

Machine Guard Training



Machine Guarding Training

**Module presentation to meet:
Code of Federal Regulations 26 CFR 1910.212
Company's Machine Safeguard Standard**

Safety Through Innovation

OSHA General Requirements



OSHA General Requirements

Crushed hands and arms, severed fingers and limbs, lacerations and abrasions - the list of possible machinery-related injuries is long and horrifying. Many hazards are created by moving machine parts. Safeguards are essential for protecting workers from preventable injuries.

The following standards have been established to ensure the safety of machine operators and other employees in the area:

- Machine Guarding
- Point of Operation Guarding
- Additional Guarding
- Barrels, Containers, and Drums
- Exposure of Blades
- Anchoring Fixed Machinery
- Eye and Face Protection
- Lockout/Tagout

MECHANICAL HAZARDS



Point of Operation

The point of operation is where work is performed on the material, such as cutting, shaping, boring, or forming of stock.

Power Transmission Device

The power transmission apparatus is all components of the mechanical system which transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

Operating Controls

A mechanical or electrical power control shall be provided on each machine to make it possible for the operator to cut off the power from each machine without leaving his position at the point of operation.

Rotating

Rotating

Rotating motion can be dangerous; even smooth, slowly rotating shafts can grip hair and clothing, and through minor contact force the hand and arm into a dangerous 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 or set screws are exposed on rotating parts.

Examples of Hazardous Projections on Rotating Parts



Rotating coupling with projecting bolt heads



Rotating shaft and pulleys with projecting key and set screw

Reciprocating

Reciprocating

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.

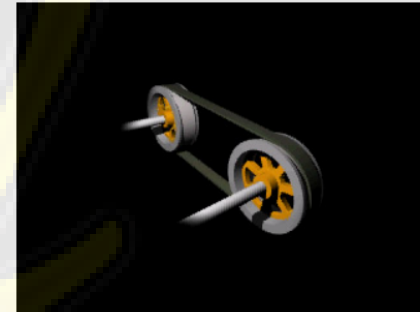


Worker Caught Between a Reciprocating Table Piece and a Stationary Part

Transversing

Transversing

Transverse motion (movement in a 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

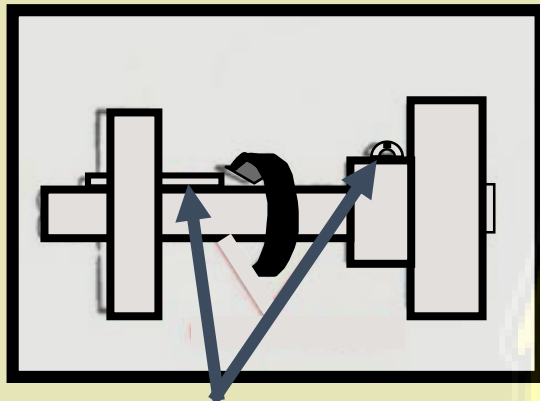
Safety Through Innovation

NIP POINTS / IN-RUNNING

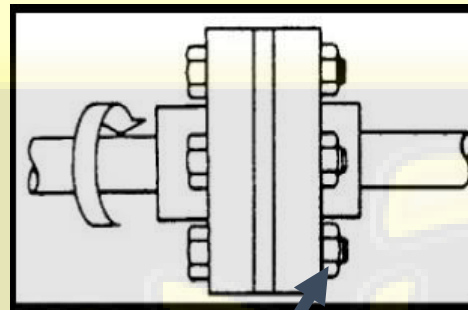


In-running **nip point hazards** are caused by the rotating parts on machinery. There are three main types of in-running nips. Parts can **rotate** in opposite directions while their axes are parallel to each other. These parts may be in contact (producing a nip point) or in close proximity. In the latter 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 calenders. Nip points are also created between **rotating and tangentially moving parts**. Some examples would be: 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 are: spoked handwheels or flywheels, screw conveyors, or the periphery of an abrasive wheel and an incorrectly adjusted work rest and tongue.

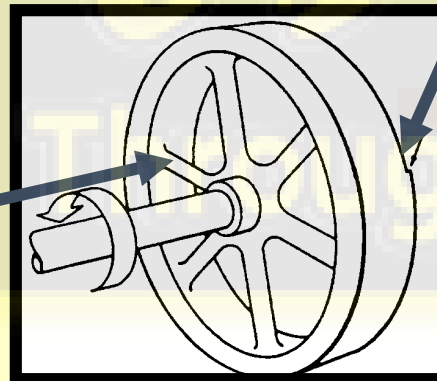
ROTATING MOTIONS



KEY & SET
SCREW

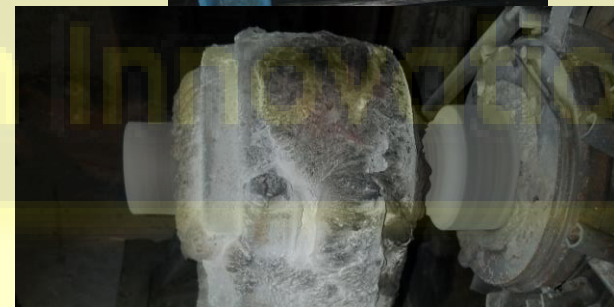
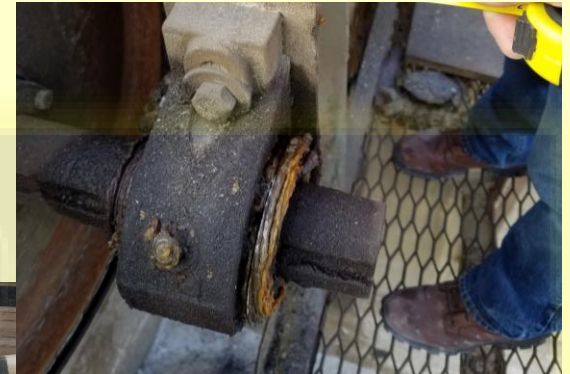


BOLTS &
NUTS

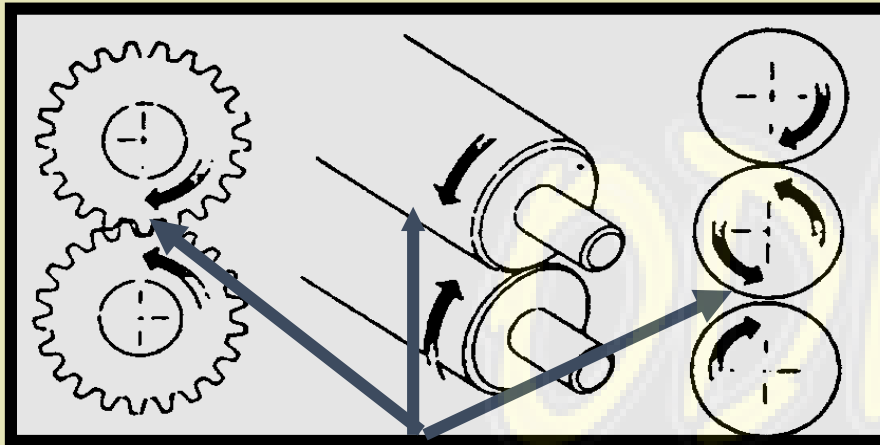


SPOKES

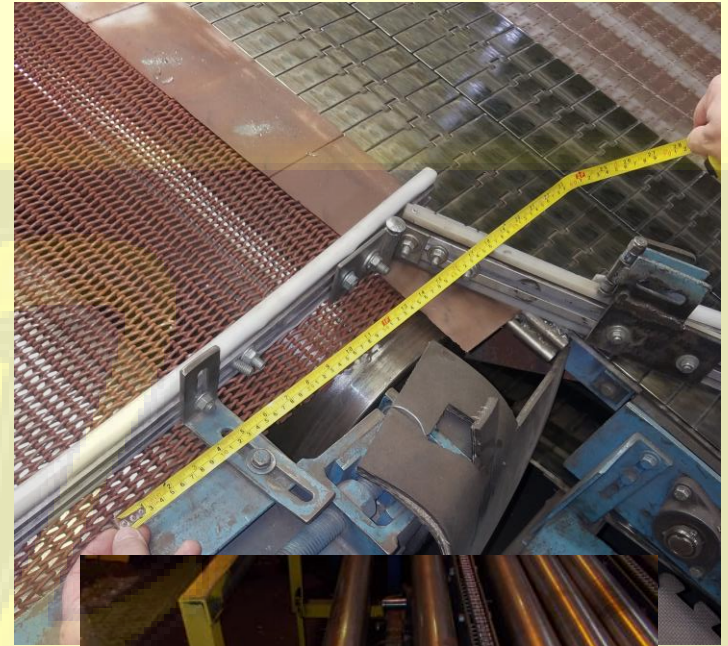
BURR



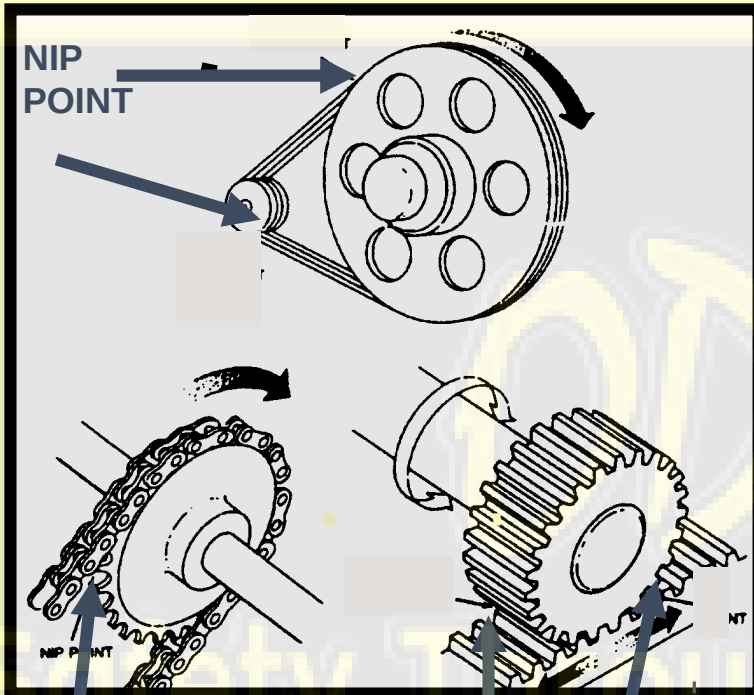
NIP POINTS / IN-RUNNING



NIP POINTS



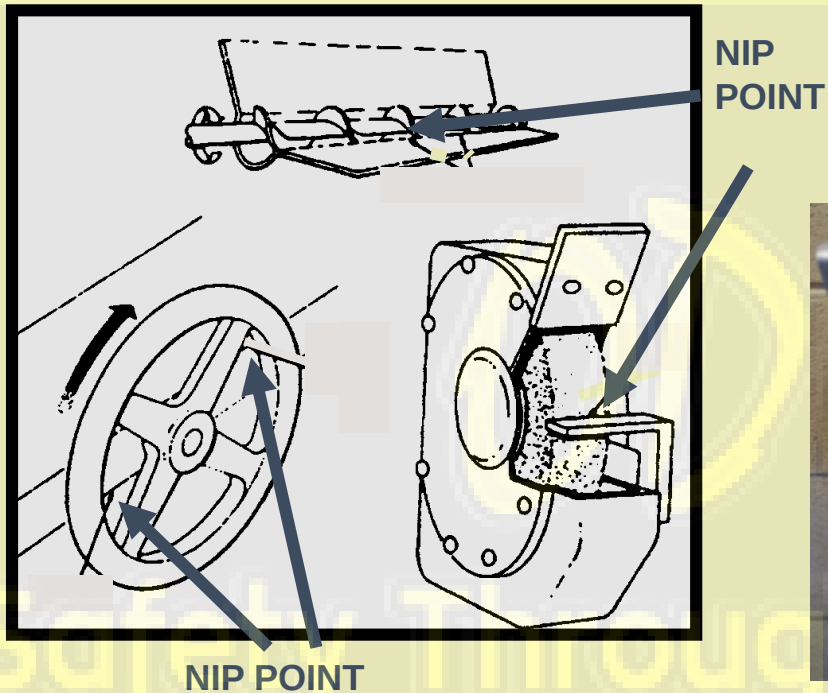
NIP POINTS TANGENTIAL & ROTATING



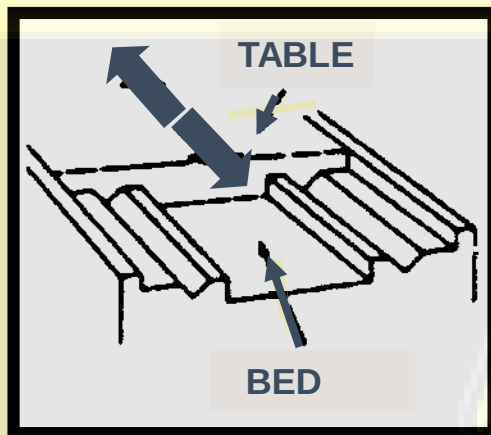
NIP POINT

NIP POINT

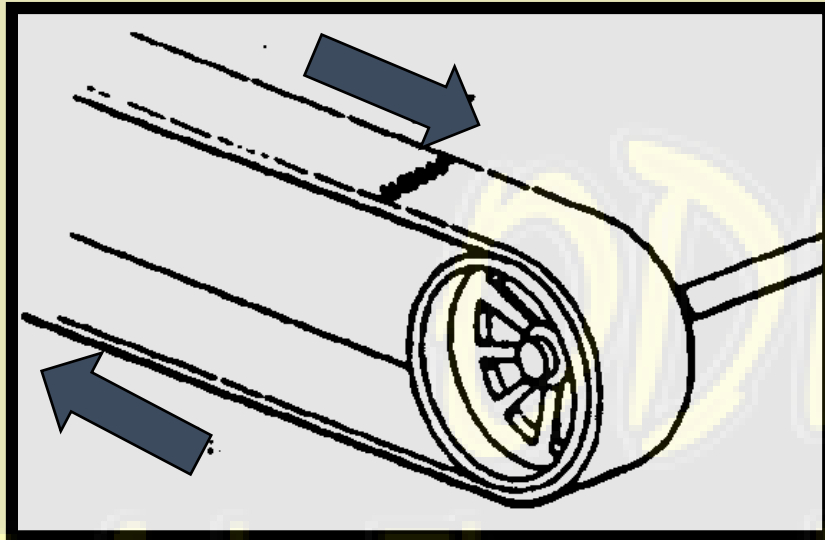
NIP POINTS ROTATING & FIXED PARTS



RECIPROCATING MOTION



TRANSVERSE MOTION

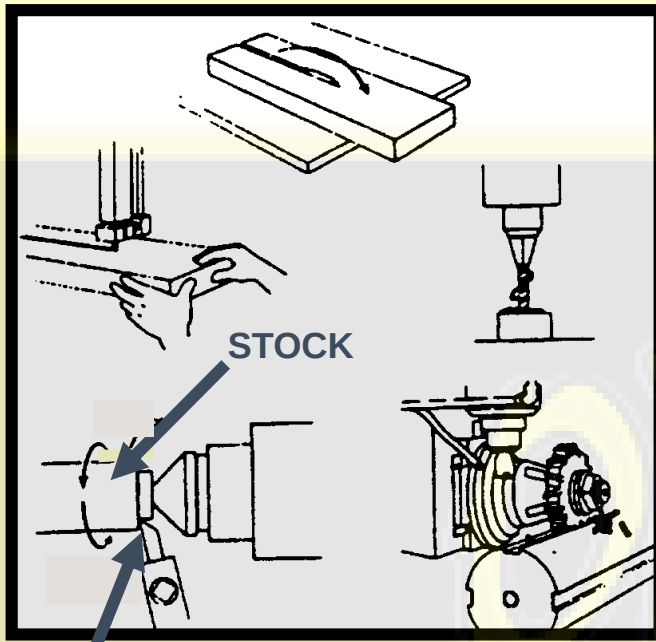


ACTION INJURIES

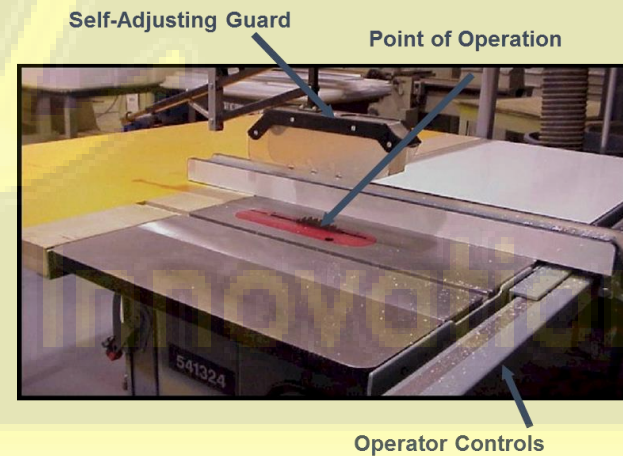
- CUTTING
- PUNCHING
- SHEARING
- BENDING



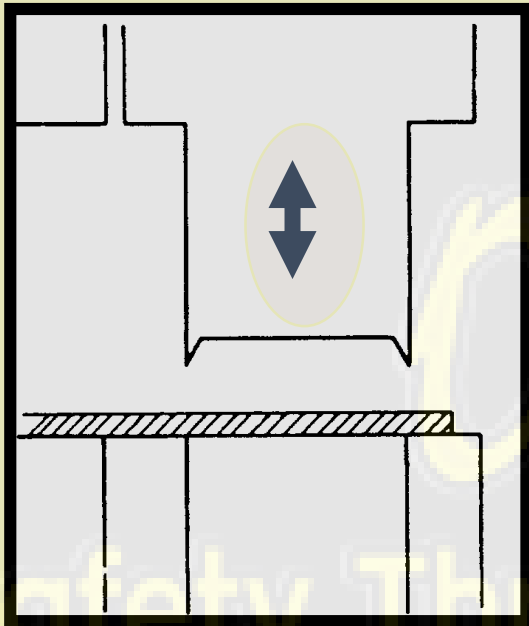
CUTTING ACTION



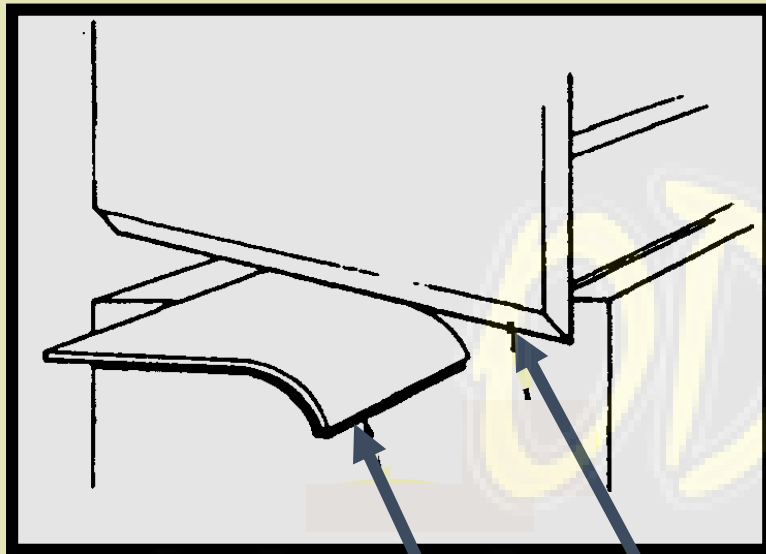
CUTTING TOOL



PUNCHING ACTION



SHEARING ACTION

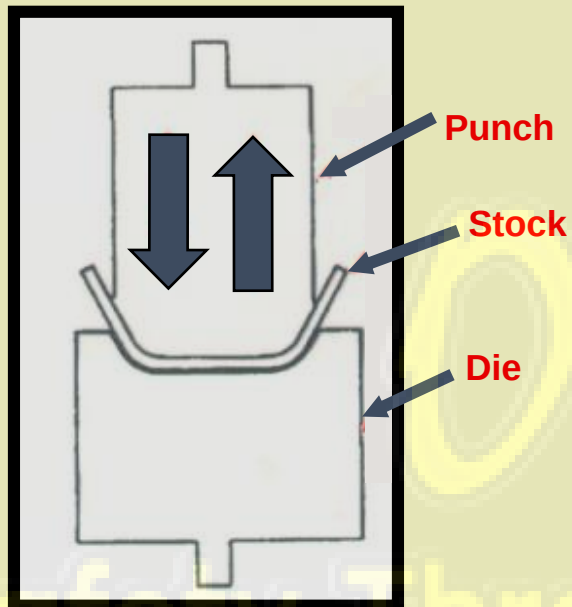


STOCK

BLADE



BENDING ACTION



ABRASIVE WHEEL

Light Bulbs

Adjustable Face Shields

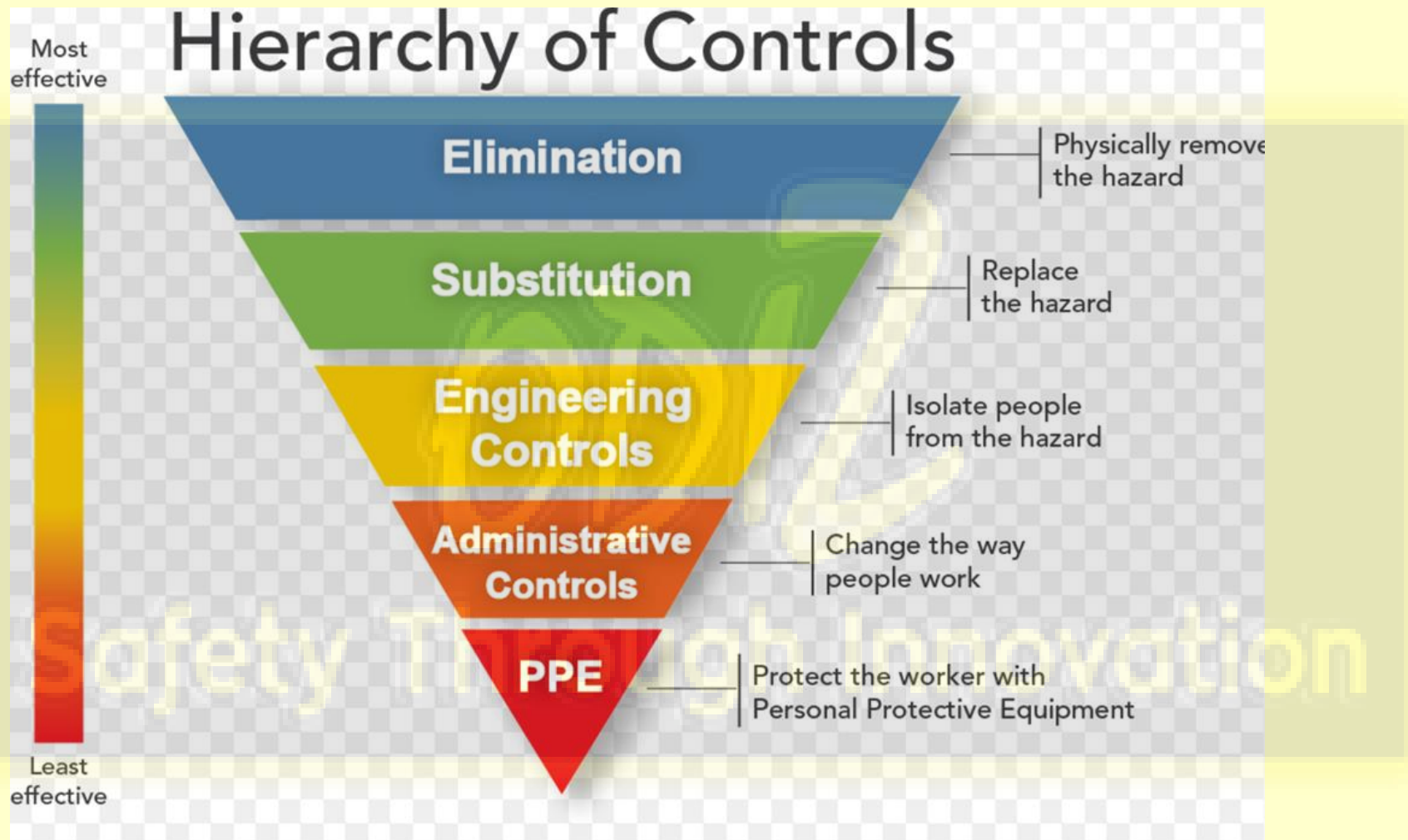


Tongue
Guard



Tool Rest

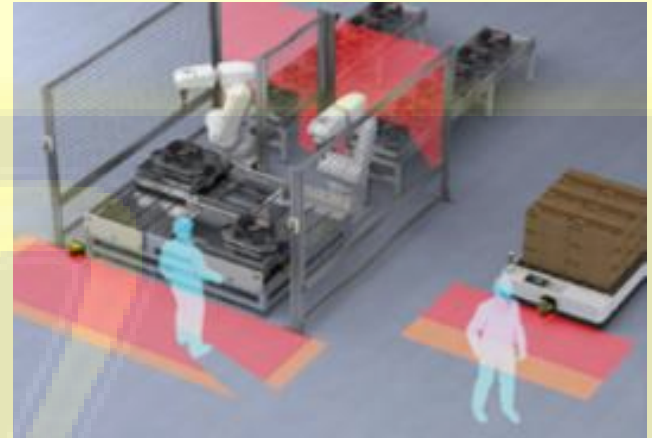
OSHA Hierarchy of Controls



DEVICES



- Photoelectric (optical)
- Radiofrequency (capacitance)
- Electromechanical
- Pullback
- Restraint (holdback)
- Safety Trip Controls (pressure-sensitive body bar, safety tripod, safety tripwire)
- Two-Hand Control
- Two-Hand Trip
- Gate



DEVICES



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 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 employee's hand can reach across the distance from the guard to the danger zone.

Safeguarding Action

- Machine will not start cycling when the light field is interrupted
- When the light field is broken by any part of the operator's body during the cycling process, immediate machine braking is activated

Advantages

- Can allow freer movement for operator
- Simplicity of use
- Used by multiple operators
- Provide passerby protection
- No adjustment required

Limitations

- Does not protect against mechanical failure
- Limited to machines that can be stopped

DEVICES



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 shall only be used on machines which can be stopped before the worker can reach the danger area. This requires the machine to have a friction clutch or other reliable means for stopping.

Safeguarding Action

- Machine cycling will not start when the capacitance field is interrupted.
- When the capacitance field is disturbed by any part of the operator's body during the cycling process, immediate machine breaking is activated

Advantages

- Can allow freer movement for operator

Limitations

- Does not protect against mechanical failure
- Antennae sensitivity must be properly adjusted; this adjustment must be maintained properly
- Limited to machines that can be stopped

DEVICES



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 its full predetermined distance, the control circuit does not actuate the machine cycle.

Safeguarding Action

- Contact bar or probe travels a predetermined distance between the operator and the danger area.
- Interruption of this movement prevents the starting of machine cycle.

Advantages

- Can allow access at the point of operation

Limitations

- Contact bar or probe must be properly adjusted for each application; this adjustment must be maintained properly

DEVICES



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.

Safeguarding Action

- As the machine begins to cycle, the operator's hands are pulled out of the danger area

Advantages

- Eliminates the need for auxiliary barriers or other interferences at the danger area

Limitations

- Limits movement of operator
- May obstruct work space around operator
- Adjustments must be made for specific operations and for each individual
- Requires frequent inspections and regular maintenance
- Requires close supervision of the operator's use of the equipment

DEVICES



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.

Safeguarding Action

- Prevents the operator from reaching into the danger area

Advantages

- Little risk of mechanical failure

Limitations

- Limits movement of operator
- May obstruct work space
- Adjustments must be made for specific operations and each individual
- Requires close supervision of the operator's use of the equipment

DEVICES



Safety Trip Controls

Safety trip controls 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.

Safeguarding Action

- Stops machine when tripped

Advantages

- Simplicity of use

Limitations

- All controls must be manually activated
- May be difficult to activate controls because of their location
- Only protects the operator
- May require special fixtures to hold work
- May require a machine brake

DEVICES



Two-Hand Control

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 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 at a safe distance from the danger area while the machine completes its closing cycle.

Safeguarding Action

- Concurrent use of both hands is required, preventing the operator from entering the danger area

Advantages

- 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

Limitations

- 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
- Protects only the operator

DEVICES



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 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. 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 prior to the slide/ram or blade reaching 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.

Safeguarding Action

- Concurrent use of two hands on separate controls prevents hands from being in the danger area when machine cycle starts

Advantages

- Operator's hands are away from danger area
- Can be adapted to multiple operations
- No obstruction to hand feeding
- Does not require adjustment for each operation

Limitations

- 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

DEVICES



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 be operated with each machine cycle. To be effective, the gate must be interlocked so that the machine will not begin a cycle unless the gate guard is in place. It must 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 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.

Safeguarding Action

- Provides a barrier between danger area and operator or other personnel

Advantages

- Can prevent reaching into or walking into the danger area

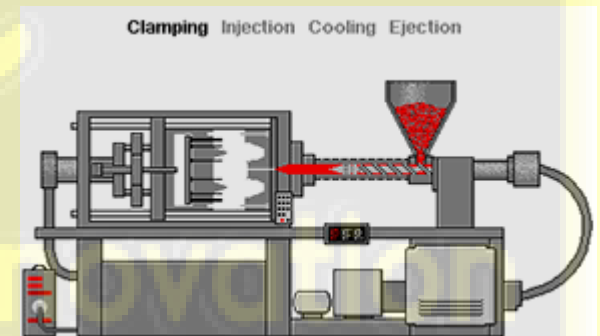
Limitations

- May require frequent inspection and regular maintenance
- May interfere with operator's ability to see the work

FEEDING & EJECTION METHODS



- **AUTOMATIC FEED**
- **SEMI- AUTOMATIC FEED**
- **AUTOMATIC EJECTION**
- **SEMI- AUTOMATION EJECTION**
- **ROBOT**



MISCELLANEOUS AIDS



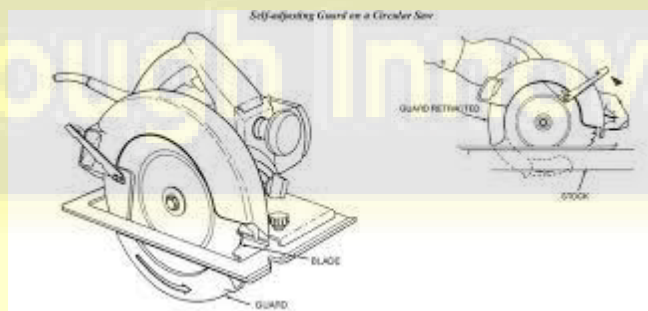
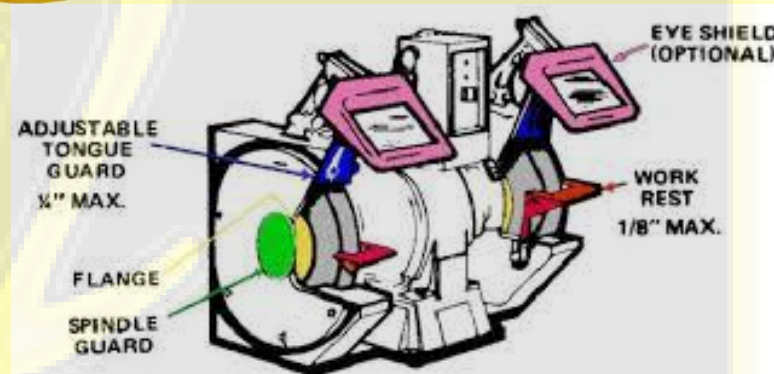
- **AWARENESS BARRIERS**
- **PROTECTIVE SHIELDS**
- **HAND-FEEDING TOOLS & HOLDING FIXTURES**



GUARDS



- FIXED
- INTERLOCKED
- ADJUSTABLE
- SELF-ADJUSTING



GUARDS

Fixed

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 all other types because of its relative simplicity.

Safeguarding Action

- Provides a barrier

Advantages

- Can be constructed to suit many specific applications
- In-plant construction is often possible
- Can provide maximum protection
- Usually requires minimum maintenance
- Can be suitable to high production, repetitive operations

Limitations

- May interfere with visibility
- Can be limited to specific operations
- Machine adjustment and repair often require its removal, thereby necessitating other means of protection for maintenance personnel

GUARDS

Interlocked

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

Safeguarding Action

- Shuts off or disengages power, stops the moving parts and prevents starting of the machine when the guard is open; should require the machine to be stopped before the worker can reach into the danger area

Advantages

- Can provide maximum protection
- Allows access to the machine for removing jams without time consuming removal of the fixed guards

Limitations

- Requires careful adjustment and maintenance
- May be easy to disengage

GUARDS



Adjustable

Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock.

Safeguarding Action

- Provides a barrier that may be adjusted to facilitate a variety of production operations

Advantages

- Can be constructed to suit many specific applications
- Can be adjusted to admit varying sizes of stock

Limitations

- 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

GUARDS



Self-adjusting

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. The guards may be constructed of plastic, metal, or other substantial material. Self-adjusting guards offer different degrees of protection.

Safeguarding Action

- Provides a barrier that moves according to the size of the stock entering the danger area

Advantages

- Off-the-shelf guards are often commercially available

Limitations

- Does not always provide maximum protection
- May interfere with visibility
- May require frequent maintenance and adjustment

METHODS OF MACHINE SAFEGUARDING



- BARRIER GUARDS
- DEVICES
- LOCATION/DISTANCE
- FEEDING & EJECTION METHODS
- MISCELLANEOUS AIDS



Two-hand Control on a Press

SUMMARY



- **REMEMBER! SAFETY IS NO ACCIDENT**
Design for success, Hierarchy of Controls!
- **BUILD GUARDING THAT WILL WORK FOR YOU!**
- **Review company Policy & Procedures and update if necessary.**