1.0 Machine Guarding

All machines consist of three fundamental areas: the point of operation, the power transmission device, and the operating controls. Despite all machines having these same essential components, their safeguarding needs widely differ due to varying physical characteristics and operator involvement.

The point of operation is the location where work is performed on the material, such as cutting, shaping, boring, or forming of stock. The power transmission device or apparatus consists of all the components of the mechanical system which transmit energy to the part of the machine performing the work. Power transmission devices must be inspected every 60 days. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears. Operating controls are mechanical or electrical power controls provided on each machine to allow the operator to disconnect the power from the device without leaving their position at the point of operation.

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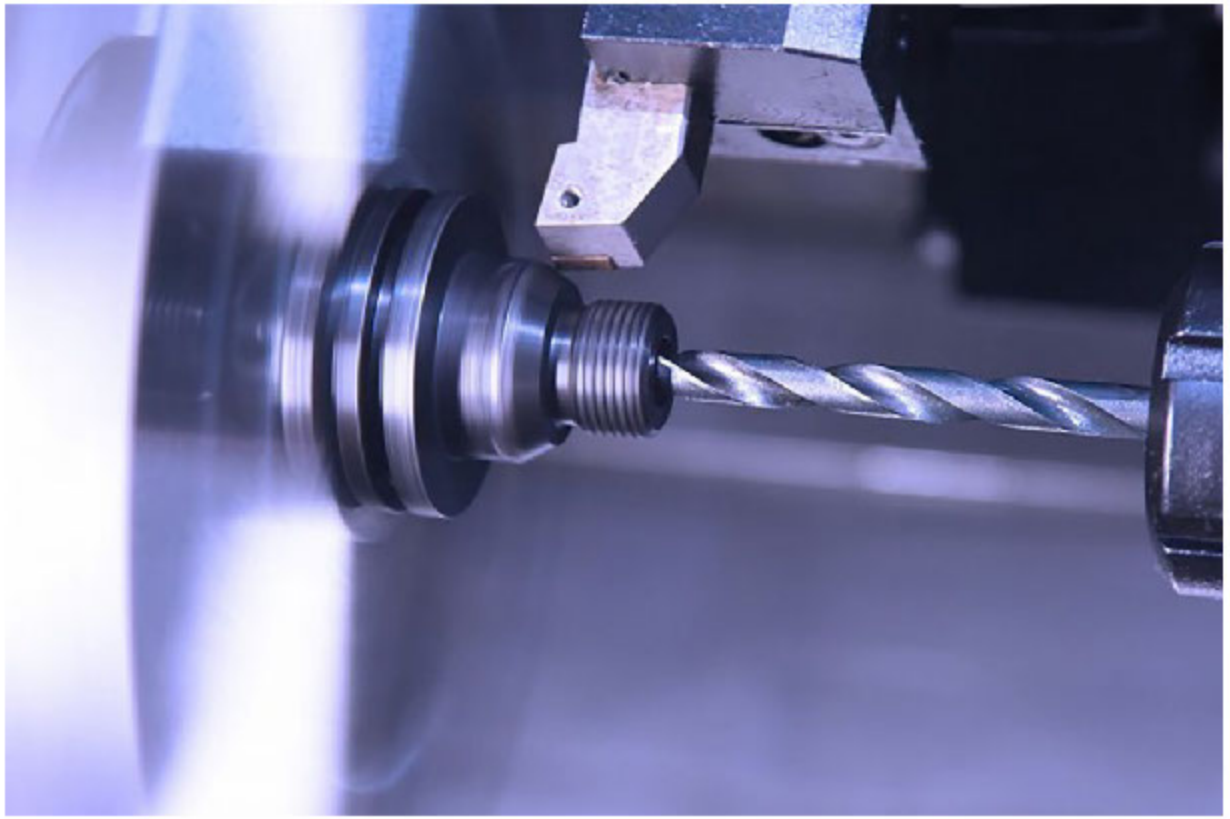
1.3 Hazardous Motions

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



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1.3.1 Rotating

Rotating motion can be very dangerous. Even smooth, slowly rotating shafts can grip hair and clothing and, through only minor contact, can force the hand and arm into a hazardous position. Injuries due to contact with rotating parts can be severe. Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms which may be hazardous. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys are exposed on rotating parts. Click play on the video to see how quickly loose clothing can be grabbed by a rotating shaft.

Click Box

1.3.2 In-Running Nip Points

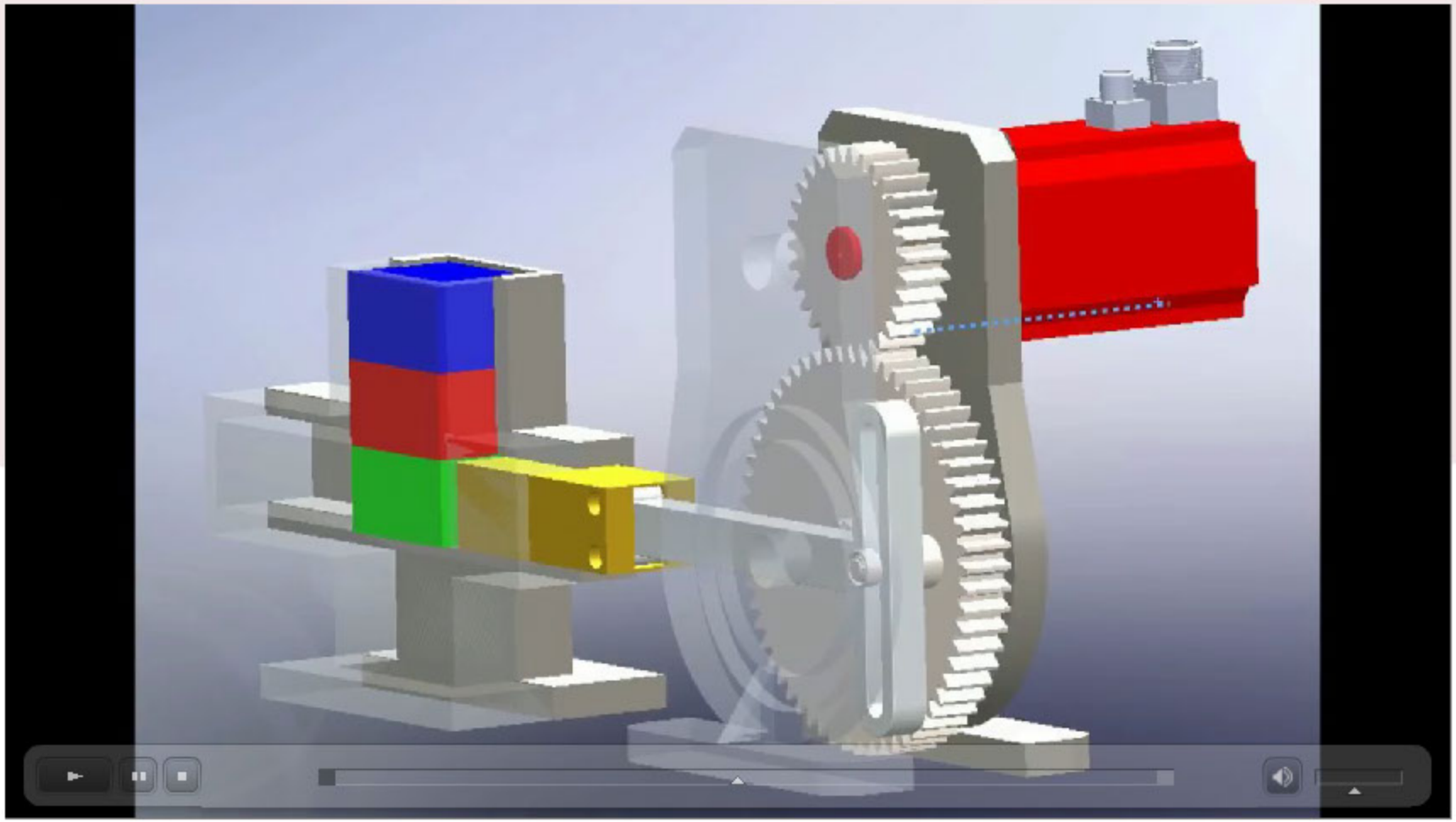
Rotating machinery parts cause in-running nip point hazards. There are three main types of in-running nips. Parts can rotate in opposite directions while their axes are parallel to each other. These parts may be in contact (producing a nip point) or nearby. In the latter case, stock fed between two rolls produces a nip point. As seen here, this danger is common on machines with intermeshing gears, rolling mills, and calendars.

Nip points are also created between rotating and tangentially moving parts. Some examples include the following: the point of contact between a power transmission belt and its pulley, a chain and a sprocket, and a rack and pinion.

Nip points can occur between rotating and fixed parts which create a shearing, crushing, or abrading action. Examples include spoked handwheels or flywheels, screw conveyors, the periphery of an abrasive wheel, and an incorrectly-adjusted work rest and tongue.

1.3.3 Reciprocating

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



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1.3.4 Transversing

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

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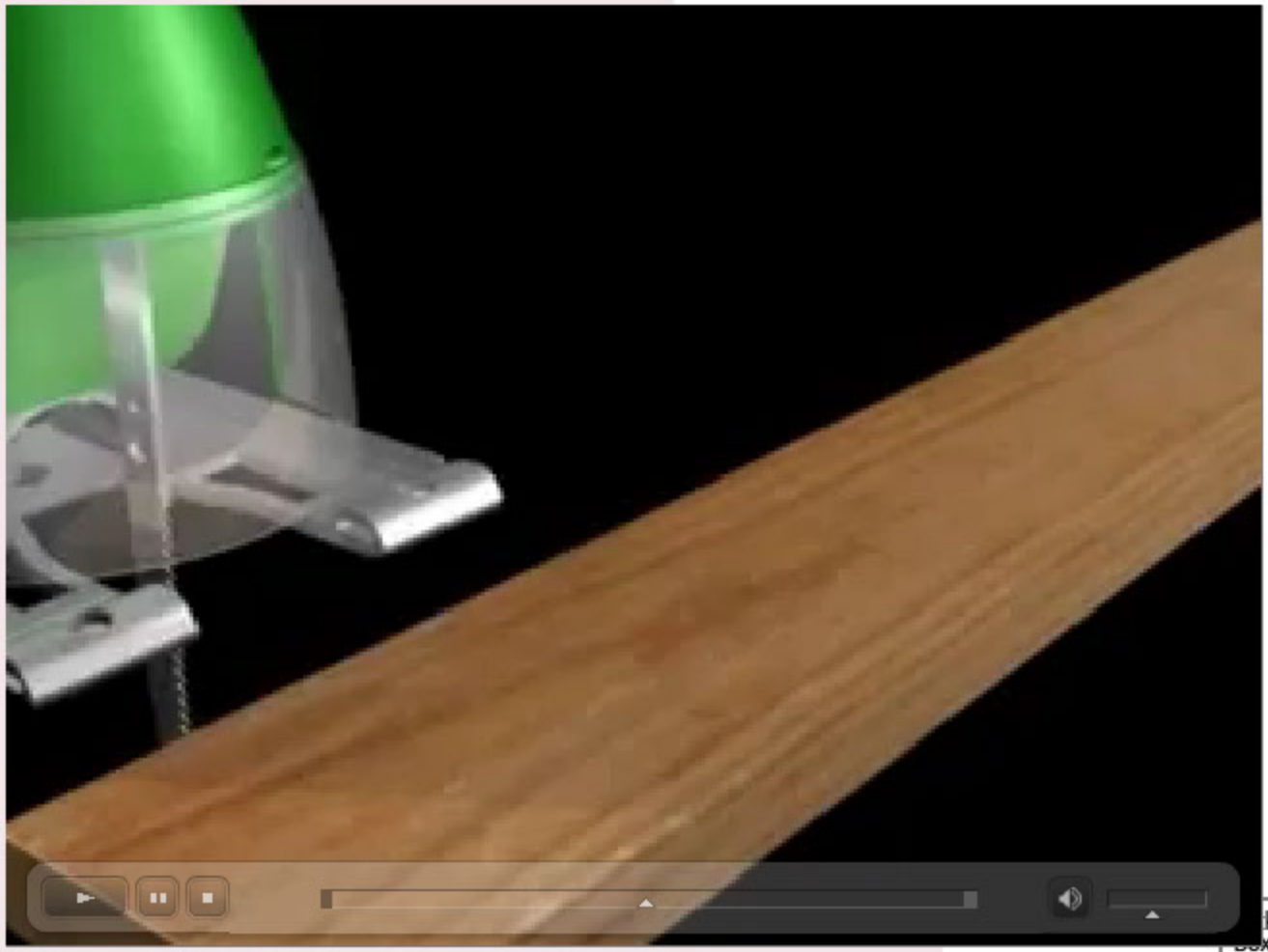
1.4 Hazardous Actions

The different types of hazardous actions are basic in varying combinations to nearly all machines and recognizing them is the first step toward protecting employees from the danger they present.

Click Box

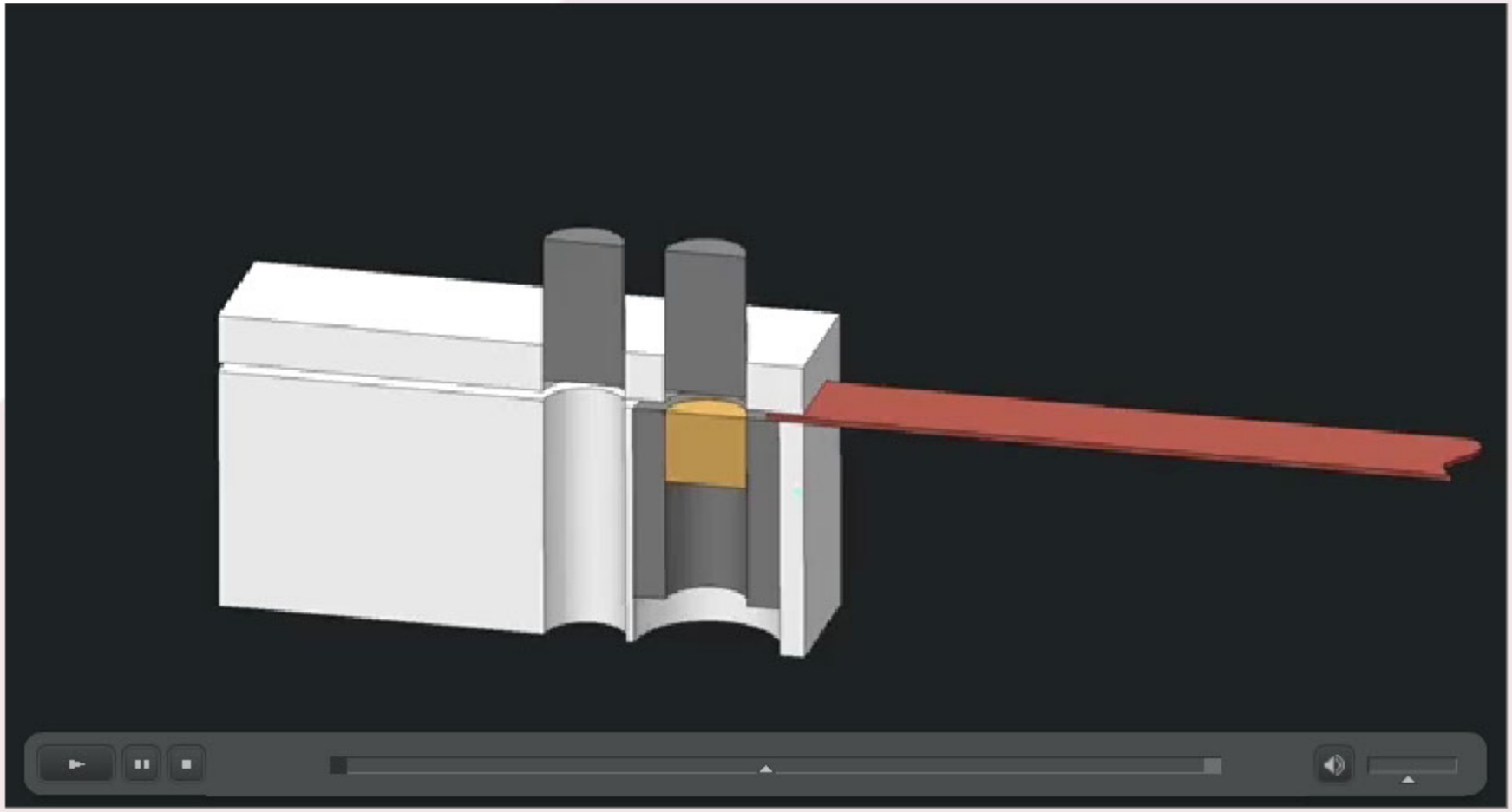
1.4.1 Cutting

Cutting action may involve rotating, reciprocating, or transversing motion. The danger of cutting action exists at the point of operation where finger, arm, and body injuries can occur and where flying chips or scrap material can strike the head, particularly in the area of the eyes or face. Such hazards are present at the point of operation in cutting wood, metal, and other materials. Examples of mechanisms involving cutting hazards include bandsaws, circular saws, boring and drilling machines, turning machines (lathes), or milling machines.



1.4.2 Punching

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



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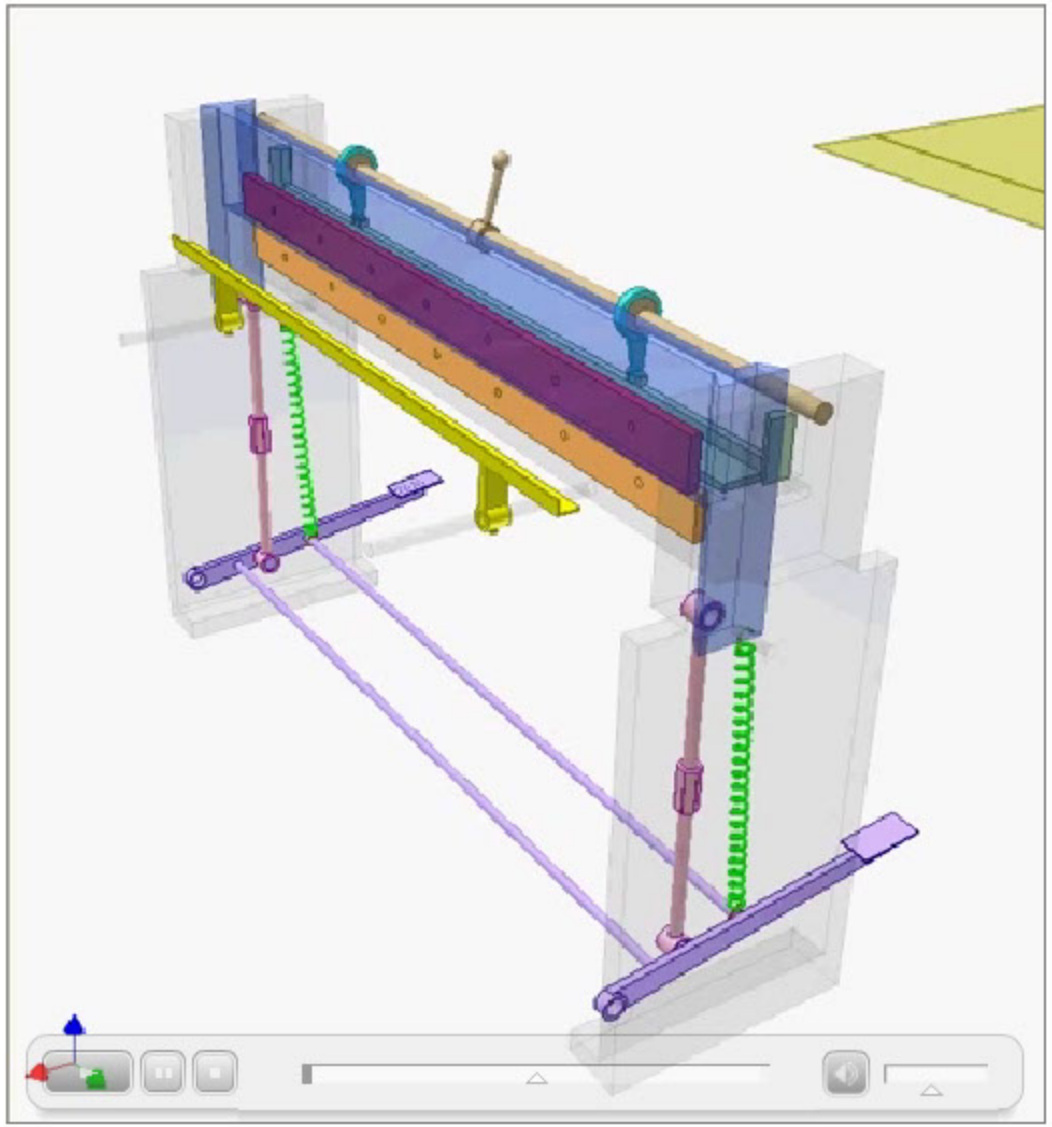
1.4.3 Shearing



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

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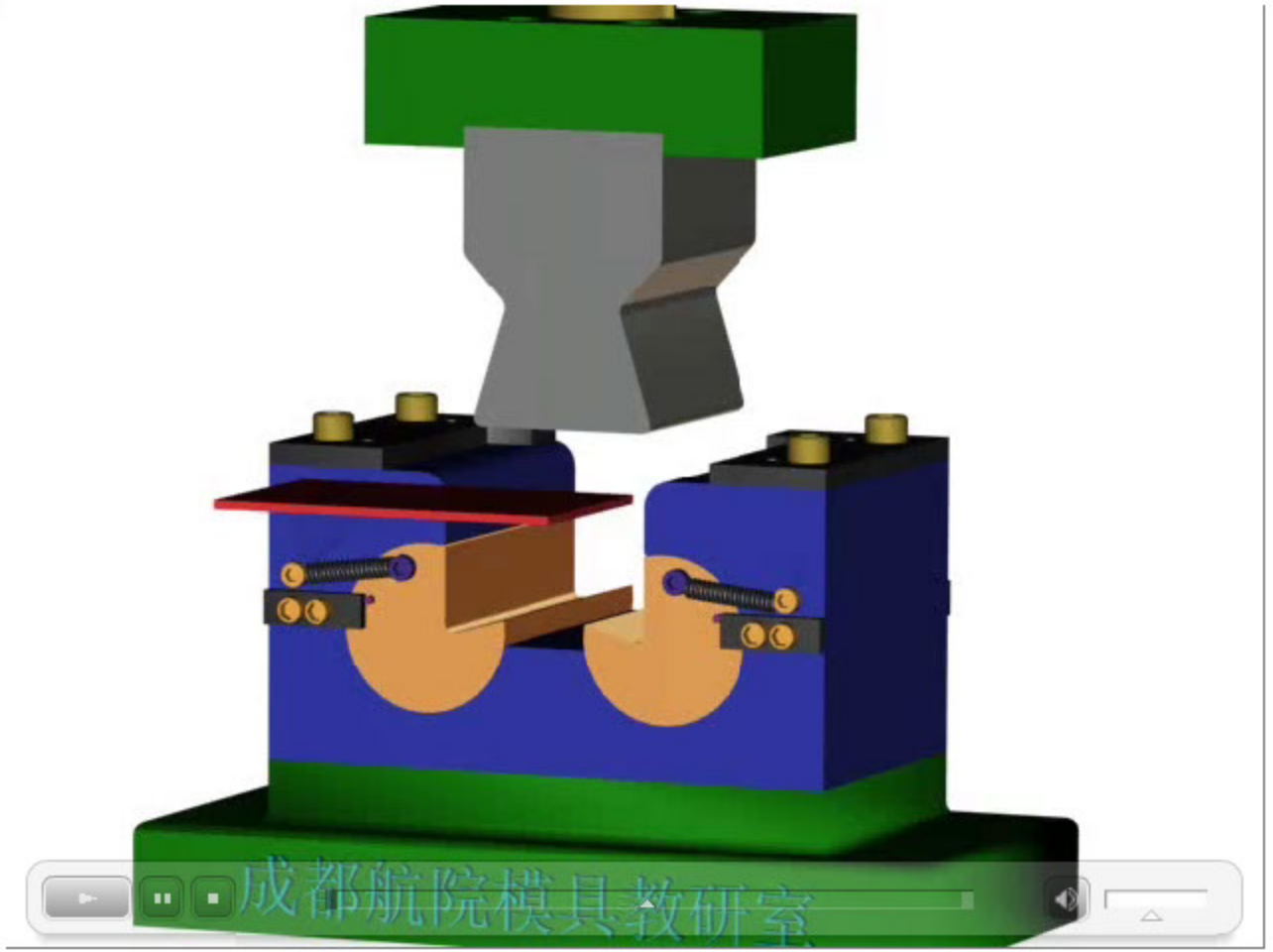
1.4.4 Bending

Bending action results when power is applied to a slide to draw or stamp metal or other materials. A hazard occurs at the point of operation where the stock is inserted, held, and withdrawn. Equipment that uses bending action includes power presses, press brakes, and tubing benders.



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1.5 General Safety Considerations

Safeguards must meet these minimum general requirements:

- ***Prevent Contact:*** The safeguard must prevent hands, arms, and any other part of an employee's body from contacting dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing portions of their bodies near harmful moving parts.

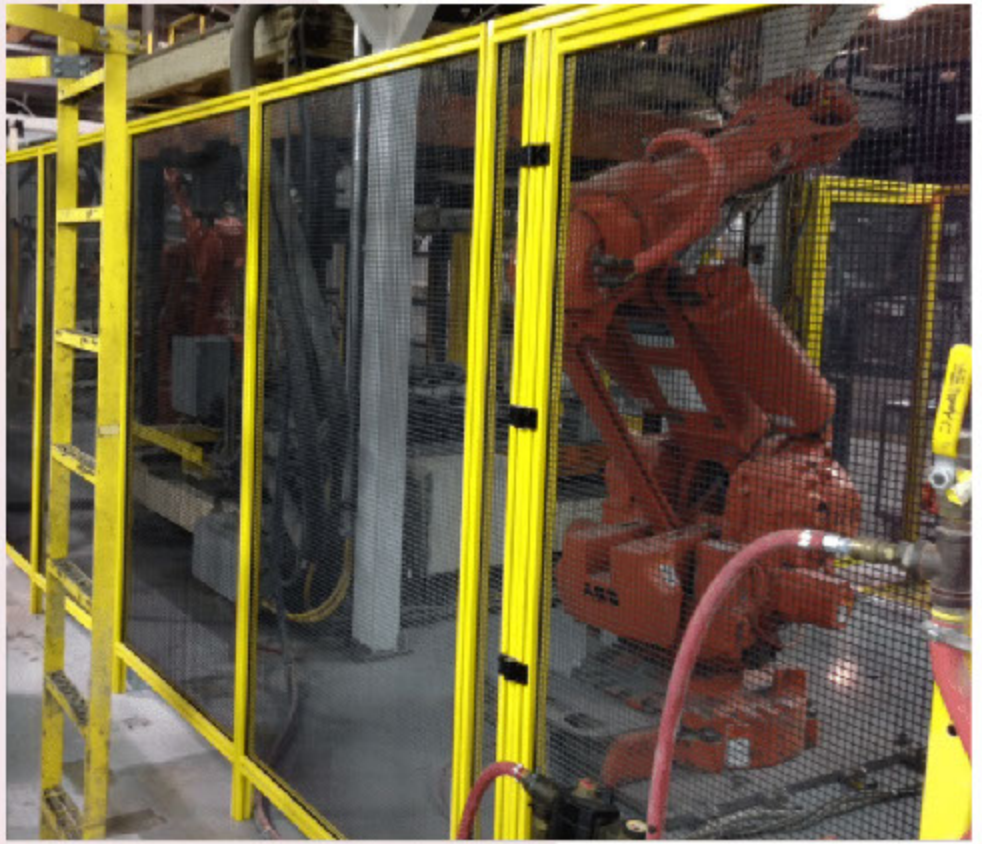
- ***Secure:*** Employees should not be able to remove or tamper with the safeguard easily, because a safeguard that can easily be made ineffective is no safeguard at all. Guards and safety devices should be constructed of durable material that will withstand the conditions of regular use. They must be firmly secured to the machine.

1.5 General Safety Considerations

- ***Protect from Falling Objects:*** The safeguard should ensure that no objects can fall into moving parts. A small tool which is dropped into a cycling machine could easily become a projectile that could strike and injure someone.

- ***Create No New Hazards:*** A safeguard defeats its own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration. The edges of guards, for instance, should be rolled or bolted in such a way that they eliminate sharp edges.

- ***Create no interference:*** Any safeguard which impedes a worker from performing the job quickly and comfortably might soon be overridden or disregarded. Proper safeguarding can enhance efficiency as it can relieve the employee's apprehensions about injury.



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

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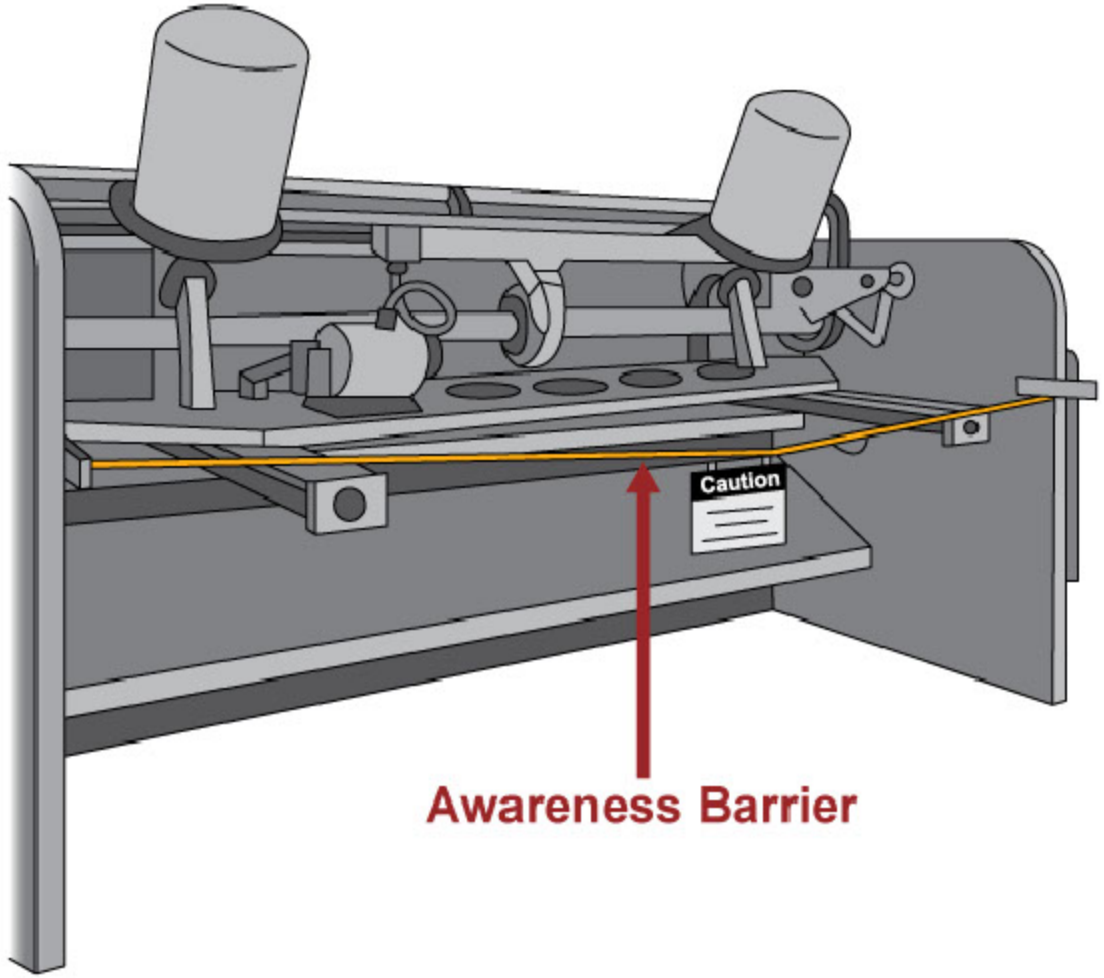
1.5.1 Miscellaneous Aids

While 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 application and usage. Examples of possible application include the following:



- An awareness barrier serves as a reminder to a person that he or she is approaching the danger area. Although the barrier does not physically prevent a person from entering the danger area, it calls attention to it. For an employee to cross the threshold of the danger area, an overt act must take place. That is, the employee must either reach or step over, under or through the barrier. Generally, awareness barriers are not considered adequate when frequent exposure to the hazard exists.

- Special hand tools may be used to place or remove stock, mainly from or into the point of operation of a machine. A typical use would be for reaching into the danger area of a press or press brake. A push stick or block may be used when feeding stock into a saw blade. When it becomes necessary for hands to be near the blade, the push stick or block may provide a few inches of safety and prevent a severe injury.

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1.6 Guard Construction

Today, many builders of single-purpose machines provide point-of-operation and power transmission safeguards as standard equipment. However, not all machines in use have built-in safeguards provided by the manufacturer. Guards designed and installed by the builder offer two main advantages:

1. They usually conform to the design and function of the machine

2. They can be designed to strengthen the machine in some way or to serve some additional functional purposes

1.6 Guard Construction

User-built guards are sometimes necessary for a variety of reasons. They have these advantages:

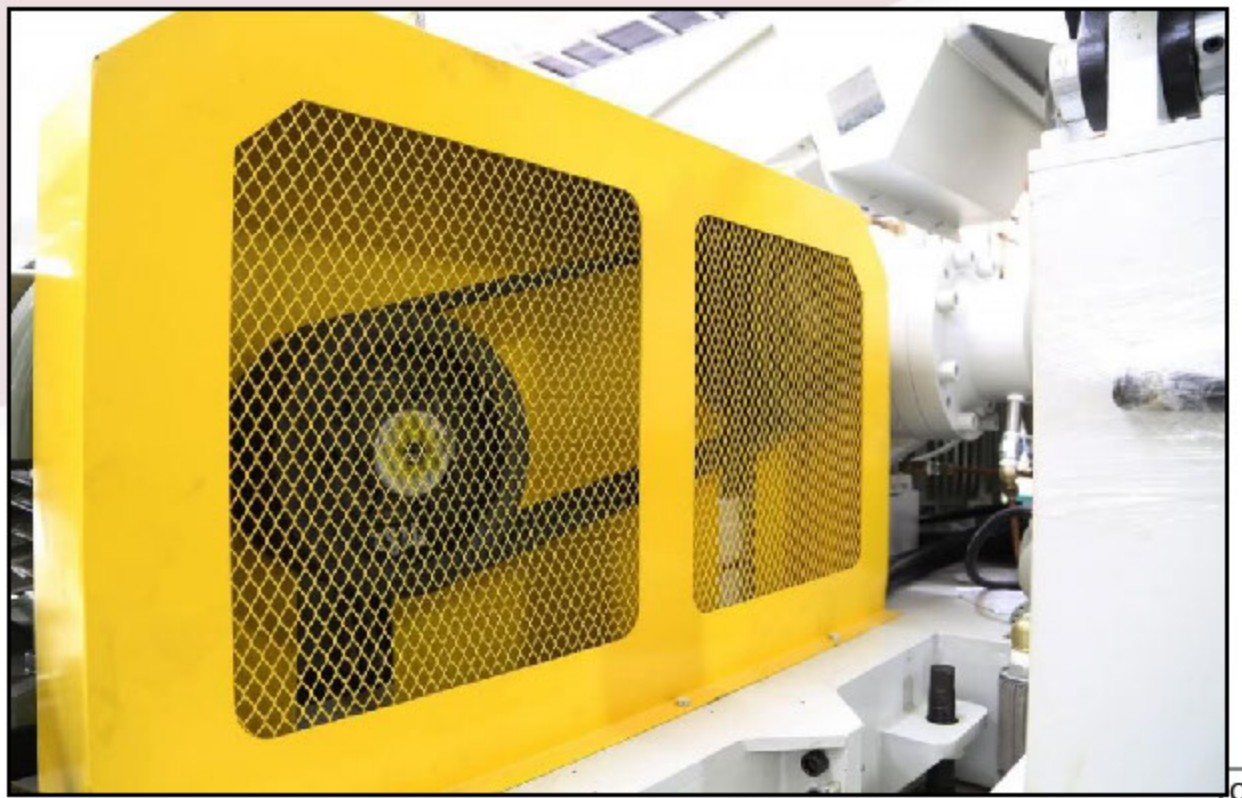
- Often, with older machinery, they are the only practical safeguarding solution
- They may be the only choice for mechanical power transmission apparatus in older plants, where individual motor drives do not power machinery
- They permit options for point-of-operation safeguards when skilled personnel design and construct them
- They can be designed and built to fit unique and ever-changing situations
- They can be installed on individual “dies and feeding” mechanisms
- Design and installation of machine safeguards by plant personnel can help to promote safety consciousness in the workplace

Click Box

1.6 Guard Construction

User-built guard disadvantages include:

- User-built guards may not conform well to the configuration and function of the machine
- There is a risk that user-built guards may be poorly designed or built
- Feeding and ejection methods may be hindered
- Machinery maintenance and repair may be affected



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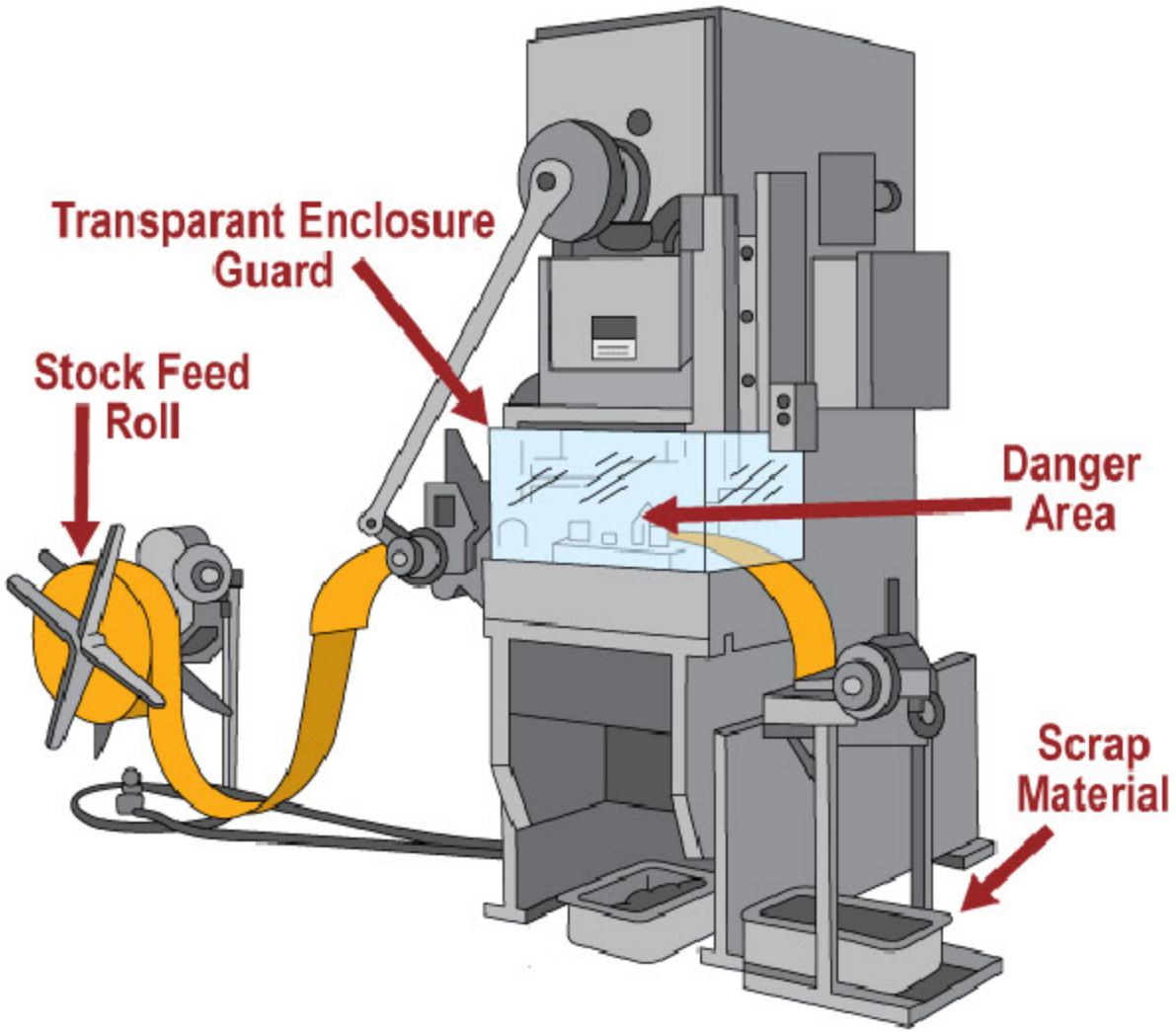
1.7 Feeding and Ejection Methods



Many feeding and ejection methods do not require the operator to place his or her hands in the danger area. In some cases, no operator involvement is necessary after the machine is set up. In other situations, operators may manually feed the stock with the assistance of a feeding mechanism. Adequately designed ejection methods do not require any operator involvement after the machine starts to function.

Using these feeding and ejection methods does not eliminate the need for guards and devices. Guards and devices should be used wherever they are necessary and possible to protect from exposure to hazards.

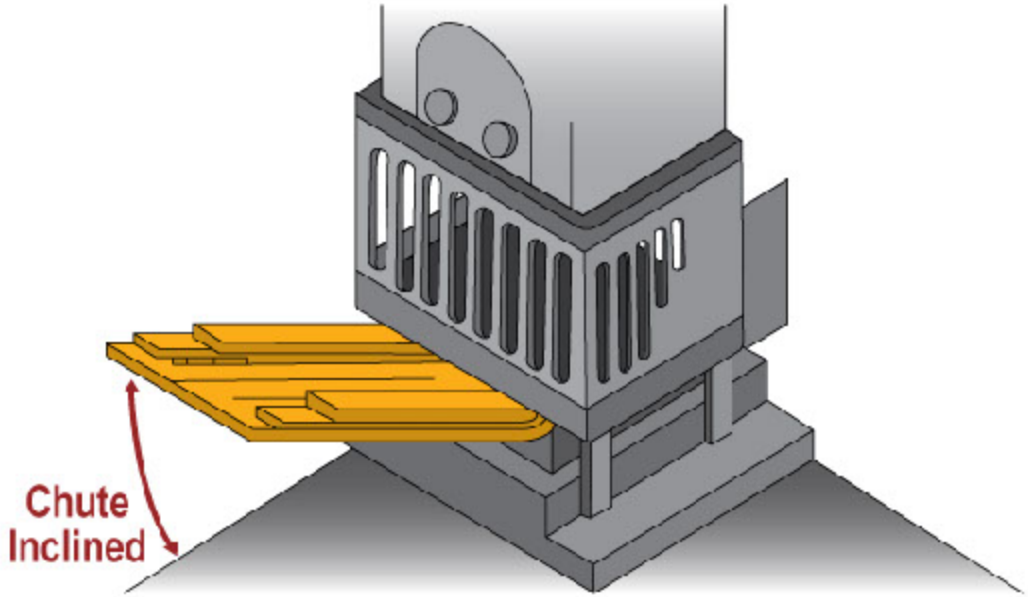
Click Box

1.7 Feeding and Ejection Methods

The following are the various types of feeding and ejection methods with a description of each:

- **Automatic Feed:** Stock is fed from rolls, indexed by machine mechanism which removes the need for operator involvement in the danger area. Usually, additional guarding is required for operator protection such as fixed barrier guards. Automatic feeds are not very adaptable when stock varies in size and shape, and the machines usually require frequent upkeep and maintenance.

- **Semi-automatic Feed:** Works similarly to Automatic feeds. However, the stock is fed by chutes, movable dies, dial feed, plungers, or sliding bolsters.

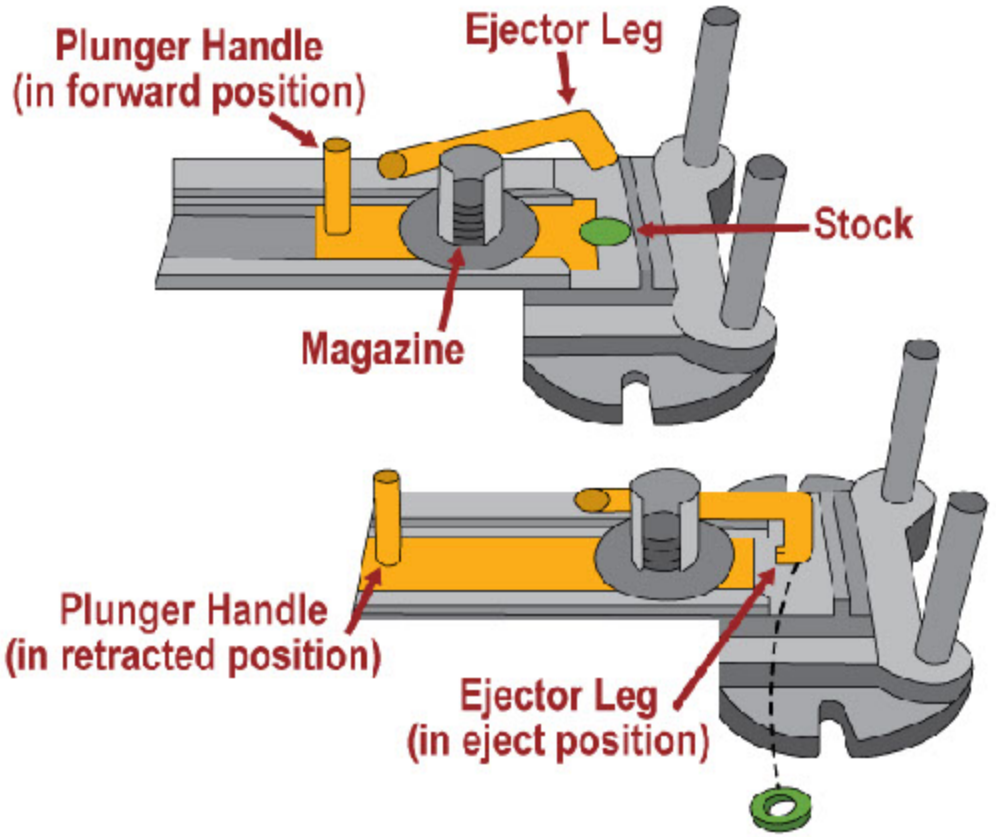


- **Automatic Ejection:** Workpieces are ejected by air or mechanical means which may create a new hazard of blowing chips or debris. The size of the stock limits the use of the automatic ejection method. The air used in the ejection may present noise hazards into the workplace.

Click Box

1.7 Feeding and Ejection Methods

- **Semiautomatic Ejection:** Through this method, workpieces are ejected by mechanical means which are initiated by the operator. In semiautomatic ejection, the operator does not have to enter danger area to remove finished work, though additional safeguards may need to be used. As with the automatic feed method, variations in stock size and shape may not be suitable.



- **Robots:** Perform work usually done by the operator eliminating the need for entering danger area. Using robots is suitable for operations where high-stress factors are present such as heat and noise. The downsides to robotic feeding and ejection is that the machinery often requires extensive maintenance and is only suitable to specific product operations, and the robots themselves can cause workplace hazards.

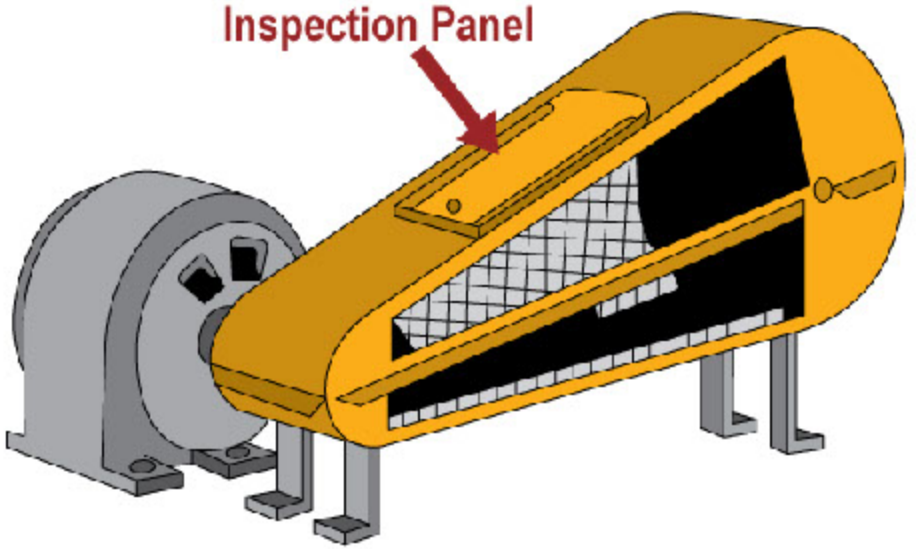
Click Box

1.8 Machinery Maintenance and Repair

Proper maintenance and repair procedures contribute significantly to the safety of the maintenance crew, as well as that of machine operators. Safe maintenance and repair work may be challenging due to the following:

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

If possible, machine design should permit routine lubrication and adjustment without removal of safeguards. When safeguards must be removed, and the machine serviced, the lockout procedure of 29 CFR 1910.147 must be followed. The maintenance and repair crew must never fail to replace the guards before the job is considered finished and the machine released from the lockout.



1.8 Machinery Maintenance and Repair

To prevent hazards while servicing machines, each machine or piece of equipment should be safeguarded during the conduct of servicing or maintenance by:

1. Notifying all affected employees (usually machine or equipment operators or users) that the machine or equipment must be shut down to perform some maintenance or servicing
2. Stopping the machine
3. Isolating the machine or piece of equipment from its energy source
4. Locking out or tagging out the energy source
5. Relieving any stored or residual energy
6. Verifying that the machine or equipment is isolated from the energy source

Click Box

1.8 Machinery Maintenance and Repair

Although this is the general rule, there are exceptions which include:

- When the servicing or maintenance is not hazardous for an employee
- When the servicing which is conducted is minor in nature
- When the servicing is performed as an integral part of production
- When the employer utilizes alternative safeguards which provide adequate protection as is required by 29 CFR 1910.212 or other specific standards

Click Box

1.8 Machinery Maintenance and Repair

If it is necessary to oil machine parts while the machine is running, special safeguarding equipment may be needed solely to protect the oiler from exposure to hazardous moving parts. Maintenance personnel must know which machines can be serviced while running and which cannot. The danger of accident or injury is greatly reduced by shutting off and locking out all sources of energy.

Click Box

2.0 Guards

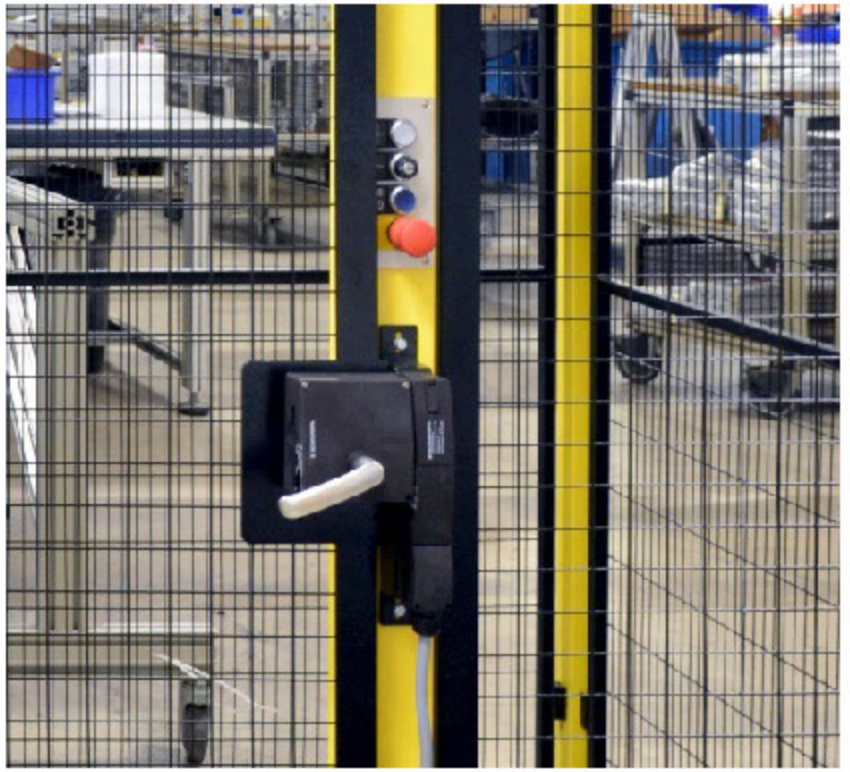
Guards are barriers which prevent access to danger areas. There are four general types of guards which are described in the following slides:

Click Box

2.1 Fixed Guards

As its name implies, a fixed guard is a permanent part of the machine. It is not dependent upon moving parts to function. It may be constructed of sheet metal, screen, wire cloth, bars, plastic, or any other material that is substantial enough to withstand whatever impact it may receive and to endure prolonged use. This guard is usually preferable to other types because of its relative simplicity. As a barrier, it provides the following safeguarding advantages and limitations:

Advantages	Limitations
• May be constructed to suit many specific applications. • Allows for in-plant construction. • Provides maximum protection. • Usually requires minimal maintenance. • Suitable to high production and repetitive operations.	• May interfere with visibility. • May be limited to specific operations. • Machine adjustment and repair often require its removal, thereby necessitating other means of protection for maintenance personnel.



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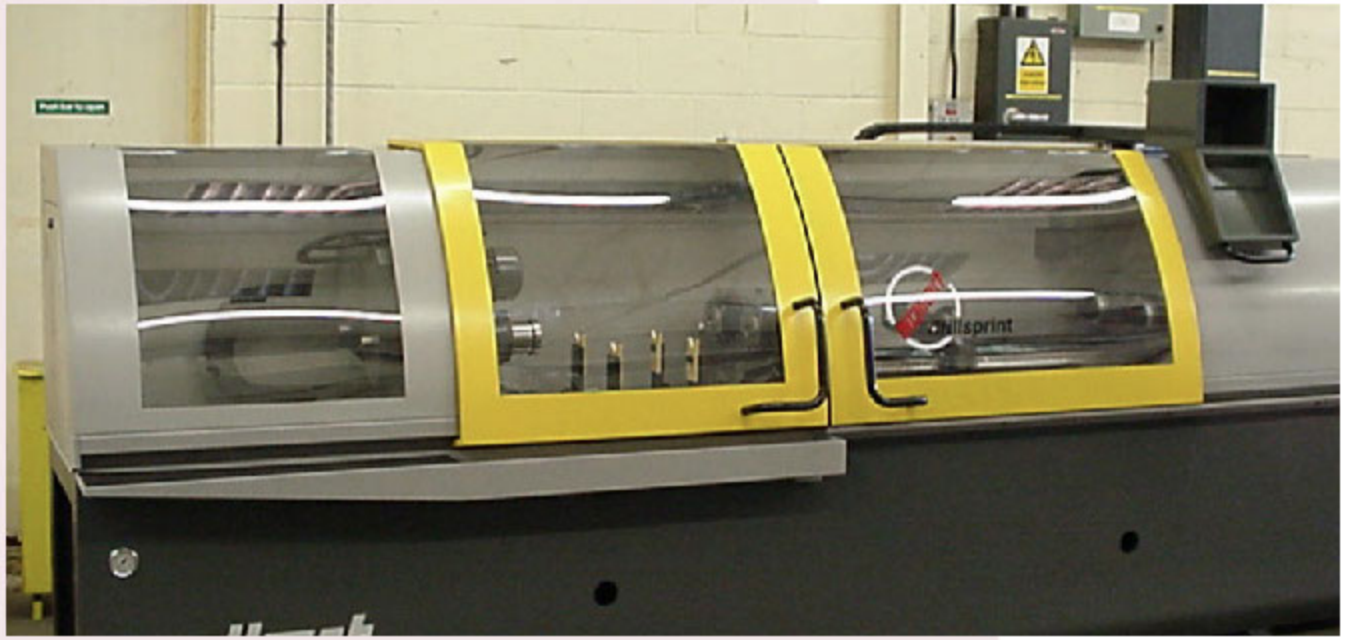
2.2 Interlocked Guards

Interlocked guards are attached to hinged or moving guard sections. This type of guard is best accomplished when tamper-resistant fasteners are implemented. When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, the moving parts of the machine are stopped, and the machine cannot cycle or be started until the guard is back in place. An interlocked guard may use electrical, mechanical, hydraulic, or pneumatic power or any combination of these. Interlocks should not prevent "inching" by remote control if required. Replacing the guard should not automatically restart the machine. To be effective, all removable guards should be interlocked to prevent occupational hazards. With the built-in safeguards, interlocked guards provide the following advantages and limitations:

Advantages	Limitations
• Provides maximum protection • Allows access to the machine for removing jams without time-consuming removal of the fixed guards	• Requires careful adjustment and maintenance • May be easy to disengage



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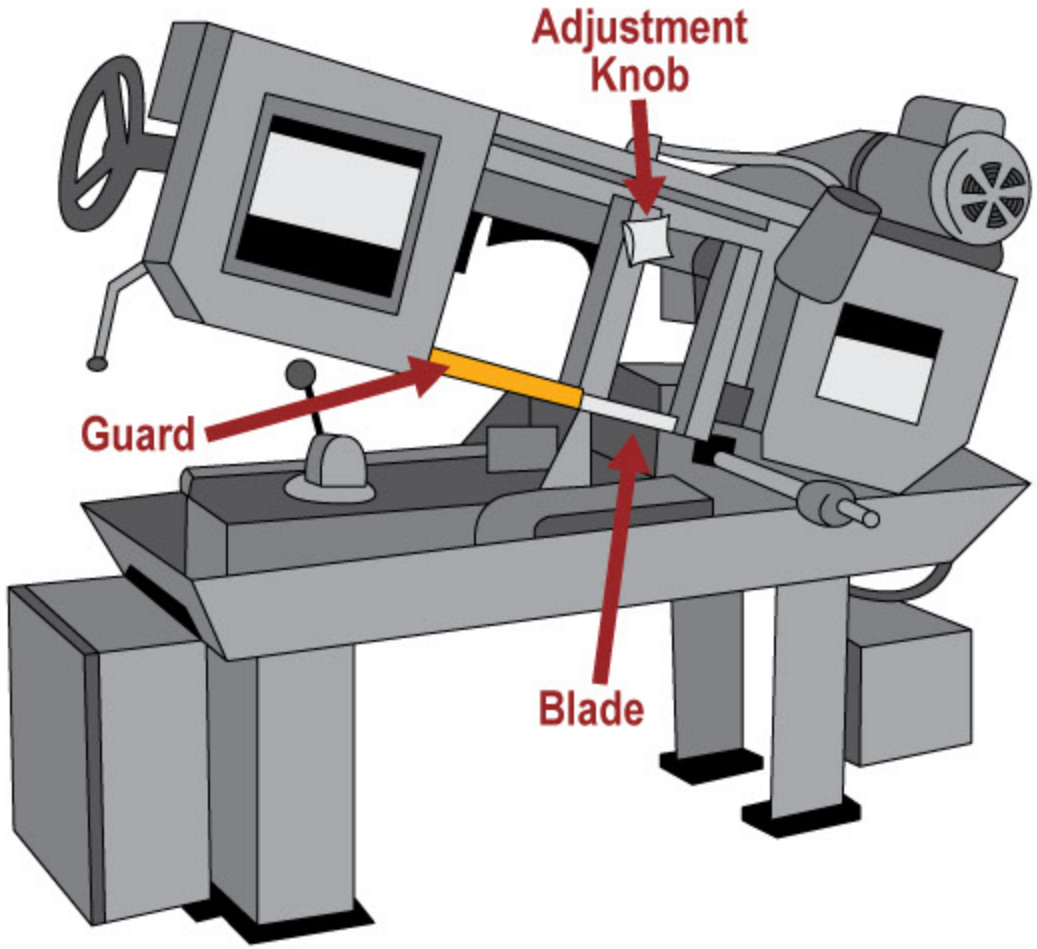
2.3 Adjustable Guards



Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock. This type of guard provides a barrier that may be adjusted to facilitate a variety of production operations. With this, adjustable guards have the following advantages and limitations:

Advantages	Limitations
• May be constructed to suit many specific applications. • May be adjusted to admit varying sizes of stock.	• Hands may enter danger area. Protection may not be complete at all times. • May require frequent maintenance and/or adjustment. • The guard may be made ineffective by the operator. • May interfere with visibility.

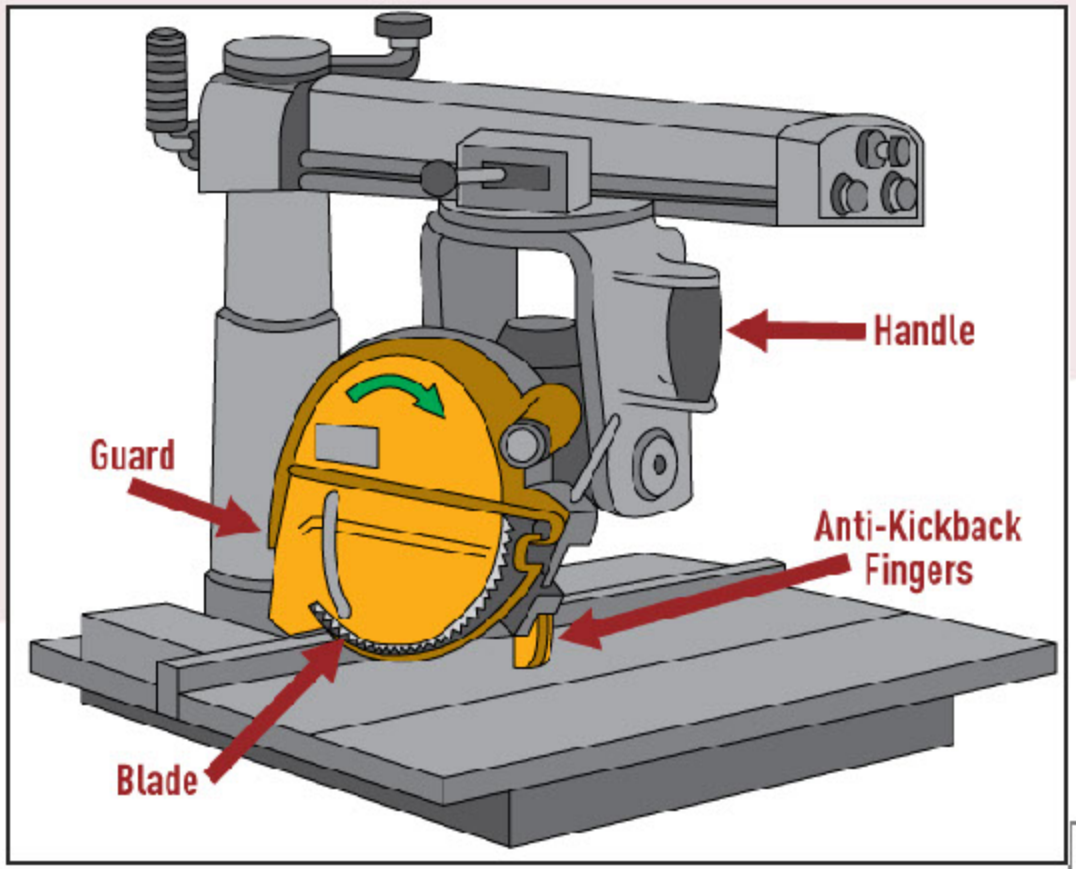
Click Box

2.4 Self-Adjusting Guards

The movement of the stock determines the openings of these barriers. 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. The guards may be constructed of plastic, metal, or other substantial material. Self-adjusting guards offer different degrees of protection.

The safeguarding action for self-adjusting guards is that provision of a barrier that moves according to the size of the stock entering the danger area. This type of guard has the following advantages and limitations:

Advantages	Limitations
• Off-the-shelf guards are often commercially available.	• May not always provide maximum protection. • May interfere with visibility. • May require frequent maintenance and adjustment.



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2.5 Devices

A safety device may perform one of several functions including:

- Stop the machine if a hand or any part of the body is inadvertently placed in the danger area
- Provide a barrier which is synchronized with the operating cycle of the machine to prevent entry to the danger area during the hazardous part of the cycle
- Restrain or withdraw the operator's hands from the danger area during operation or require the operator to use both hands-on machine controls

The devices listed in this section are utilized as control measures to minimize the hazards associated with working with various types of machinery. Some of the inherent problems with presence-sensing devices, such as the ones that follow, include the fact that they are expensive to install, can be easily defeated by employees, and are frequently prone to failure.

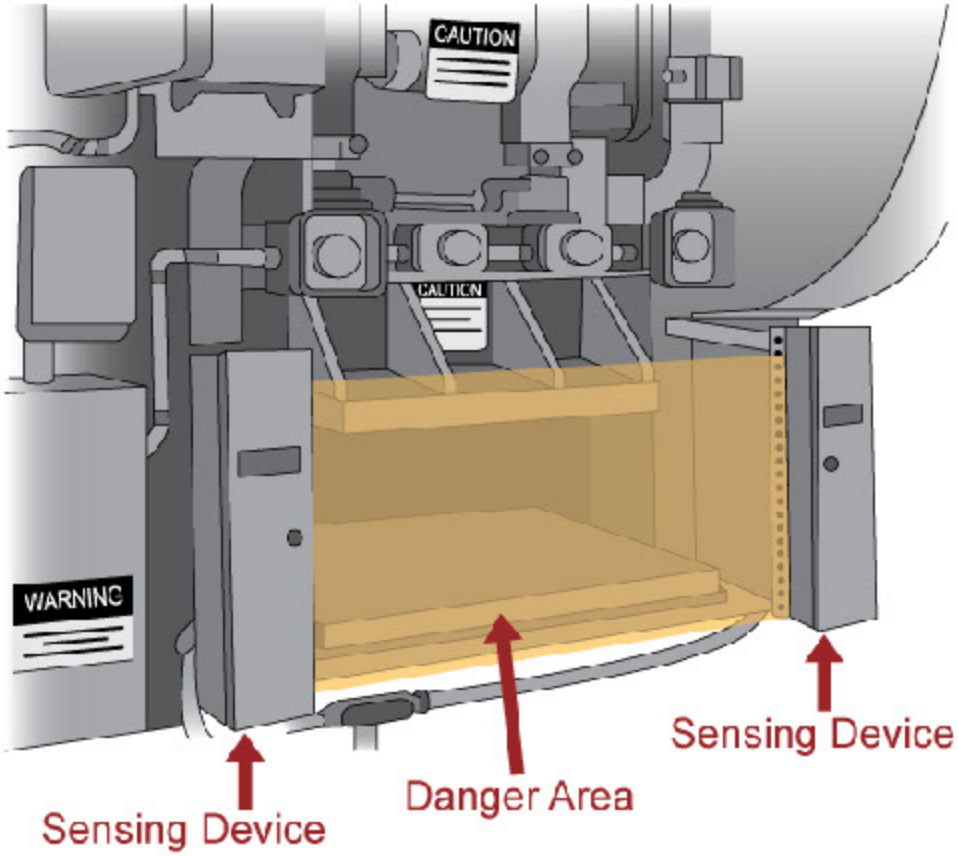
Click Box

2.5.1 Photoelectric

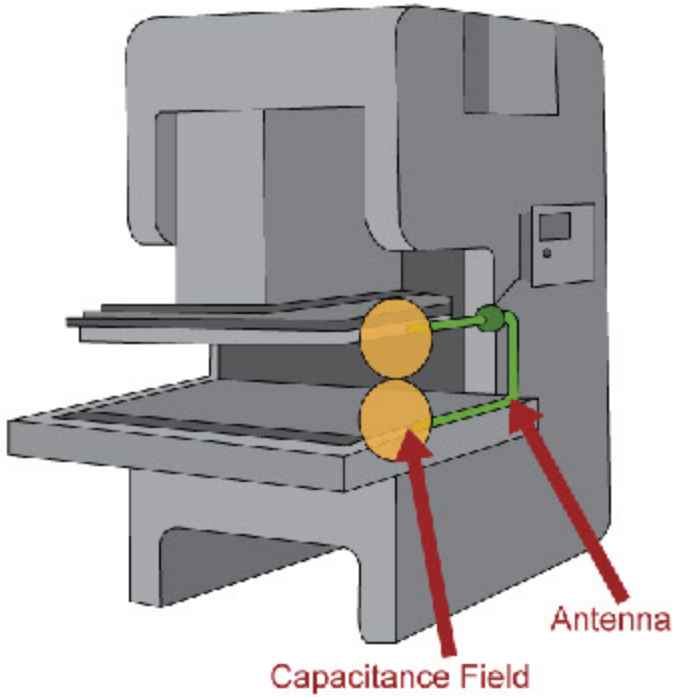
The photoelectric (optical) presence-sensing device uses a system of light sources and controls which can interrupt the machine's operating cycle. If the light field is broken, the machine stops and will not cycle. This device must be used only on machines which can be stopped before the employee can reach the danger area. The design and placement of the guard depends upon the time it takes to stop the machine and the speed at which the employee's hand can reach across the distance from the guard to the danger zone.

With this type of device, the safeguard is that the machine will not start cycling when the light field is interrupted. Additionally, when the light field is broken by any part of the operator's body during the cycling process, immediate machine braking is activated. The advantages and limitations are:

Advantages	Limitations
• Can allow freer movement for operator • Simplicity of use • Used by multiple operators • Provide passerby protection • No adjustment required	• Does not protect against mechanical failure • Limited to machines that can be stopped



2.5.2 Radiofrequency



The radiofrequency (capacitance) presence-sending device uses a radio beam that is part of the machine control circuit. When the capacitance field is broken, the machine will stop or will not activate. Like the photoelectric device, this device should only be used on machines which can be stopped before the employee can reach the danger area. This requires the machine to have a friction clutch or other reliable means for stopping.

With this type of device, the safeguard is that machine cycling will not start when the capacitance field is interrupted. Additionally, when the capacitance field is disturbed by any part of the operator's body during the cycling process, immediate machine breaking is activated. The following advantages and limitations are associated with radiofrequency devices:

Advantages	Limitations
• May allow freer movement for the operator.	• Fails to protect against mechanical failure. • Antennae sensitivity must be appropriately adjusted and maintained. • Limited to machines that can be stopped.

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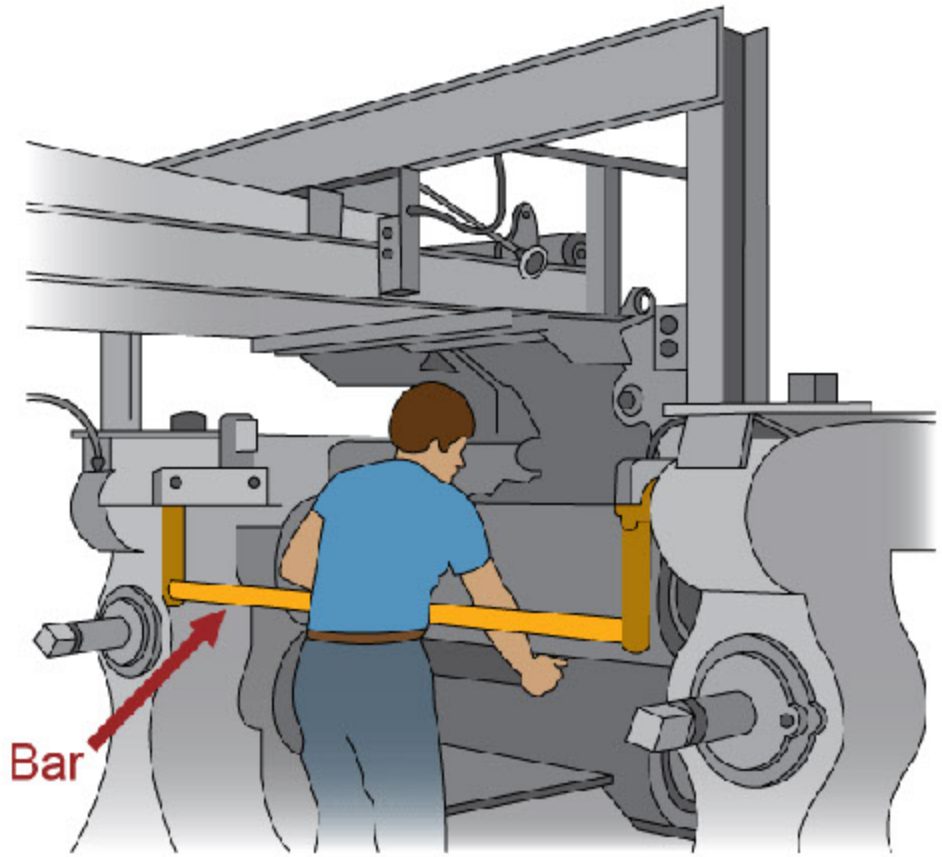
2.5.3 Electromechanical

The electromechanical sensing device has a probe or contact bar which descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending to its full predetermined distance, the control circuit does not actuate the machine cycle.



The safeguards for electromechanical devices include the contact bar or probe that travels a predetermined distance between the operator and the danger area, with interruption of this movement preventing the starting of the machine cycle. Advantages and limitations include:

Advantages	Limitations
• May allow access at the point of operation.	• Contact bar or probe must be properly adjusted and maintained for each application.

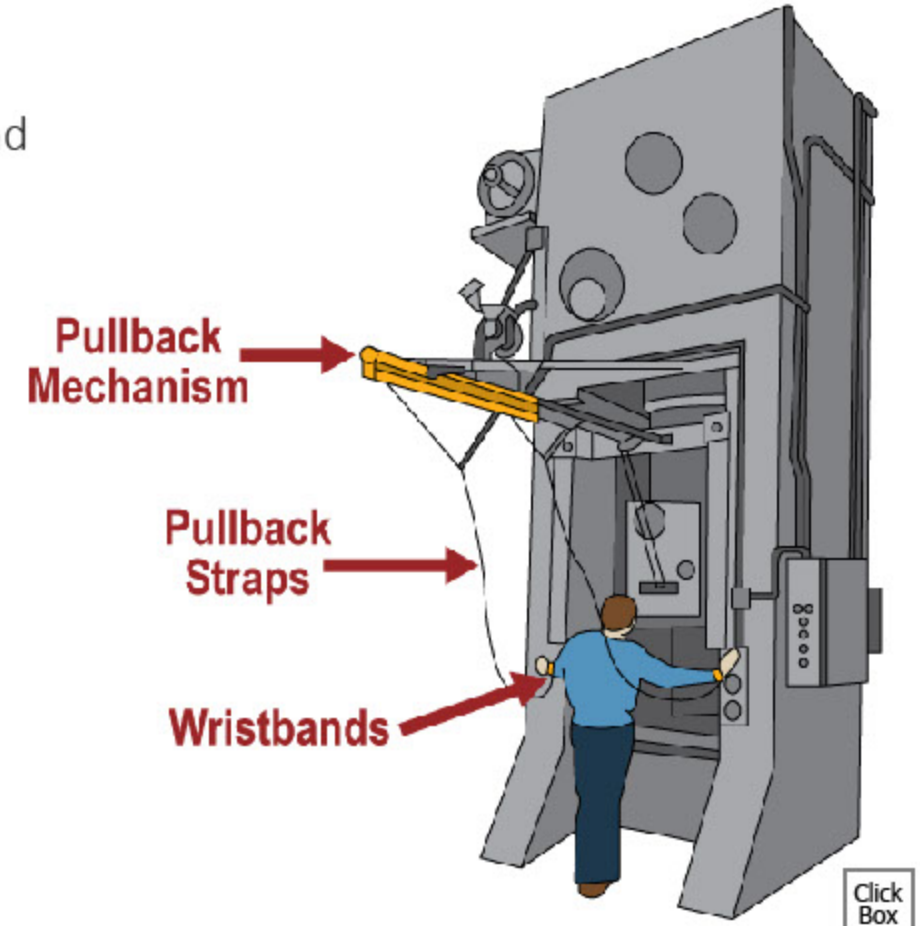
Click Box

2.5.4 Pullback

Pullback devices utilize a series of cables attached to the operator's hands, wrists, and/or arms. This type of device is primarily used on machines with stroking action. When the slide/ram is up between cycles, the operator is allowed access to the point of operation. When the slide/ram begins to cycle by starting its descent, a mechanical linkage automatically assures withdrawal of the hands from the point of operation.

The apparent safeguard with this type of device is that as the machine begins to cycle, the operator's hands are pulled out of the danger area. The advantages and limitations to pullback devices are:

Advantages	Limitations
• Eliminates the need for auxiliary barriers or other interferences at the danger area.	• Limits movement of the operator. • May obstruct workspace around the operator. • Adjustments must be made for specific operations and each individual operating the machine. • Requires frequent inspections and regular maintenance. • Requires close supervision of the operator's use of the equipment.



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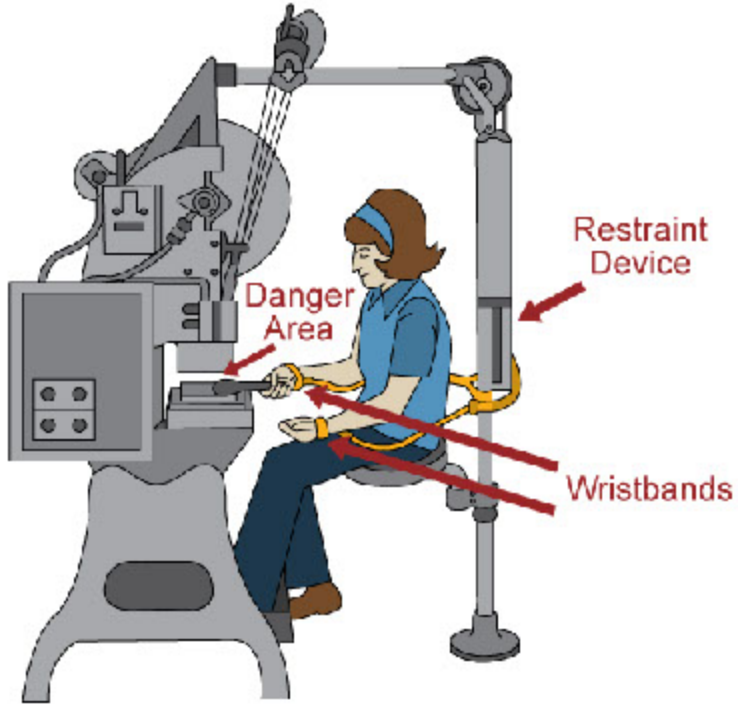
2.5.5 Restraint

The restraint (hold-back) device utilizes 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.

With these restraint devices, the operator is prevented from reaching into the danger zone, providing a safeguard from the hazard. The advantages and limitations include:

Advantages	Limitations
• Little risk of mechanical failure.	• Limits movement of the operator. • May obstruct workspace. • Adjustments must be made for specific operations and each individual. • Requires close supervision of the operator's use of the equipment.



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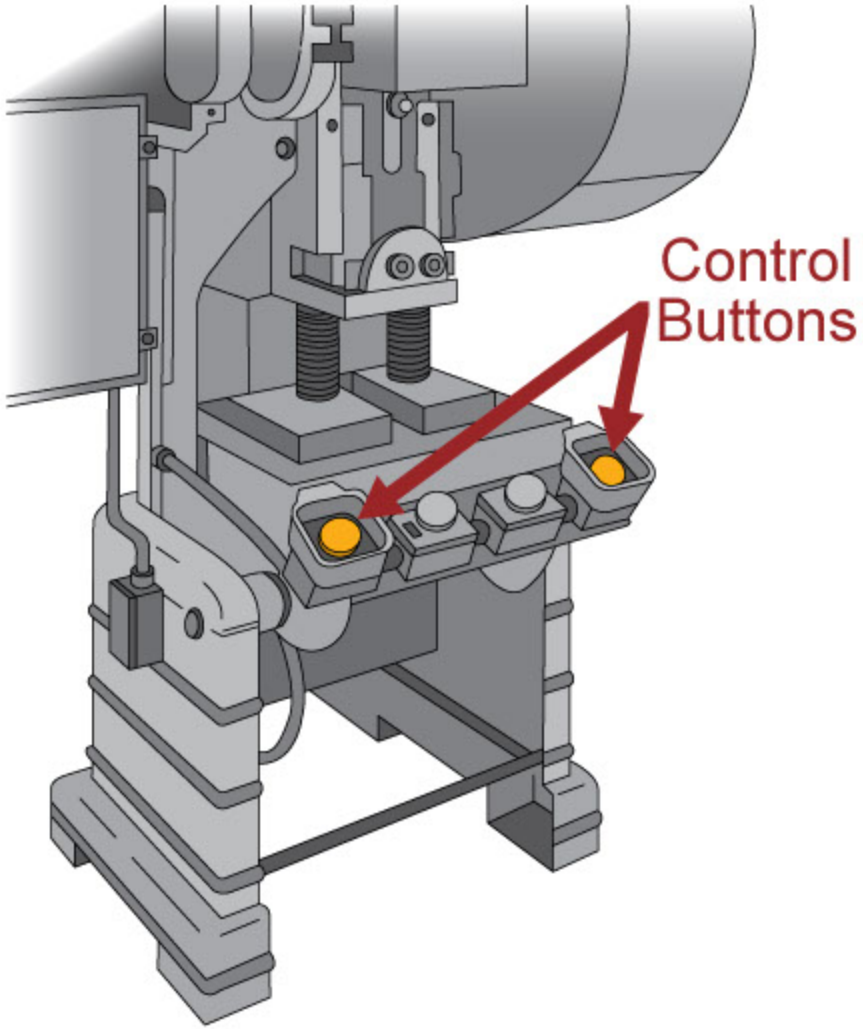
2.5.6 Two-Hand Control



The two-hand control requires constant, concurrent pressure by the operator to activate the machine. This kind of control needs a part-revolution clutch, brake, and a brake monitor if used on a power press. With this type of device, the operator's hands are required to be at a safe location (on control buttons) and distance from the danger area while the machine completes its closing cycle. This type of control is considered a more reliable means of cycling a press over the foot-switch. It is important to consider ergonomics when choosing two-handed controls, especially with high-production operations.

For the safeguard to be sufficient with this type of device, concurrent use of both hands is required, preventing the operator from entering the danger area. Advantages and limitations include:

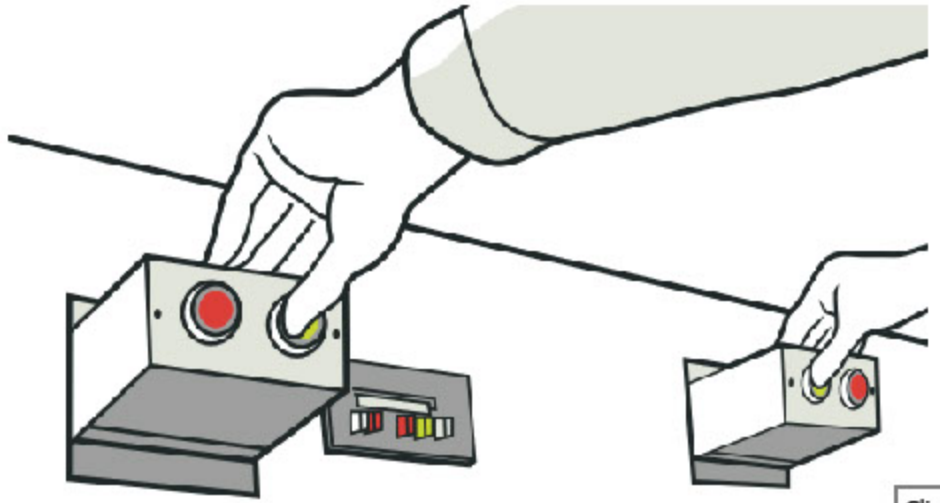
Advantages	Limitations
• Operator's hands are at a pre-determined location. • Operator's hands are free to pick up a new part after first half of the cycle is completed.	• Requires a partial cycle machine with a brake. • Some two-hand controls can be rendered unsafe by holding with arm or blocking, thereby permitting one-hand operation which may be unsafe. • Protects only the operator.

2.5.7 Two-Hand Trip

The two-hand trip requires concurrent application of both 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 operator to move their hands from the trip buttons or handles into the point of operation before the first half of the cycle is completed. The distance from the trip button depends upon the speed of the cycle and the band speed constant. Thus, the operator's hands are kept far enough away to prevent them from being placed in the danger area before the slide/ram or blade reaches the full "down" position. To be effective, both two-hand controls and trips must be located so that the operator cannot use two hands, or one hand and another part of his/her body to trip the machine.

The concurrent use of two hands on separate controls prevents hands from being in the danger area when machine cycle starts, providing a safeguard against injury. A two-hand trip device offers the following advantages and limitations:

Advantages	Limitations
• Operator's hands are away from danger area. • May be adapted to multiple operations. • No obstruction to hand feeding. • No adjustment required for each operation.	• The operator may try to reach into danger area after tripping machine. • Some trips can be rendered unsafe by holding with arm or blocking, thereby permitting one-hand operation. • Protects only the operator. • May require special fixtures.



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2.5.8 Gate

The gate is a moveable barrier that protects the operator at the point of operation before the machine cycle can be started. Gates are, in many instances, designed to operate with each machine cycle. To be effective, the gate should interlock so that the machine will not begin a cycle unless the gate guard is in place. It should be in the closed position before the machine can function. If the gate is not permitted to descend to the fully closed position, the press will not operate.

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 pedestrian traffic as well.

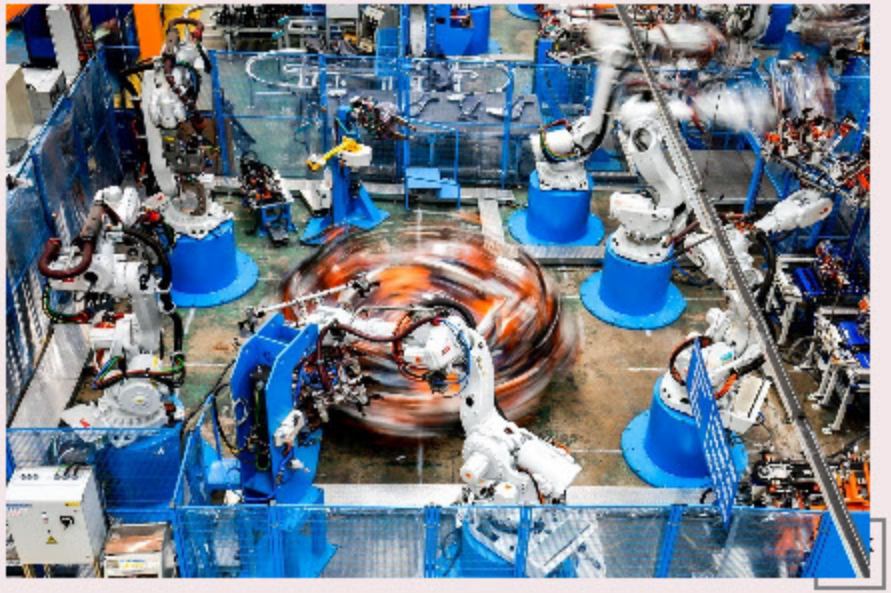
The safeguard for this type of device is that it provides a barrier between danger area and operator or other personnel. The advantages and limitations to gates are:

Advantages	Limitations
• May prevent reaching into or walking into the danger area	• May require frequent inspection and regular maintenance • May interfere with operator's ability to see the work

2.6 Robots

Industrial robots are programmable multifunctional mechanical devices designed to move material, parts, tools, or specialized devices through variable programmed motions to perform a variety of tasks. An industrial robot system includes not only industrial robots but also any devices and/or sensors required for the robot to perform its functions, as well as sequencing or monitoring communication interfaces.

Robots are generally used to perform unsafe, hazardous, highly repetitive, and unpleasant tasks. They have many different functions such as material handling, assembly, arc welding, resistance welding, machine tool load and unload functions, painting and spraying. Most robots are set up for operation by the teach-and-repeat technique. In this mode, a trained operator (programmer) typically uses a portable control device (a teach pendant) to show a robot its task manually. Robot speeds during these programming sessions are slow.



2.6 Robots

Generally speaking, robots are beneficial for the following reasons:

- Robots perform work usually performed by the operator
- An operator does not have to enter the danger area
- Robots may be suitable for operations where high-stress factors are present, such as heat and noise
- However, the drawbacks include the following:
  - A robot may create hazards themselves
  - Robots may require maximum maintenance
  - They may be suitable only for specific operations

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2.6.1 Hazards

The operational characteristics of robots can be significantly different from other machines and equipment. Robots are capable of high-energy (fast or powerful) movements through a large volume of space even beyond the base dimensions of the robot. The pattern and initiation of movement of the robot is predictable if the item being "worked" and the environment are held constant. Any change to the object being worked (i.e., a physical model change) or the environment can affect the programmed movements.

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2.7 Abrasive Wheels

Abrasive wheels are a type of power-driven cutting tool that consists of abrasive grains held together by organic or inorganic bonds. Abrasive wheels are a common type of machinery found in almost any workplace, particularly with those with support functions such as maintenance and repair. They are frequently used by operators who may or may not understand the hazards involved, so it is critical that the machinery be appropriately guarded.

Abrasive wheel hazards include contacting the rotating abrasive wheel and being struck by or inhaling abrasive wheel fragments or particles during the grinding process. The design of the abrasive wheel machine guard is to meet the specifications of ANSI *Use, Care, and Protection of Abrasive Wheels* standard. The guard should cover the spindle end, the nut, and the flange projections to reduce the hazards, providing a suitable measure of protection to the operator. There are a variety of guard exposure angles for specific types of wheels, so it is essential that an employer ensure that the machine guarding meets the specifications for the type of wheel being used.

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2.7 Abrasive Wheels

For machinery where the operator stands in front of the opening, safety guards are to be constructed so that the peripheral protecting member, commonly referred to as a “tongue,” can be adjusted to the steadily decreasing diameter of the wheel. The distance between the wheel periphery and the adjustable tongue or the end of the peripheral member at the top should never exceed ¼ inch.

When an abrasive wheel incorporates a work rest to support the work operation, the rest should be made of rigid construction and designed to be adjustable to compensate for wheel wear. The adjustment should have a maximum opening of 1/8 inch to prevent the work from being jammed between the wheel and the rest, which may result in wheel breakage. No adjustments should be made with the wheel in operation. Also, the work rest should be securely clamped after each adjustment.

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2.7 Abrasive Wheels

As with any machine guarding, an inspection of the guards installed on abrasive wheels is critical for the ongoing protection of the operator. Immediately before mounting a wheel, it should be carefully inspected by the user to make sure they have not been damaged in transit, storage, or otherwise. This type of test is known as the "Ring Test." If they sound cracked or "dead," they should not be used. The inspector should ensure that wheels are dry and free from sawdust when applying the ring test. Otherwise the sound will be deadened. It should also be noted that organic bonded wheels do not emit the same clear metallic ring as do other types of wheels. Click play to see how a ring test is conducted.

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