create no new hazards
5. Create no interference
6. Allow safe lubrication

A “GUARD” prevents entry into the danger area!



Machine Guards/Guarding

There are four types of machine guards:

1. *Fixed*
2. *Interlocked*
3. *Adjustable*
4. *Self-adjusting*

First Choice – Guards

Barriers that prevent access

Fixed guards are usually a permanent part of the machine that prevent access to the danger area.

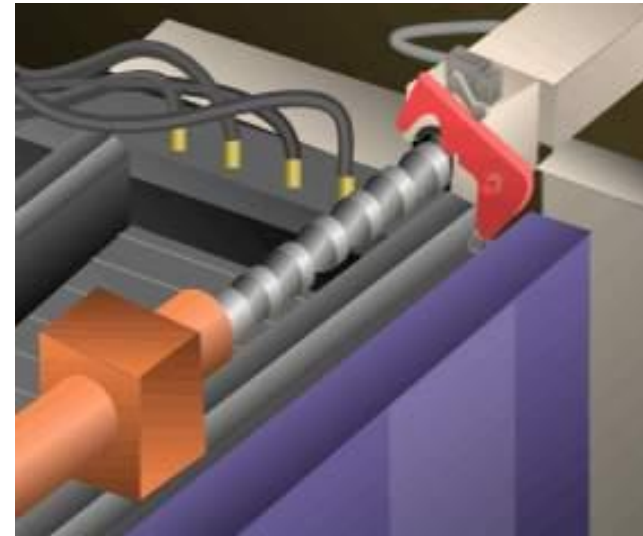
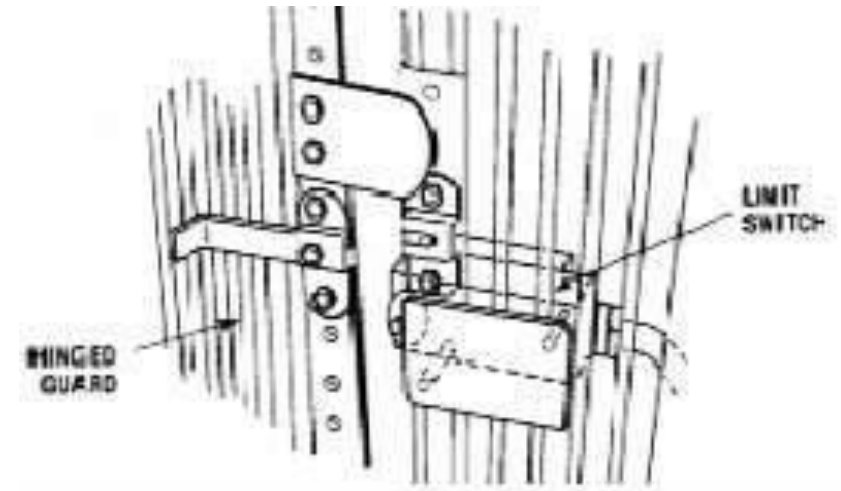
Fixed Guards

- Permanent part of the machine
- Not dependent upon moving parts to perform its intended function
- Constructed of sheet metal, screen, wire cloth, bars, plastic or other substantial material.
- Usually preferable to all other types because of its relative simplicity and permanence.



Interlocked Guards

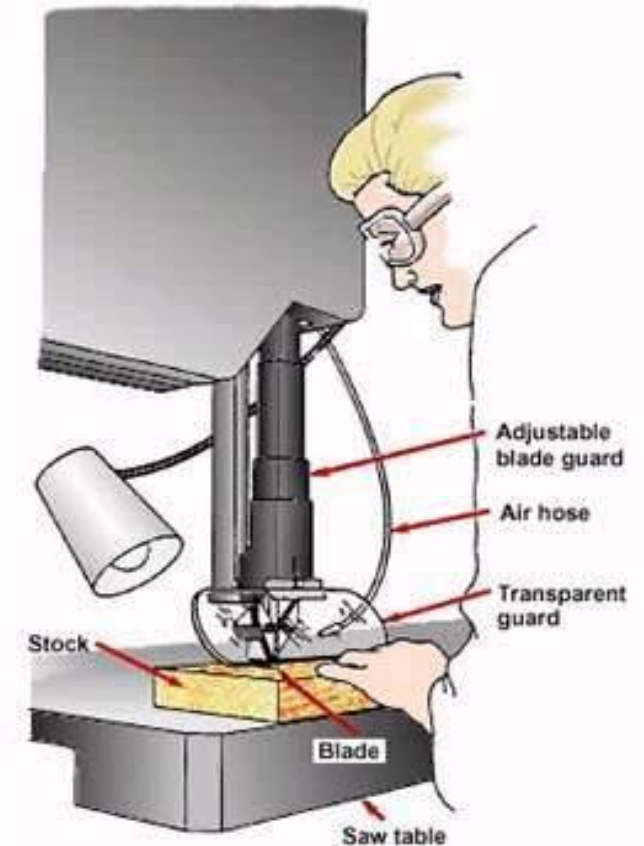
When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place.



Adjustable Guards

Self-Adjusting Guard: *The openings of these barriers are determined by the movement of the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator.*

Adjustable guards allow flexibility in accommodating various sizes of stock.



Machine Guarding Devices

A “device” controls entry into the danger area.

Six types of Machine Devices:

1. *Presence sensing device*
2. *Two hand control*
3. *Pullbacks/restraints*
4. *Moveable barriers (gates)*
5. *Safety trip controls*

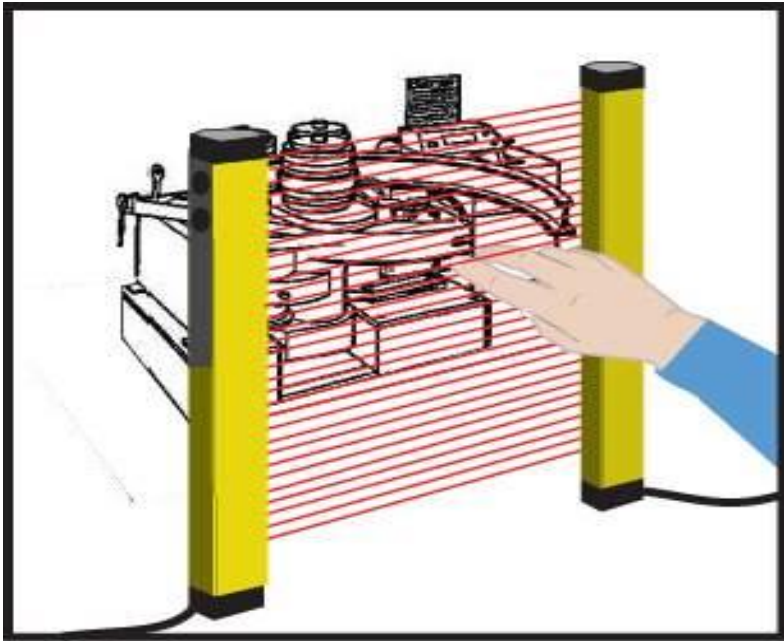
Second Choice – Devices (Control Access)

Devices control access to the point of operation and may replace or supplement guards. To qualify as a device, it may perform one of several functions.

- Stop the machine if a hand or any part of the body is inadvertently placed in the danger area
- Restrain or withdraw the operator's hands from the danger area during operation.
- Require the operator to use both hands-on machine controls, thus keeping both hands and body out of danger.
- Provide a barrier which 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.
- Allow safe lubrication and maintenance and not create hazards or interfere with normal machine operation.
- 7/9Be secure, tamper-resistant and durable.

Presence Sensing Device

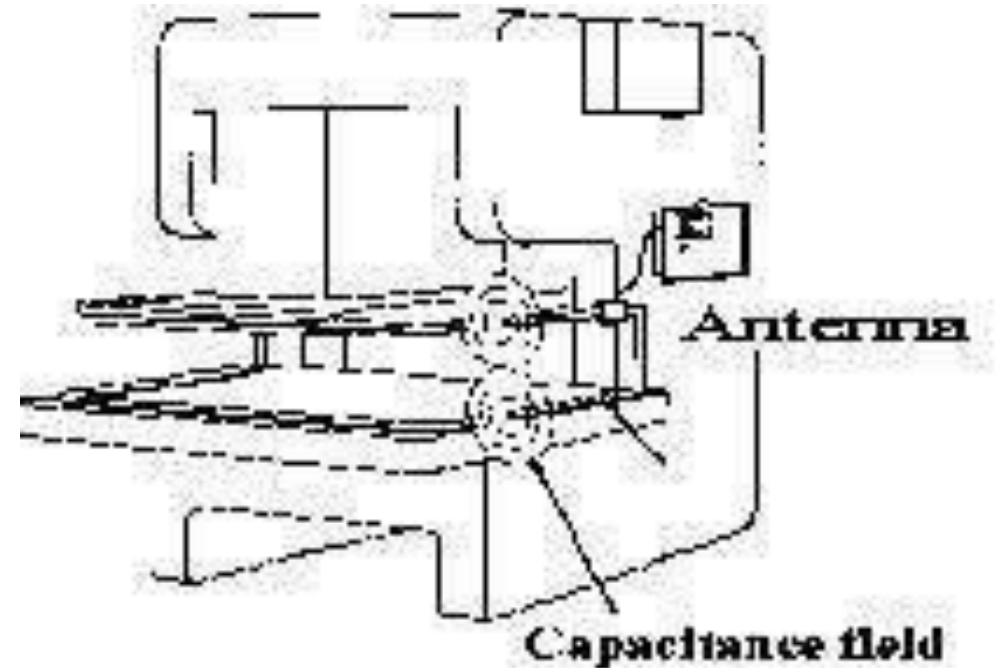
These devices either stop the machine, or will not start the cycle, if a hand or any part of the body is inadvertently placed in the danger area. There are 4 types of presence sensing devices.



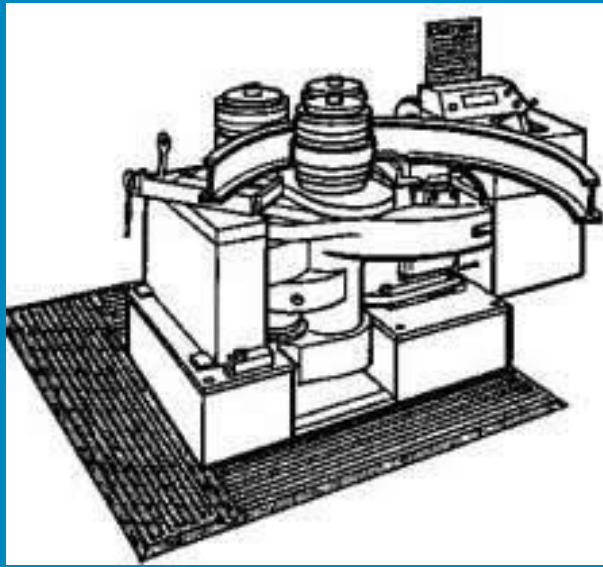
The light curtain (photoelectric-optical) presence sensing device uses a system of light sources and controls that can interrupt the machine's operating cycle. If the light field is broken, the machine stops and will not cycle. This device must be used only on machines which can be stopped before the worker can reach the danger area. The light curtain must be positioned at a minimum safe distance from the machine's point of operation. If the light curtain is too close to the point of operation, the worker's hand could reach a danger zone before the machine has time to stop.

Presence Sensing Device

Radiofrequency presence-sensing device



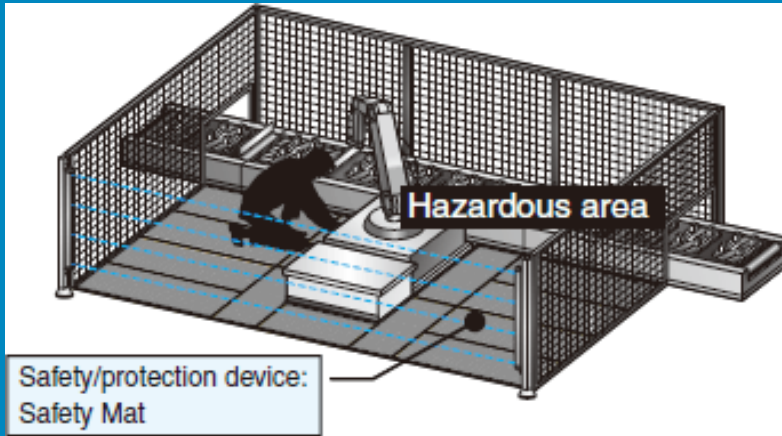
Presence Sensing Devices



Safety Mat

The safety mat is a pressure sensitive safeguarding product that is designed to detect the presence of people on its sensing surface. Picture shows guarding application using pressure sensitive floor mats. It can be used to detect the presence of someone or something within the protected area and can be used to safeguard a floor area around a machine or robot.

A matrix of interconnected mats (safety mat system) can be laid around the hazardous area and any pressure (e.g. an operator's footstep) will cause the controller unit to send a stop signal to the machine. They can also be used as a point of entry alert method. Other safeguarding devices such as pressure sensitive safety edges and bumpers also fall into this family of devices.



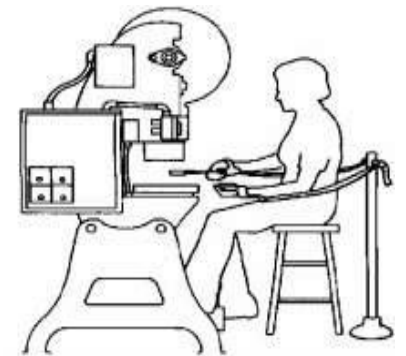
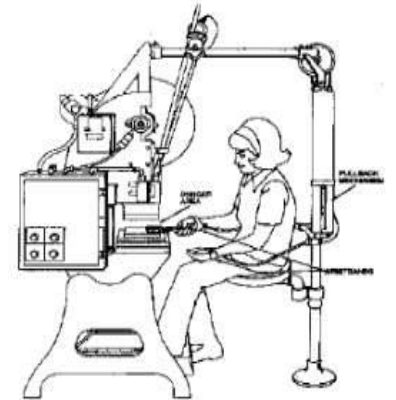
Source: Omron Industrial Automation

Guarding Devices – Pullback/Restrains

Uses a series of cables attached to the operator's hands, wrists, and/or arms and to a moving or fixed point.

The ***pullback*** is primarily used on machines with stroking action. When the slide/ram is up, the operator is allowed access to the point of operation. When the slide/ram begins to descend, a mechanical linkage automatically assures withdrawal of the hands from the point of operation.

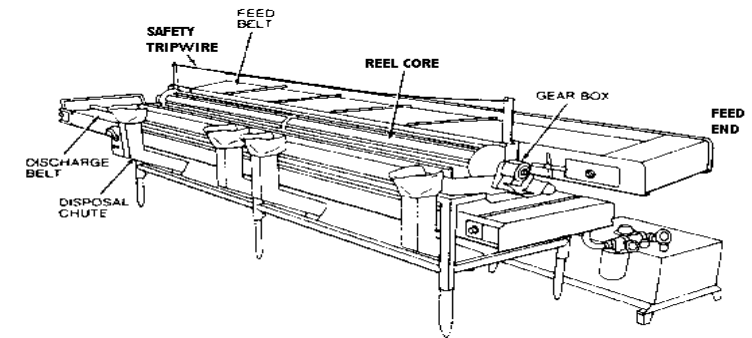
The ***restraint*** (holdout) device uses cables or straps that are attached to the operator's hands and a fixed point. The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area. There is no extending or retracting action involved. Consequently, hand-feeding tools are often necessary if the operation involves placing material into the danger area.



Guarding Devices – Safety Trip Controls

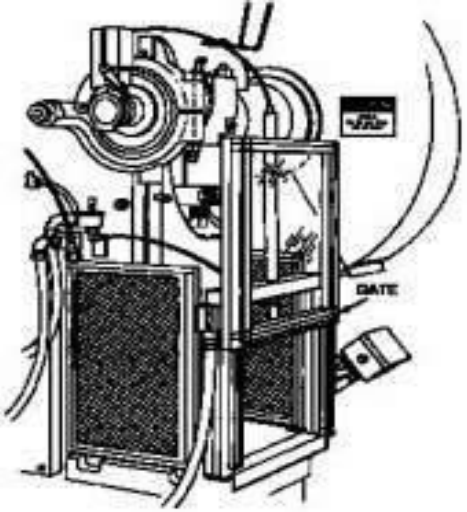
These devices provide a quick means for deactivating the machine in an emergency situation.

- A **pressure-sensitive body bar**, when depressed, will deactivate the machine. If the operator or anyone trips, loses balance, or is drawn toward the machine, applying pressure to the bar will stop the operation. The positioning of the bar, therefore, is critical. It must stop the machine before a part of the employee's body reaches the danger area.
- When pressed by hand, the **safety trip-rod** deactivates the machine. Because it has to be actuated by the operator during an emergency situation, its proper position is also critical.
- **Safety tripwire cables** are located around the perimeter of or near the danger area. The operator must be able to reach the cable with either hand to stop the machine. All of these tripwires, rods or other safety devices must be manually reset to restart the machine.



Guarding Devices – Gates & Movable Barriers

A gate is a moveable barrier which protects the operator at the point of operation before the machine cycle can be started.



Gates are, in many instances, designed to be operated with each machine cycle. If the gate is not permitted to descend to the fully closed position, the press will not function. Another potential application of this type of guard is where the gate is a component of a perimeter safeguarding system. Here the gate may provide protection not only to the operator but to pedestrian traffic as well. There are two types of gate functions:

A type “A” gate remains closed during the entire cycle of the machine. Use for full or part revolution clutches.

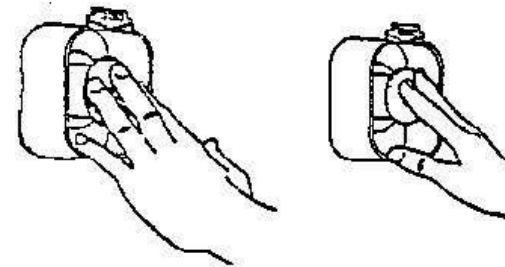
A type “B” gate opens after the die closing portion of the machine cycle has been completed. Use for part revolution clutch only.

Guarding Devices – Two Hand Controls/Trips

These devices prevent the operator from reaching into the point of operation when the machine cycles by requiring the hands to be on palm buttons or levers.

The **two-hand control** requires constant, concurrent pressure by the operator to activate the machine. This kind of control requires a part-revolution clutch, brake, and brake monitor if used on a power press as shown. With this type of device, the operator's hands are required to be at a safe location (on control buttons) and at a minimum safe distance from the danger area while the machine completes its closing cycle.

The **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 usually 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 operator to move his or her hands from the trip buttons or handles into the point of operation before the first half of the cycle is completed. Thus the operator's hands are kept far enough away to prevent them from being accidentally placed in the danger area prior to the slide/ram or blade reaching the full "down" position.



Machine Guarding Other Methods

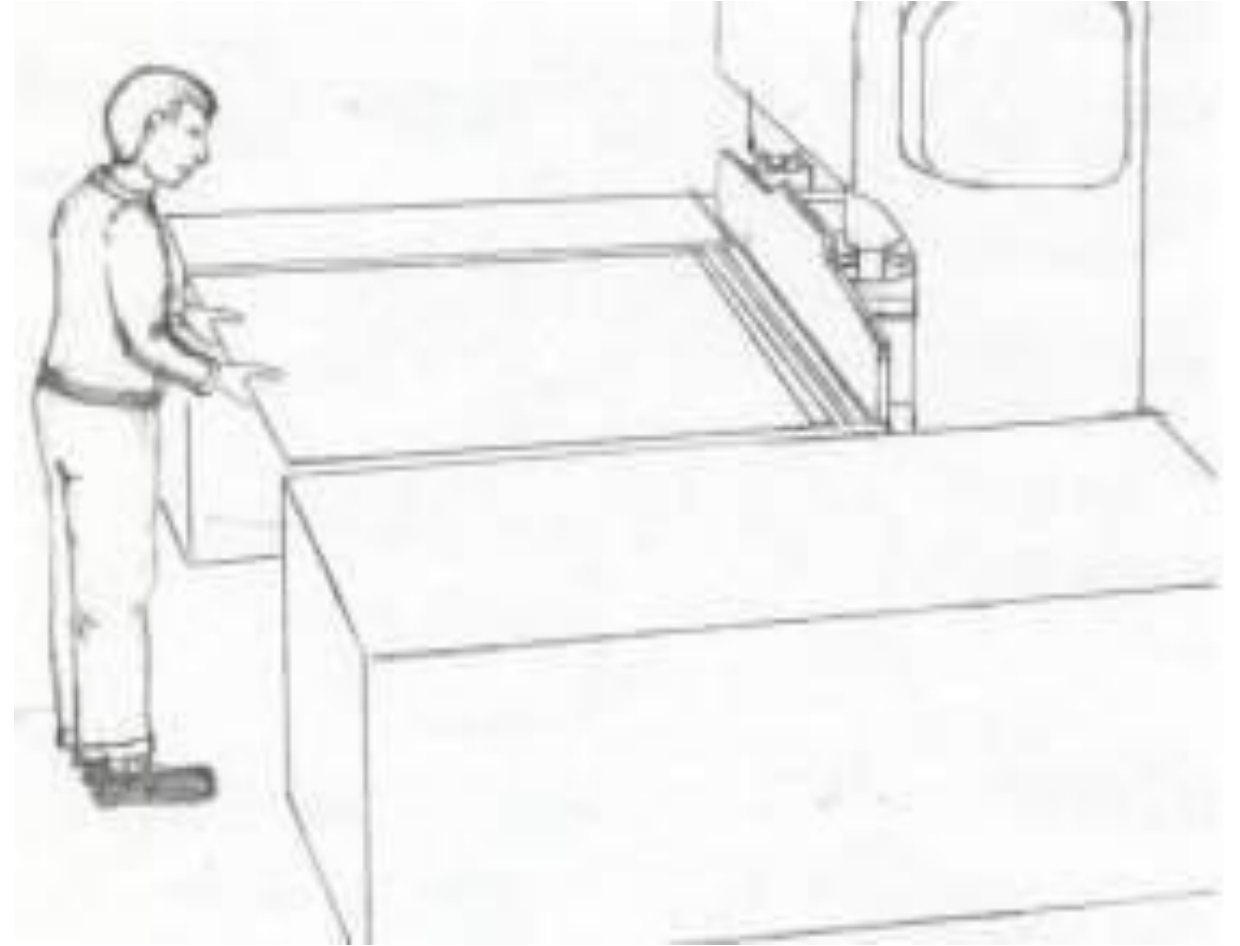
When guards or devices cannot be used, “Other Methods” can be selected. These other methods (safe distance, safe holding, safe opening, safe position of controls) are methods of safeguarding that can be applied to machines with unique safeguarding problems.

Other methods do not provide the protection of guards or devices. These methods require placement or adjustment for each operation. They depend upon specific procedures, work rules, extensive training and supervision to prevent the tendency to circumvent the method used.

Other Methods

Safe Holding

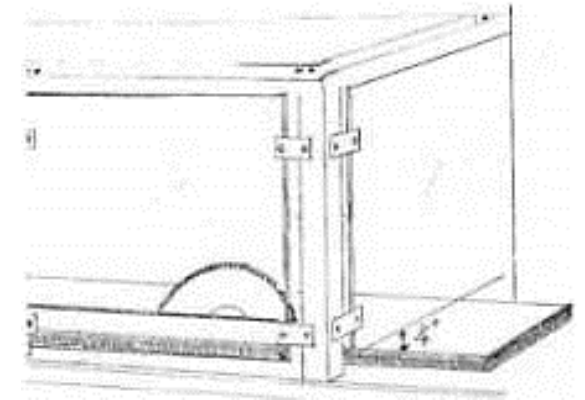
This method is one that is designed and constructed so when the operator is required to hold or support the work piece, the operator is prevented from inadvertently reaching into the hazard area.



Other Methods – Safe Opening

This method is one that provides small opening to the hazardous area. It meets one of the following conditions:

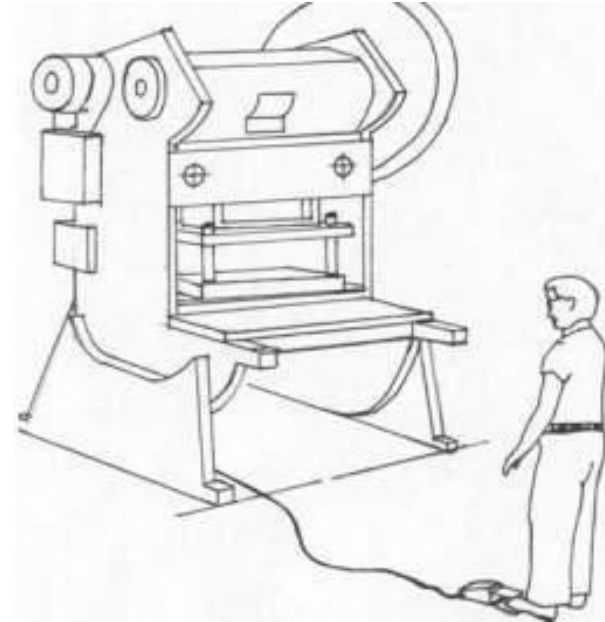
1. The opening, when no work piece is in place is small enough to prevent any part of operator's body from entering the area (1/4 inch or less opening); or
2. When part is in place, opening is only 1/4 inch to prevent any part of the operator's body from entering the hazardous area. The machine cannot cycle unless the work piece is in place. Openings for two-dimensional work pieces meet the following conditions:
 - Maximum area of any guard opening should be 7 square inches (example: opening 2-1/2 inches by 2-1/2 inches has an area of 6-1/4 inches);
 - Longest dimension of a rectangular opening should be 3.5 inches;
 - The maximum shorter dimension of the rectangular opening should be 2 inches;
 - The minimum distance from the guard to any point of operation is 4 inches.



Other Methods – Safe Position of Controls

Operating controls are properly positioned by one of these methods:

1. Controls that require continuous actuation to complete the hazardous portion of the cycle positioned so that no part of the operator's body can reach the hazardous area during the hazardous portion of the cycle or until cessation of hazardous motion; or
2. Controls for single-cycle machines located far enough from the hazardous area that no part of the operator's body can enter before the machine completes the hazardous portion of its cycle or until cessation of motion. Remote controls cannot be easily moved or are securely fixed in position.

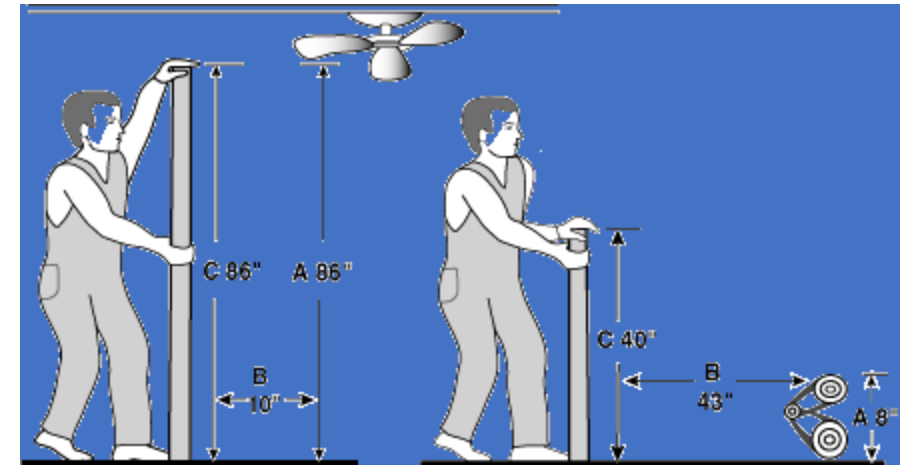


Other Methods – Safe Distance

Eliminates the need for operator's hands or other parts of the body to be in or near the hazardous area during the hazardous portion of the cycle by one of the following:

1. Work practice;
2. Size and location of work piece; or
3. Operator location where the operator is not required to place any part of body within the established safe distance during hazardous portion of cycle, nor is the operator required to enter the safe distance for the purpose of loading, unloading, adjusting, measuring, cleaning.

[Link to Table 200-2 – safe distance for fixed barricades](#)





Managing the Safeguarding Program

There is more to machine safeguarding than just guarding machines. The employer must:

- Ensure that employees are trained to do the job,
- Ensure that employees wears personal protective equipment to protect against other hazards,
- Establish safe operating procedures,
- Supervise to ensure compliance with company rules.



Managing the Safeguarding Program

Even the most elaborate safeguarding system cannot offer effective protection unless the worker 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. Thorough operator training should involve instruction or hands-on training in the following key areas:

1. Parts and functions of the machine
2. Basic operator controls
3. Operator Responsibilities
4. Safeguarding
 - A description and identification of the hazards associated with particular
 - How to use the safeguards and why
 - How and under what circumstances safeguards can be removed, and by whom (in most cases, repairs or maintenance personnel only).
 - What to do (e.g., contact the supervisor) if a safeguard is damaged, missing, or unable to provide adequate protection.

This training is necessary for new operators and maintenance or setup personnel, when any new or altered safeguards are put in service, or when workers are assigned to a new machine or operation.

Further Information

Oregon OSHA – [Machine Safeguarding at the Point of Operation](#)

U.S. Dept of Health and Humane Services – [Preventing Scalping and Other Severe Injuries from Farm Machinery](#)

OSHA – [Safeguarding Equipment and Protecting Workers from Amputations](#)

OSHA – [Guide for Protecting Workers from Woodworking Hazards](#)

WorkSafe BC – [Safeguarding in Metal Products Manufacturing](#)

WorkSafe BC – [Safeguarding in Food Products Manufacturing](#)