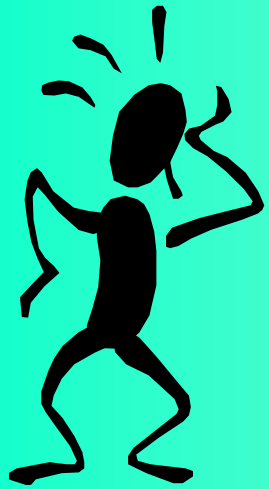


Principles of Machine Guarding



A good rule to remember is:

Any machine part, function, or process which may cause injury must be safeguarded.

Where the operation of a machine or ~~accidental contact with it~~ can injure the operator or others in the vicinity, the hazards must either be eliminated or controlled.

If it moves, it merits your attention!

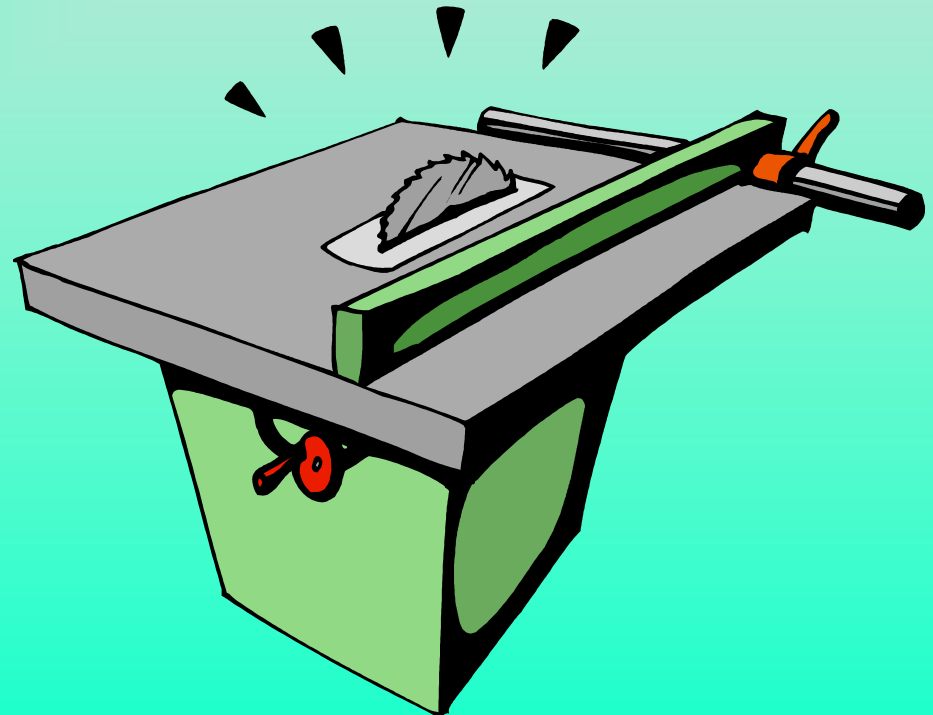
Goals

1. Describe the basic hazards involving machinery including points of operation and power transmission devices.
2. Introduce control measures through effective machine guarding principles and methods.
3. Get the most BANG for the \$\$\$.

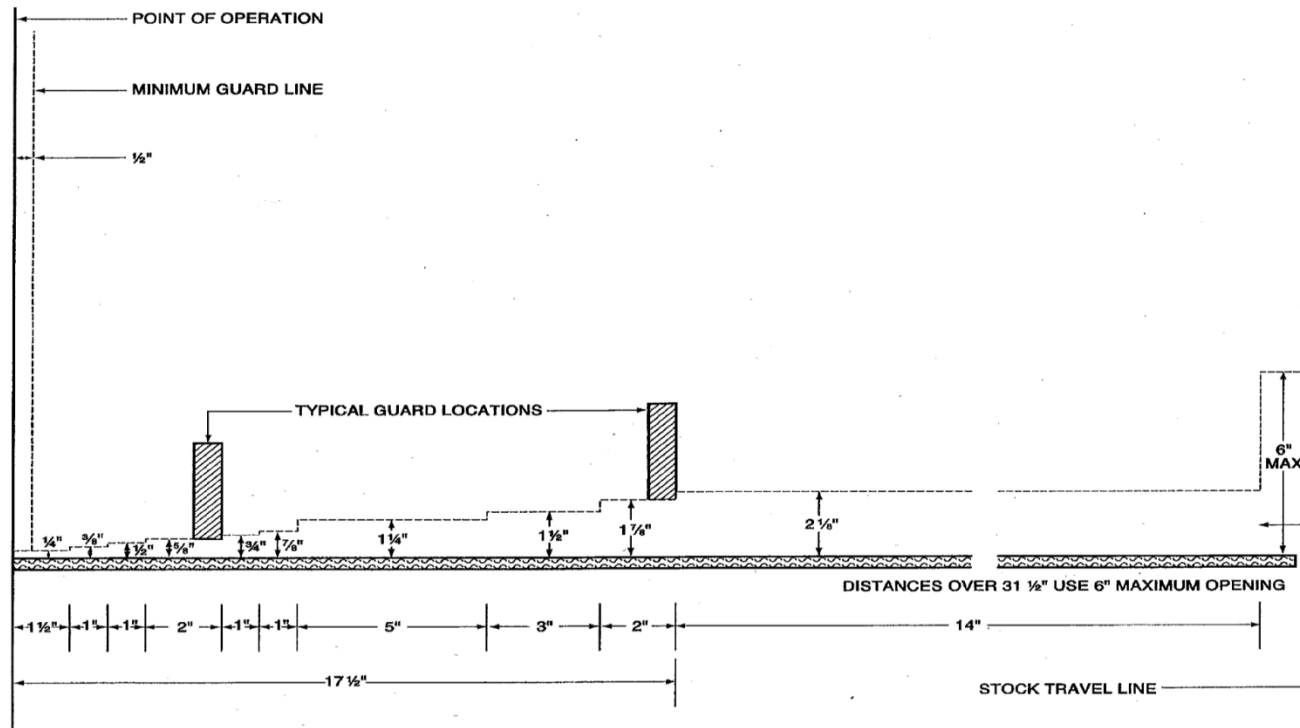
Part One: The Principles

The purpose of machine guarding is to protect against and prevent injury from....

Points of operation



Allowable point of operation guard clearances (ANSI B11.x):



Point of Operation Guarding
Figure G-8

Part One: The Principles

The purpose of machine guarding is to protect against and prevent injury from....

Points of operation

Flying Chips or Sparks



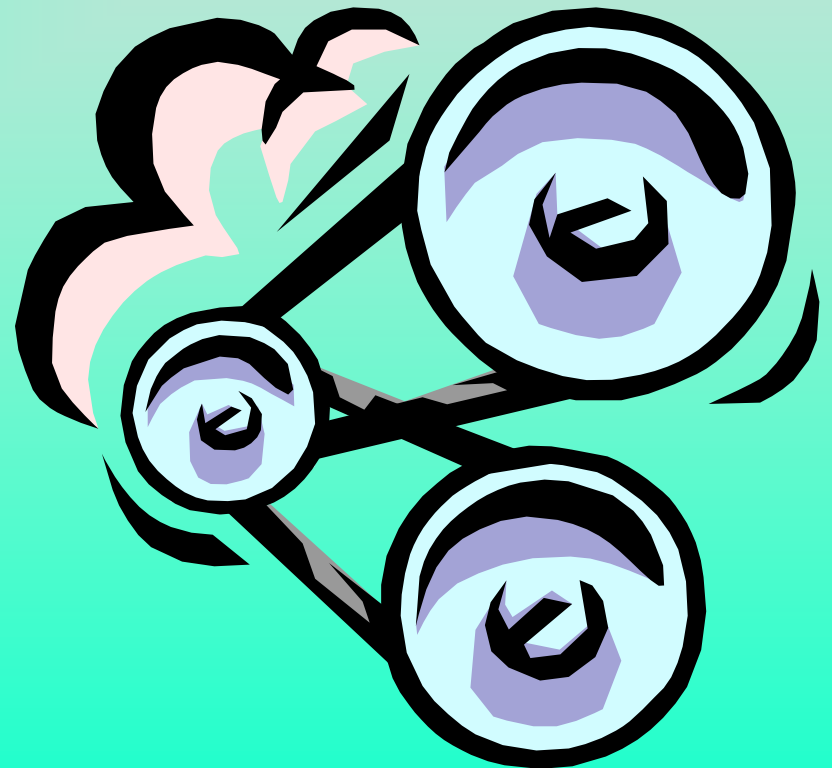
Part One: The Principles

The purpose of machine guarding is to protect against and prevent injury from....

Points of operation

Flying chips and sparks

Nip points



Part One: The Principles

The purpose of machine guarding is to protect against and prevent injury from....

Points of operation

Flying chips and sparks

Nip points

Moving parts



Allowable machine guarding clearances for other than points of operation (T8CCR 3944):

Within two inches: openings allow access to less than ½ inch diameter.

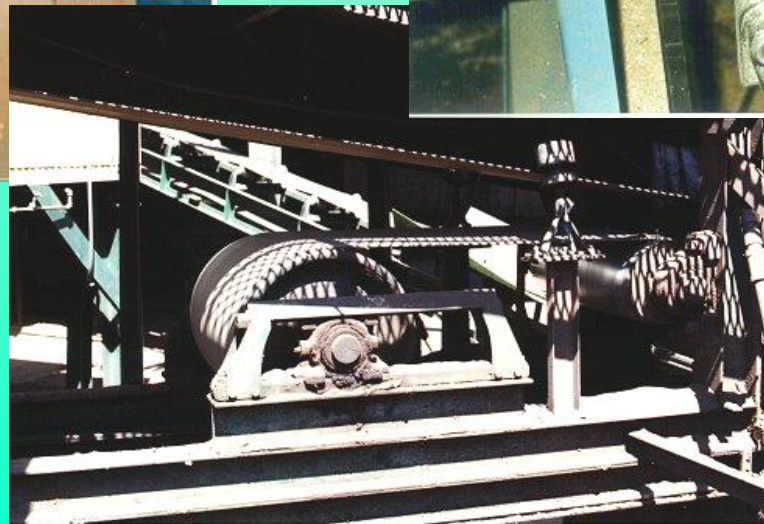
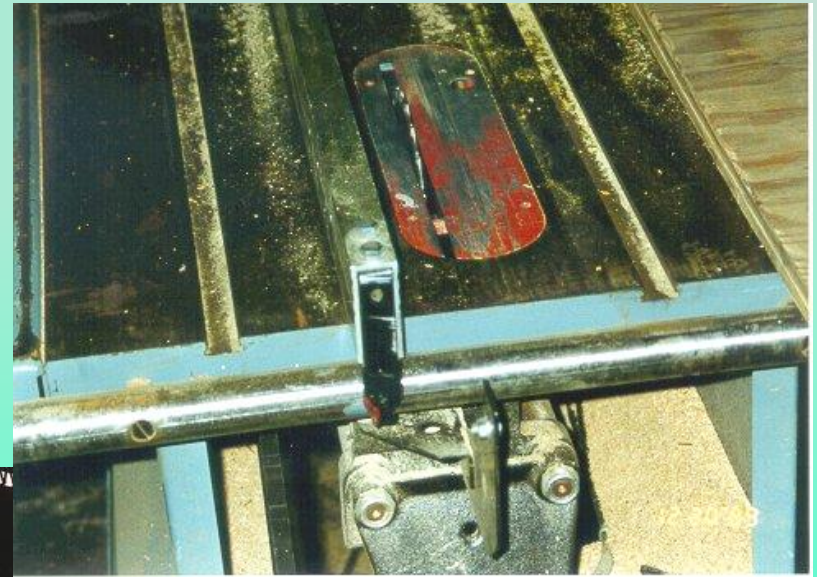
Within four inches: openings allow access to no larger than ½ inch diameter.

Four to fifteen inches: excludes objects larger than 2 inches dia. or guard has 1 inch wide slats.

Fifteen to twenty inches: Guardrails.

Where Mechanical Hazards Occur

Three basic areas require safeguarding

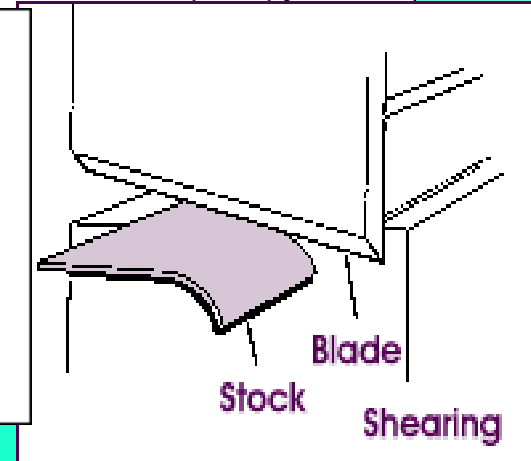
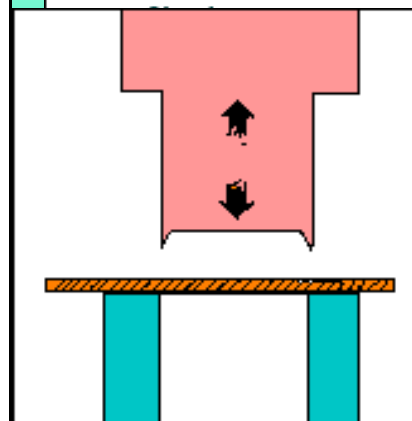
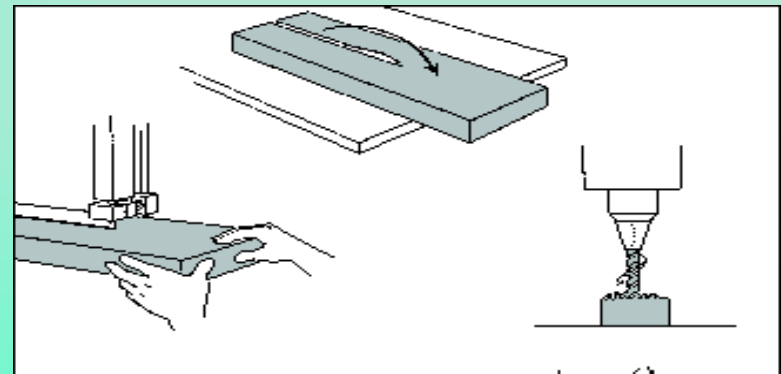
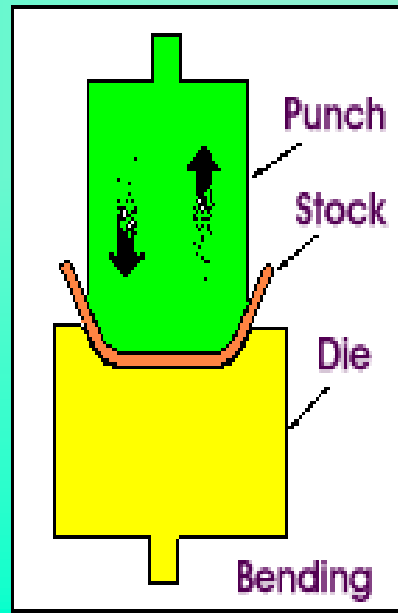


Where Mechanical Hazards Occur

1. Points of Operation

The point is that location where an operation is performed on stock or material:

Cutting,
Shaping,
Boring,
Forming,
etc., or.....



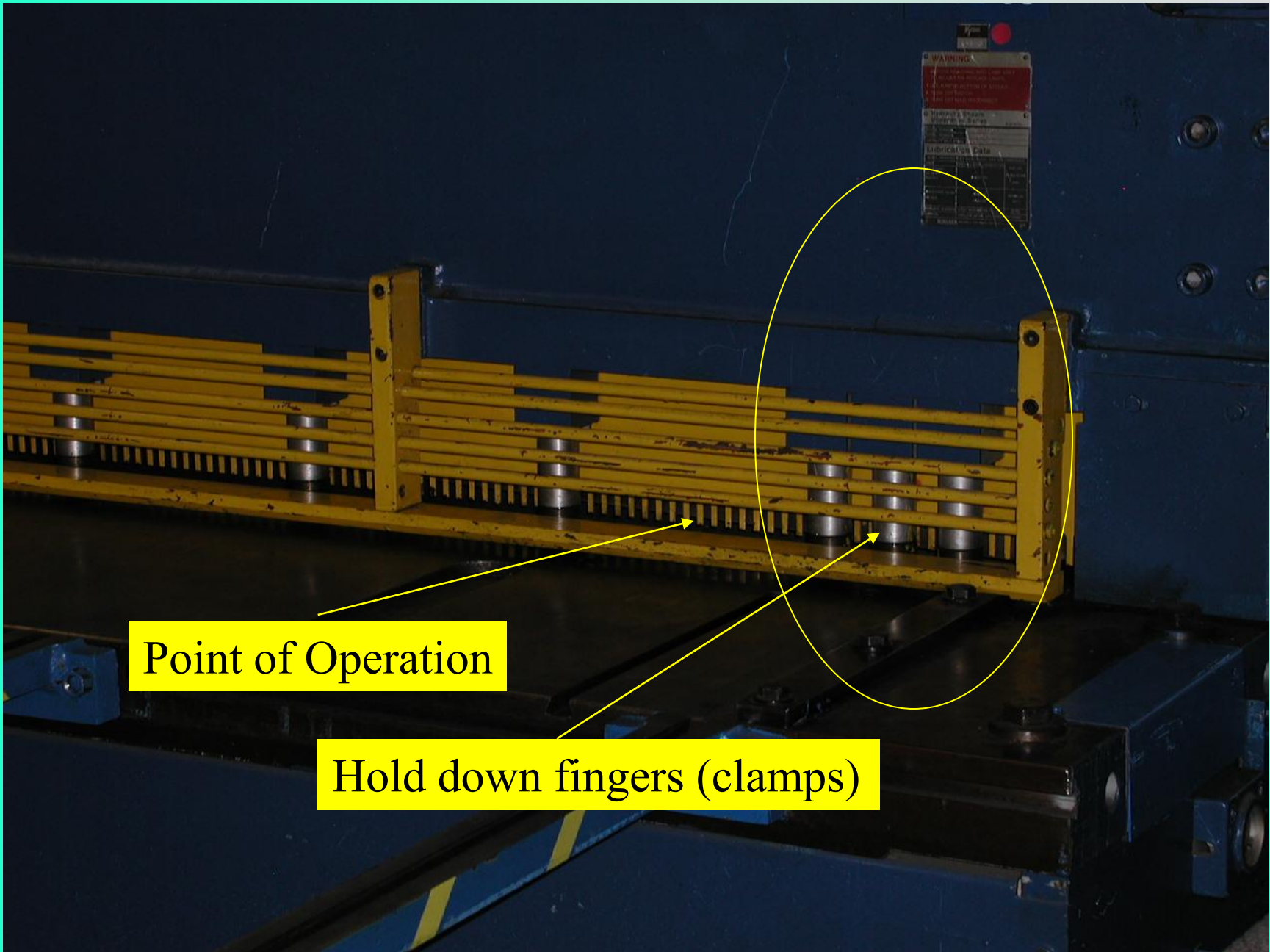
Where Mechanical Hazards Occur

1. Points of Operation

...that point or location where stock or material is fed to the machine.

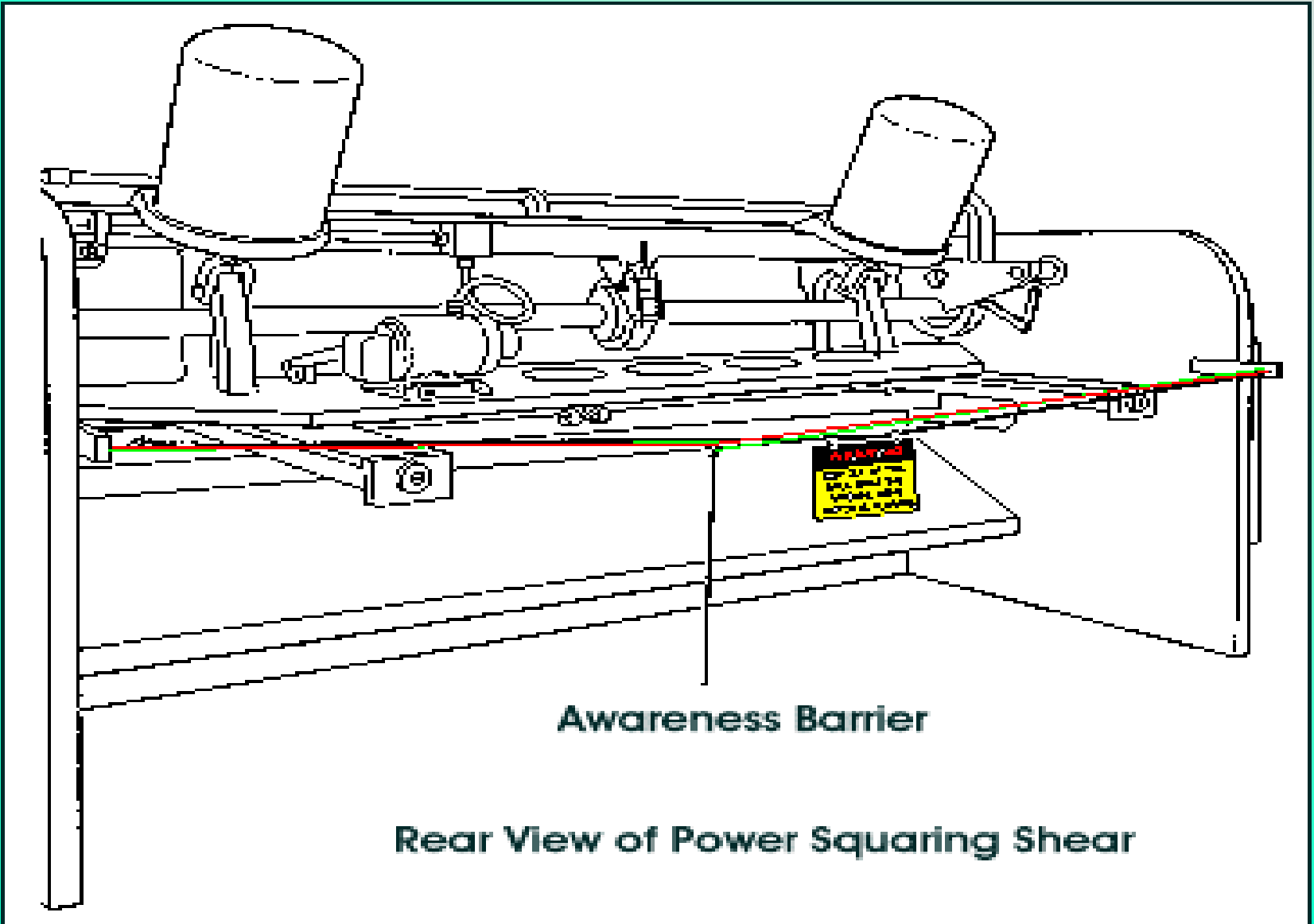






Point of Operation

Hold down fingers (clamps)



Awareness Barrier

Rear View of Power Squaring Shear

Where Mechanical Hazards Occur

2. Power Transmission Devices

The components which transmit energy to the part of the machine performing the work.



Where Mechanical Hazards Occur

2. Power Transmission Devices

Flywheels

Pulleys

Rods

Cams

Couplers

Spindles

Chains

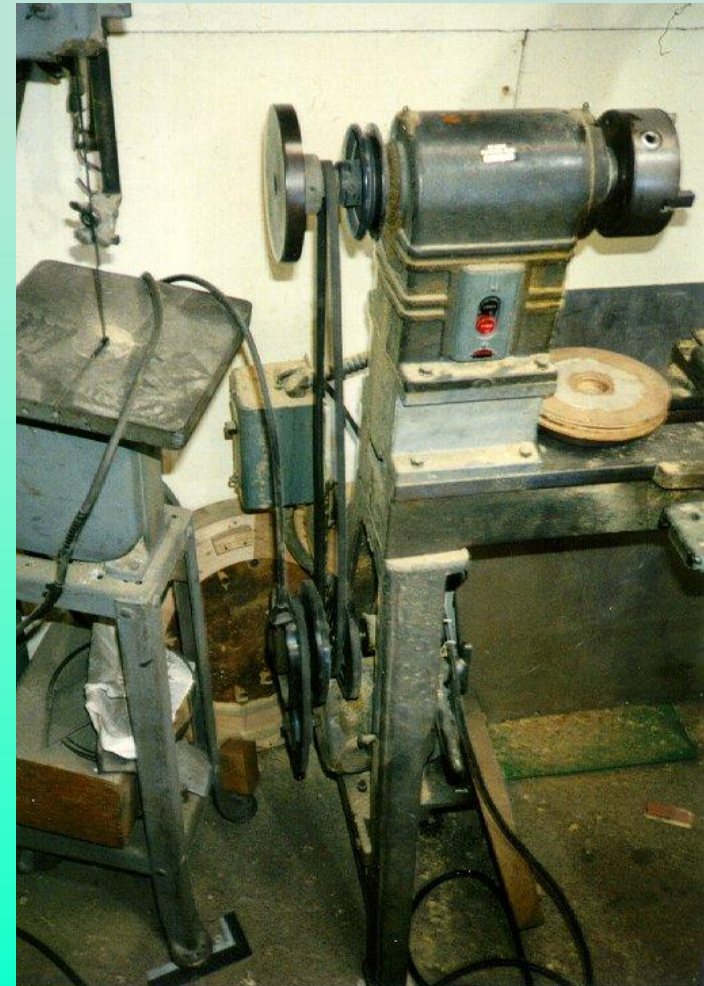
Sprockets

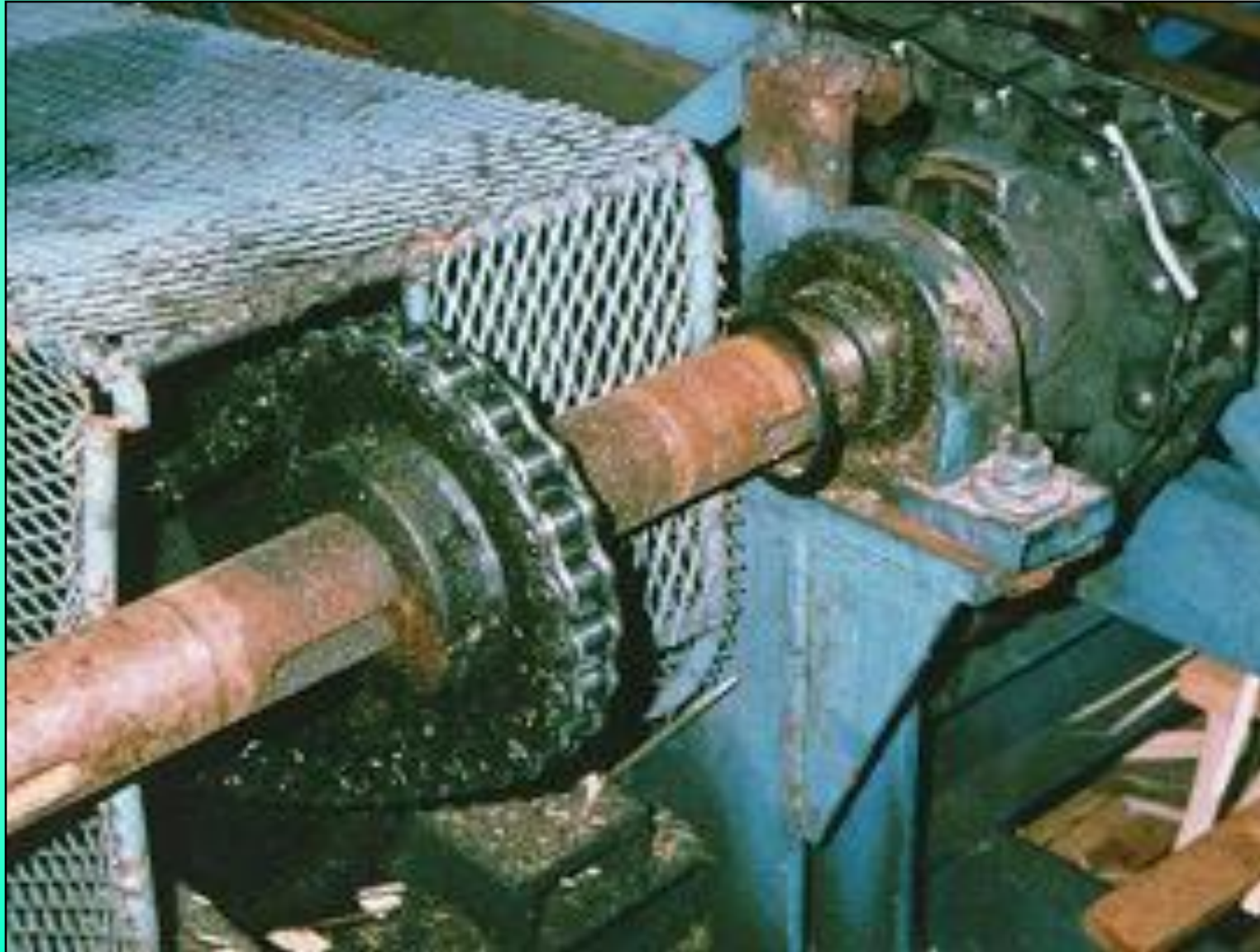
Gears

Shafts

Cranks

Belts















Where Mechanical Hazards Occur

3. All Other Moving Parts

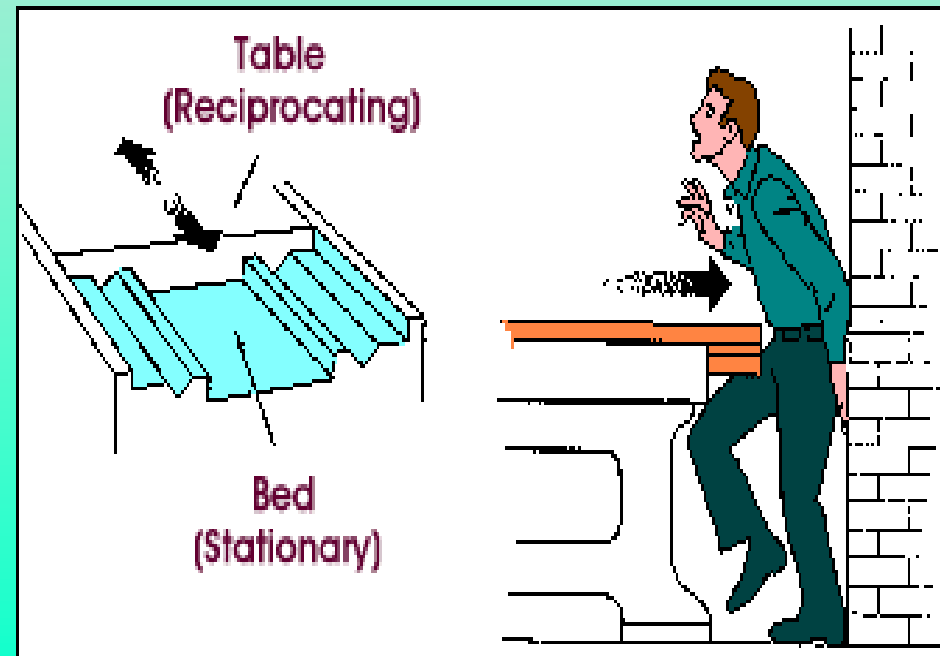
All hazardous parts which move while the machine is working.

Reciprocating

Rotating

Transverse

Feed mechanisms



Part Two: Safeguarding

There are many ways to safeguard machines!

Determine the appropriate safeguarding method.

Consider:

- the type of operation and material
- the size or shape of stock
- the method of handling
- the physical layout of the work area
- production requirements/limitations

Part Two: Safeguarding

1. Guards

Fixed

Interlocked

Adjustable

Self-adjusting



Part Two: Safeguarding

2. Devices

Presence Sensing

Pullback

Restraint

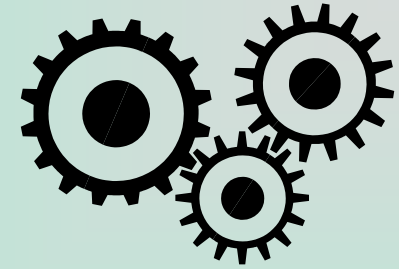
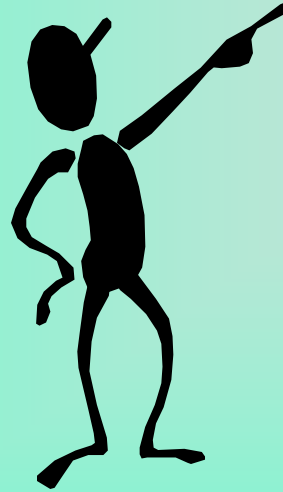
Safety Controls

Gates



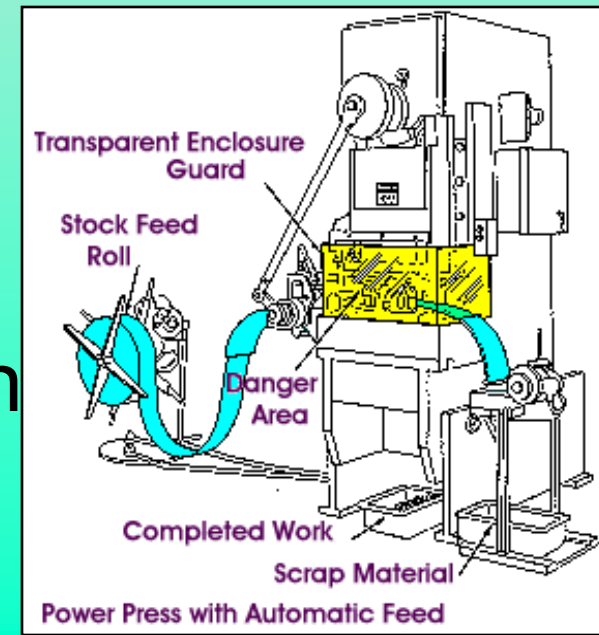
Part Two: Safeguarding

3. Location/Distance



4. Feeding/Ejection Methods

Automatic/Semi-Auto feed
Automatic/Semi-Auto ejection
Robotics

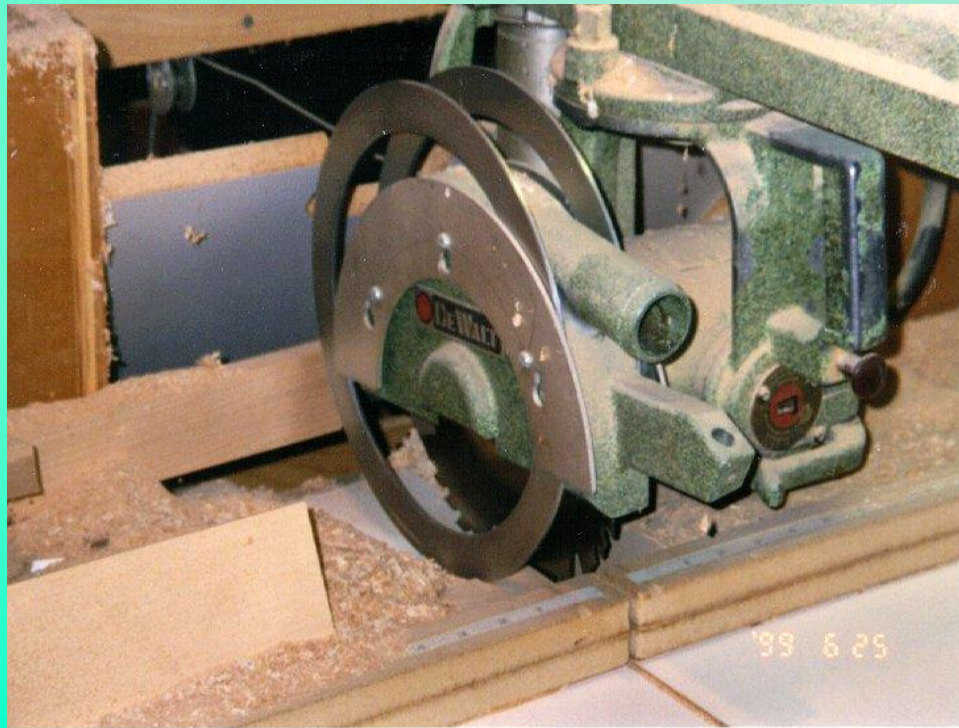


Effective Safeguarding

- Must be in conformity with any appropriate standards.
- Must not present a hazard in itself nor create interference.
- Allows safe maintenance and lubrication.

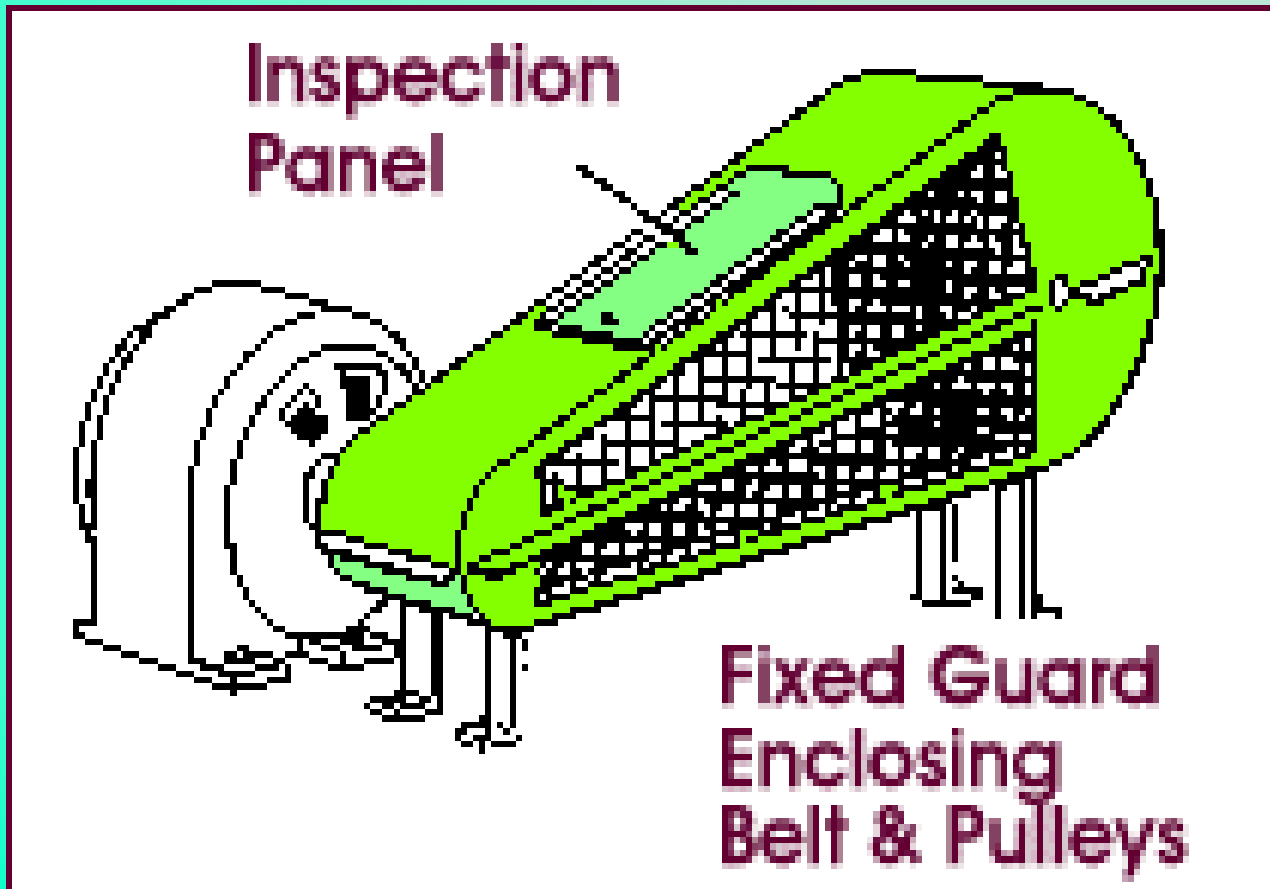
Effective Safeguarding

- Must not allow product or objects to fall into moving parts or onto people.
- Get Buy-in from Operators, PM Tech, Lube and Maintenance Techs.



First Safeguarding Strategy: Guards

Guards are barriers which prevent access to danger areas.



First Safeguarding Strategy: Guards

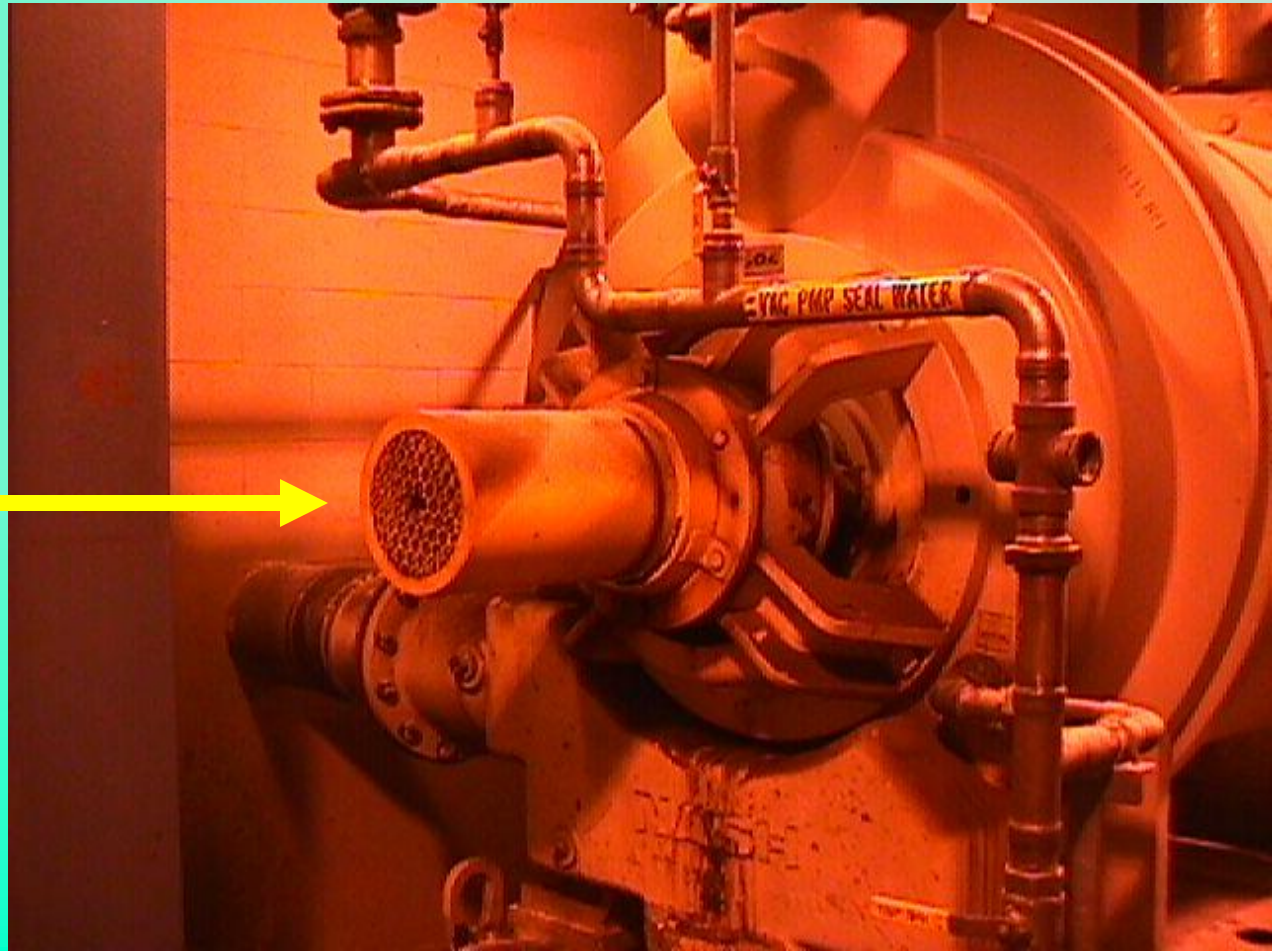
Fixed Guard Characteristics:

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

Part Two: Safeguarding

As a general rule, power transmission apparatus is best protected by fixed guards that enclose the danger areas.

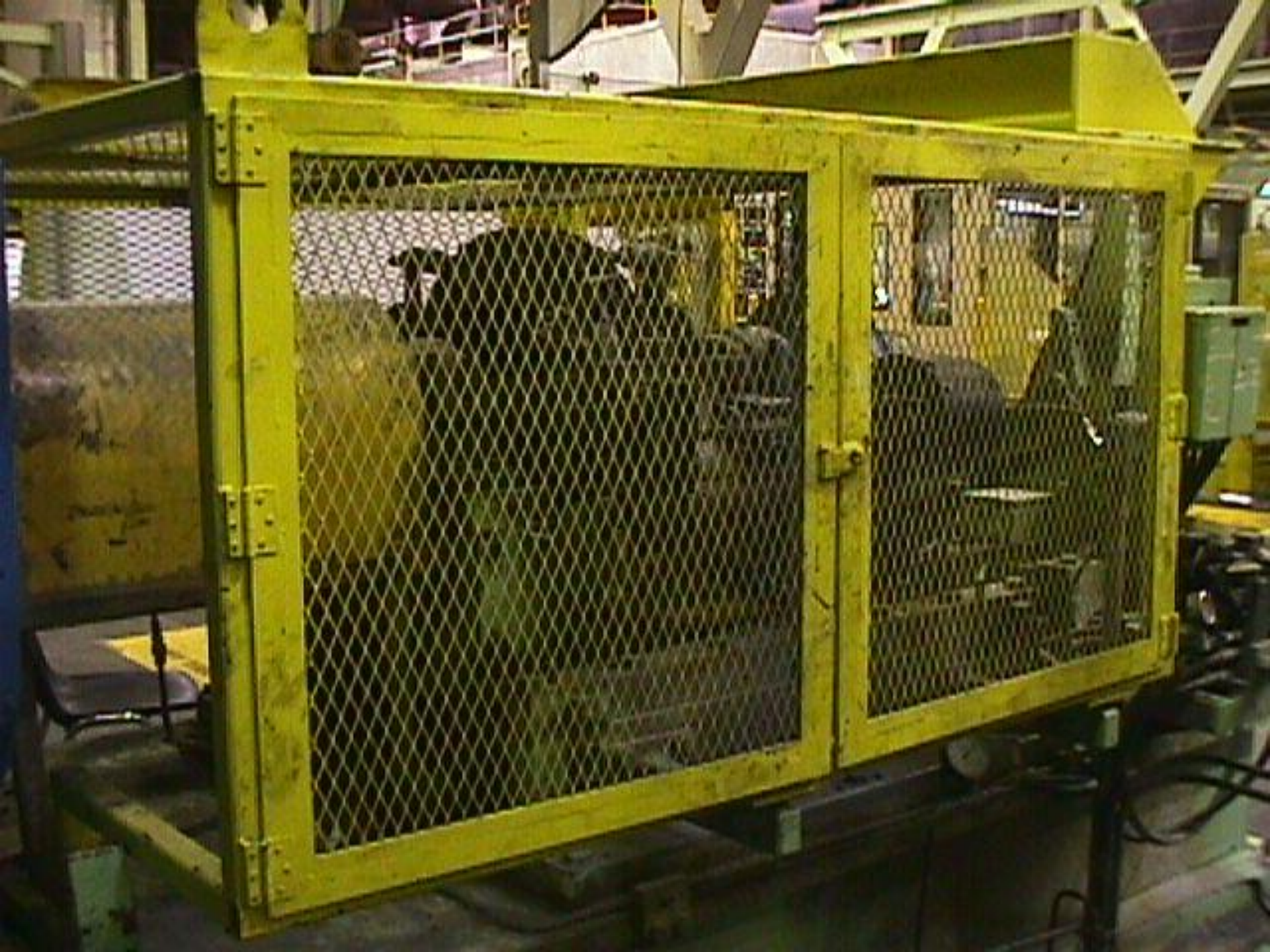
Enclosed shaft
end





Enclosed chain & sprocket

428



First Safeguarding Strategy: Guards

Interlocked Guard Characteristics:

When this type of guard is opened/removed:

- The tripping mechanism and/or power automatically shuts off or disengages.
- The machine cannot cycle or be started until the guard is back in place.

First Safeguarding Strategy: Guards

Interlocked Guard Characteristics (continued):

- They may use electrical, mechanical, hydraulic, or pneumatic power or any combination of these.
- Replacing the guard must not automatically restart the machine.
- PM is important because sometimes they fail and sometimes they are sabotaged!

Interlocked
guarding
can be
defeated!

This was
taped down.

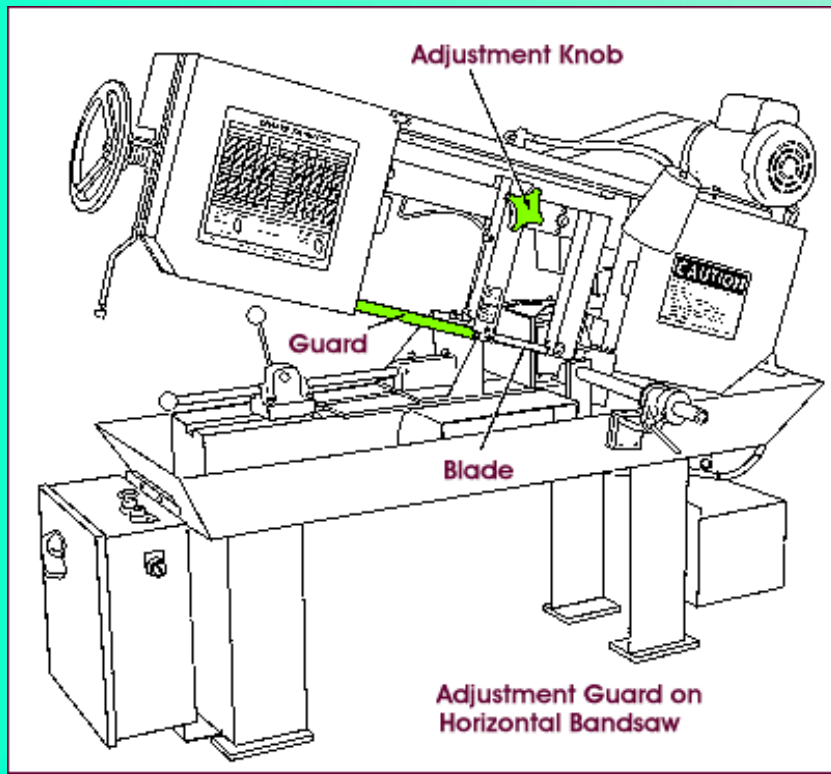
Good
opportunity
for RCA.



First Safeguarding Strategy: Guards

Adjustable Guards

- These guards allow flexibility in accommodating various sizes of stock



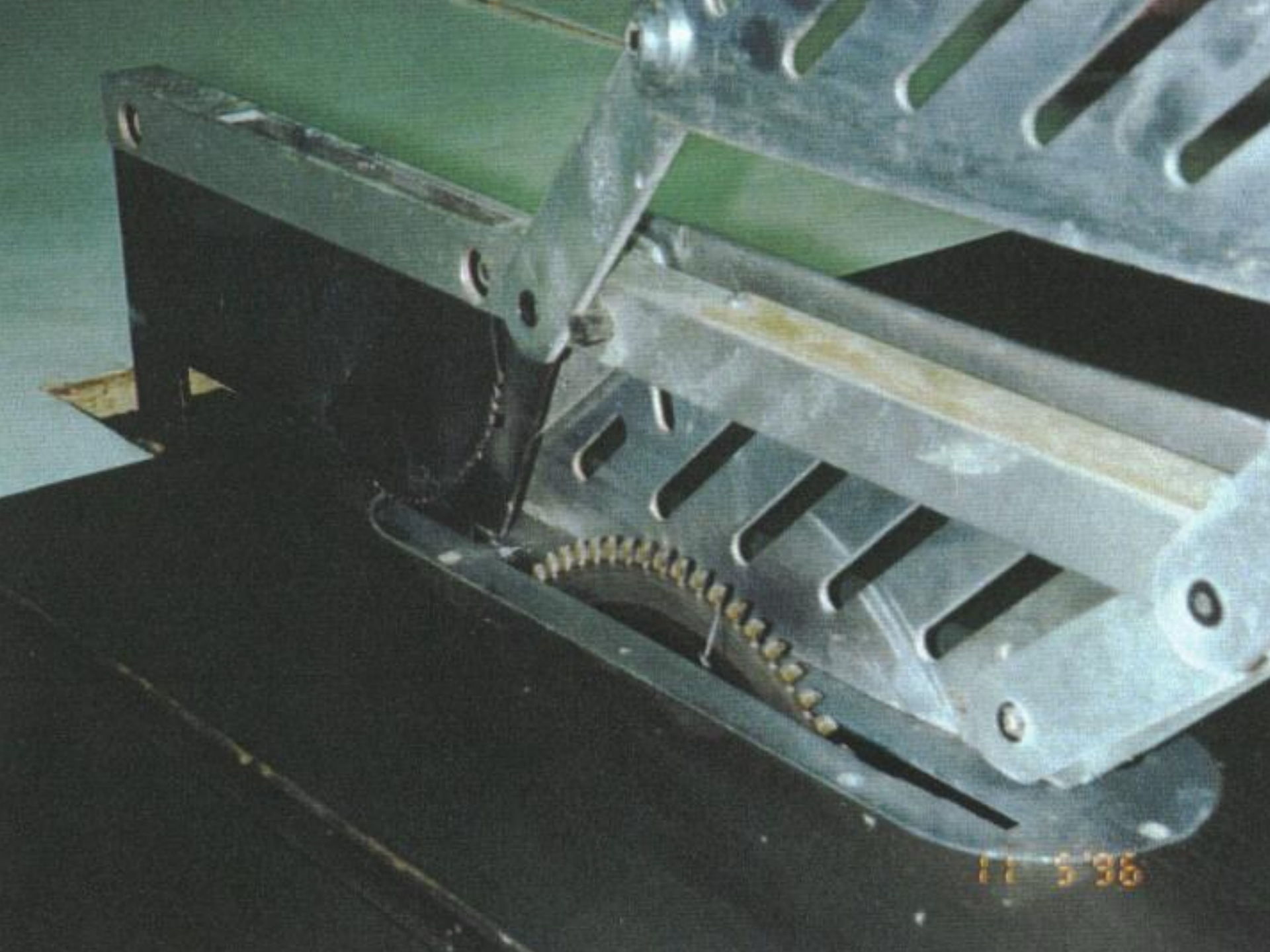


First Safeguarding Strategy: Guards

Self-Adjusting Guards

The openings of these guards 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.



96.5.11

Second Safeguarding Strategy: Devices

A safety device may perform one of several functions.



Gate Open



Gate Closed

Second Safeguarding Strategy: Devices

- **Presence-Sensing Devices**

- Photoelectric (optical)

- Uses a system of light sources and controls which can interrupt the machine's operating cycle.

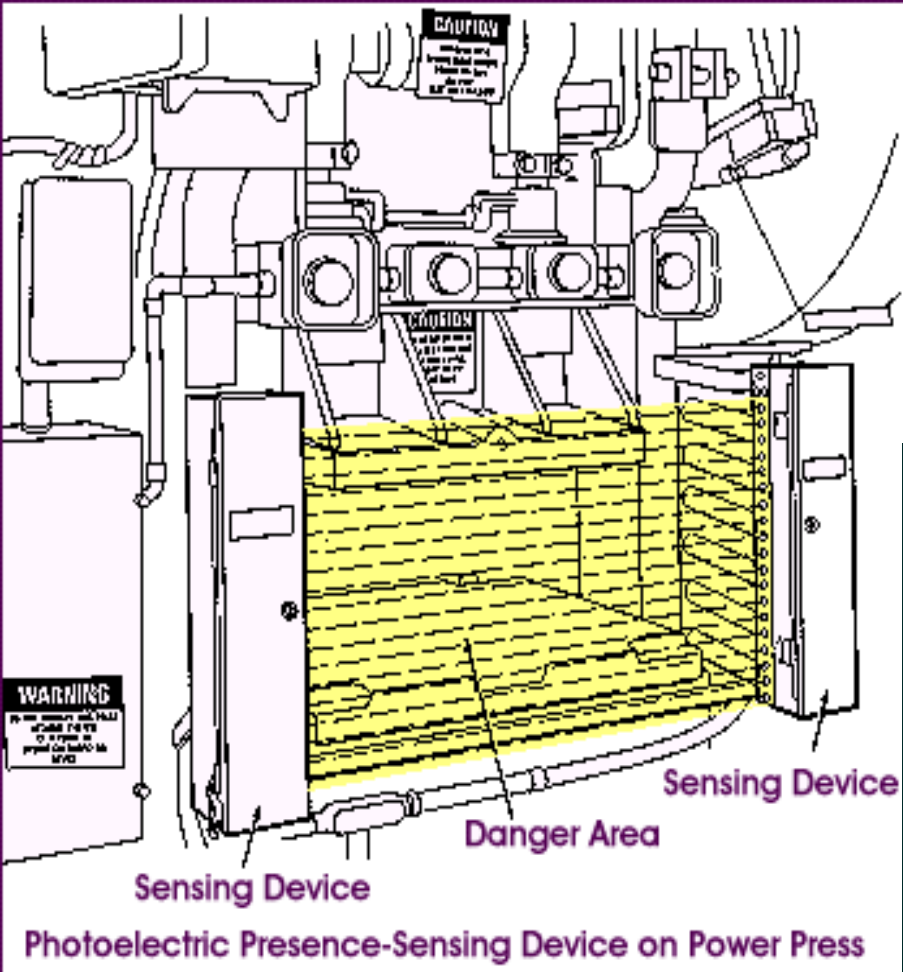
- Radiofrequency (capacitance)

- 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.

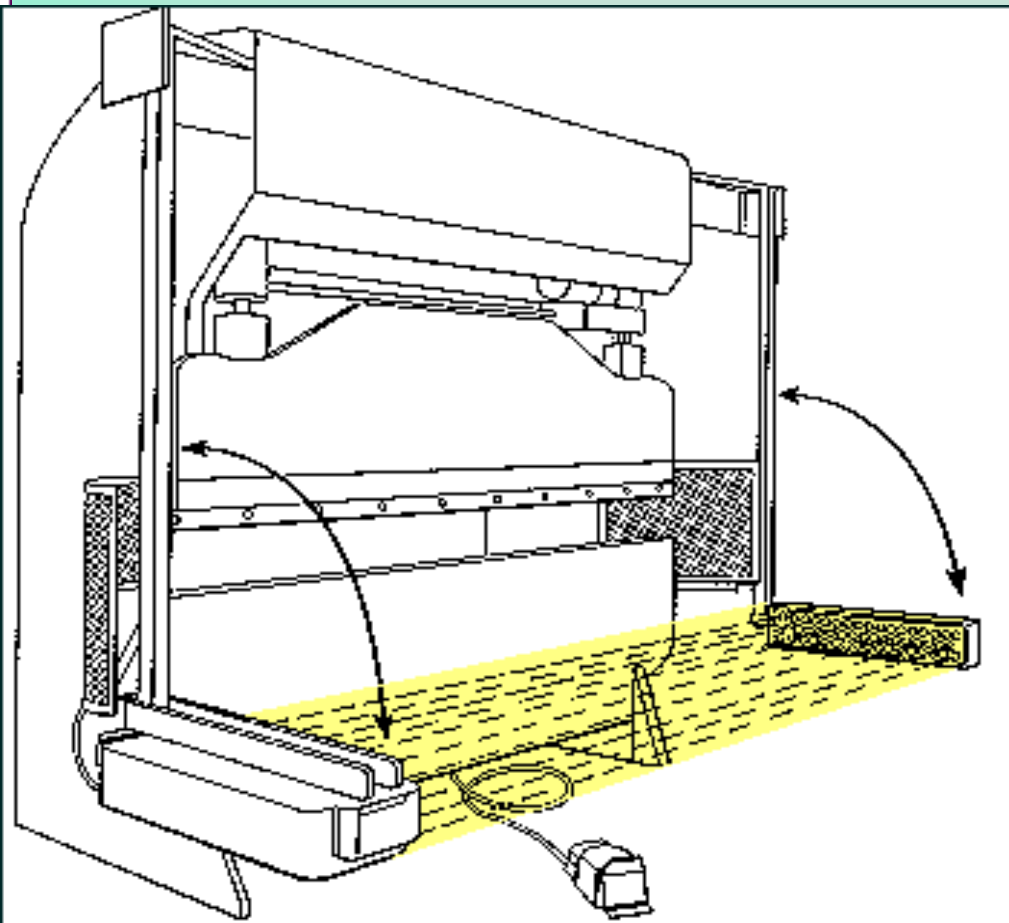
Second Safeguarding Strategy: Devices

It may stop the machine if a hand or any part of the body is inadvertently placed in the danger area.





Photoelectric Presence-Sensing Device on Power Press

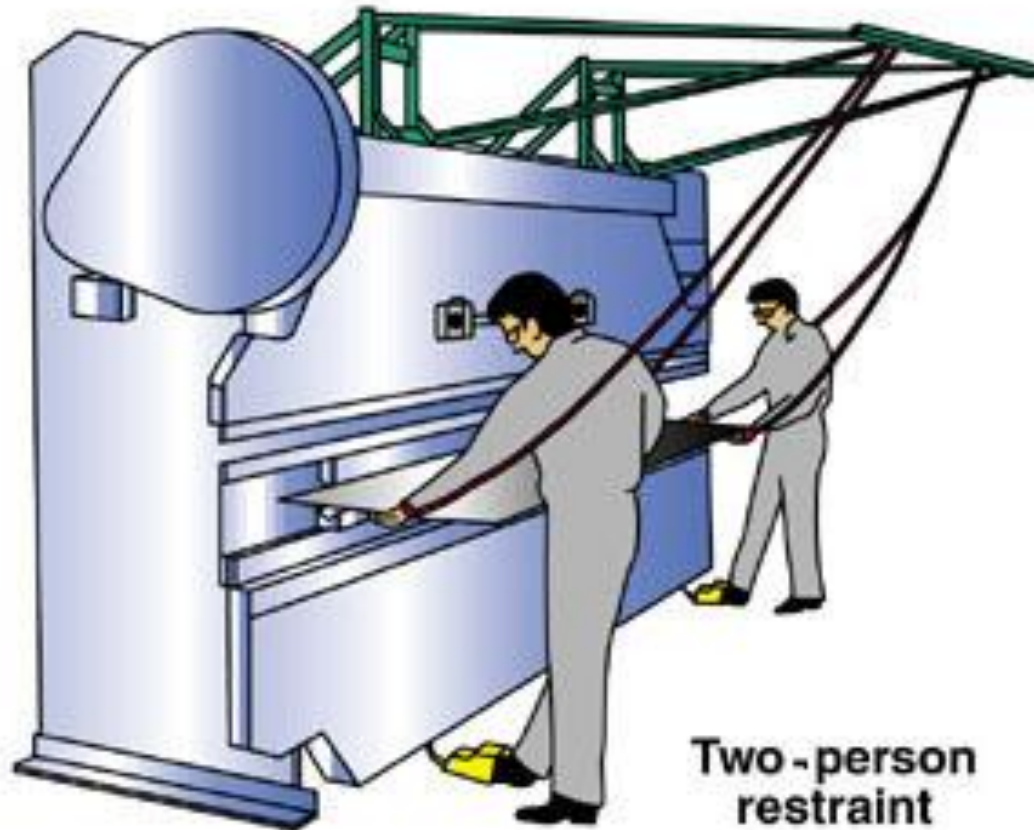


Photoelectric Presence-Sensing Device on Press Brake

Second Safeguarding Strategy: Devices

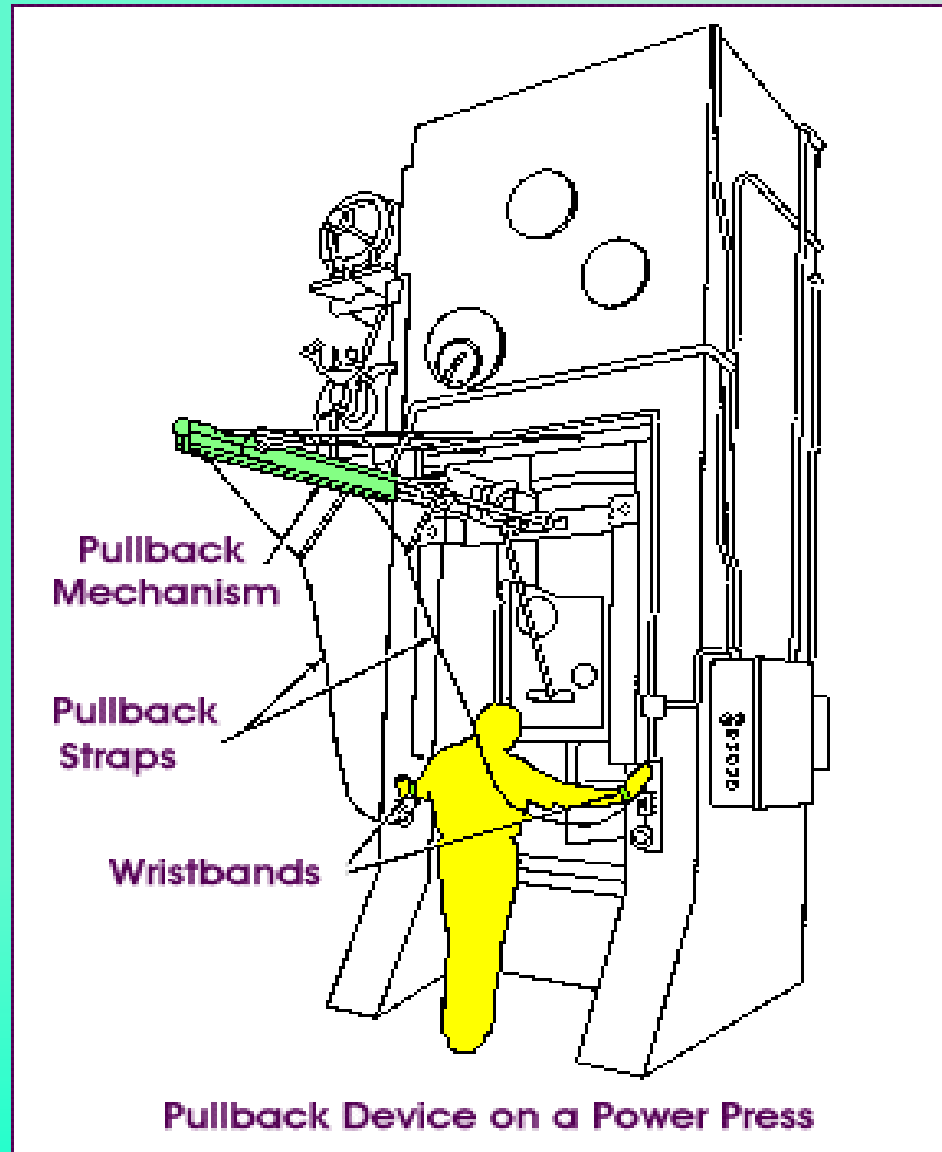
- **Restraint**
 - The restraint (holdout) device utilizes cables or straps that are attached to the operator's hands at a fixed point
 - The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area - there is no extending or retracting action involved

Second Safeguarding Strategy: Devices



Second Safeguarding Strategy: 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



Pullback Device on a Power Press

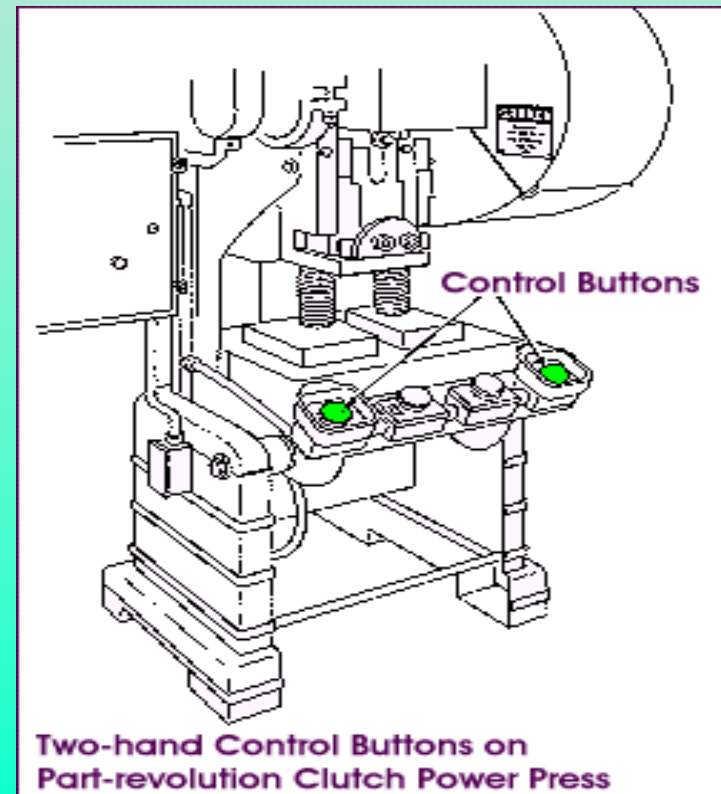
Identify the Action



Second Safeguarding Strategy: Devices

- **Two Hand Controls**

- Requires constant, concurrent pressure by the operator to activate the machine
- With this type of device, the operator's hands are required to be at a safe location (on the control buttons) and at a safe distance from the danger area



Second Safeguarding Strategy: Devices



Second Safeguarding Strategy: Devices

- **Two Hand Trips**
 - This device requires concurrent application of both the operator's control buttons to activate the machine cycle, after which the hands are free.
 - Must be far enough away to prevent **intentional** contact.



Second Safeguarding Strategy: Devices

- **Gates**
- 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



Gate Open



Gate Closed

First Safeguarding Strategy: Guards

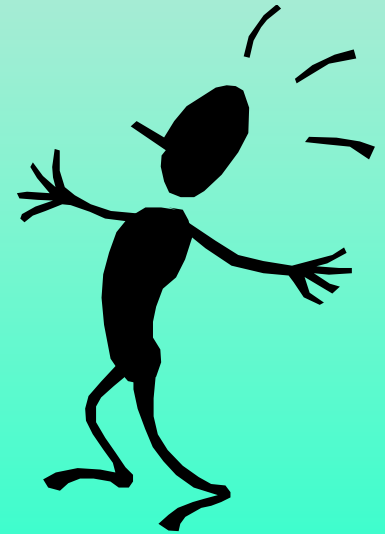
Interlocked guards:

- Vertical balers built to ANSI Z245.2 *American National Standard for Refuse Collection, Processing, and Disposal Equipment-Stationary Compactors-Safety Requirements* do not comply with Title 8 CCR 4353(h).



Another Safeguarding Strategy

- **Guarding by Location/Distance**
 - The machine or its dangerous moving parts are positioned so that hazardous areas are not accessible or do not present a hazard during normal operation
 - walls or other barricades (fences)
 - height (above worker)
 - size of stock (single end feeding, punching)

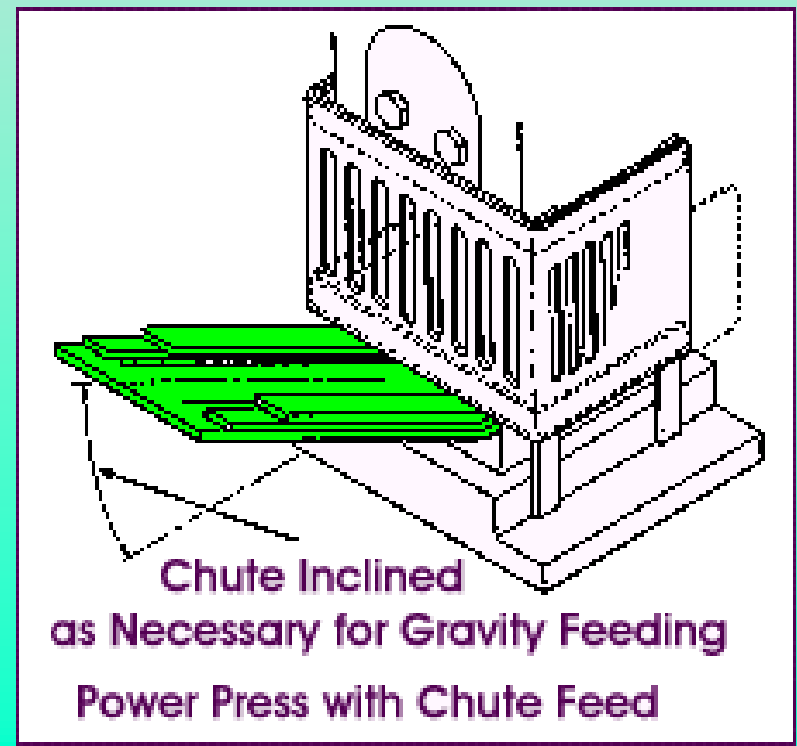
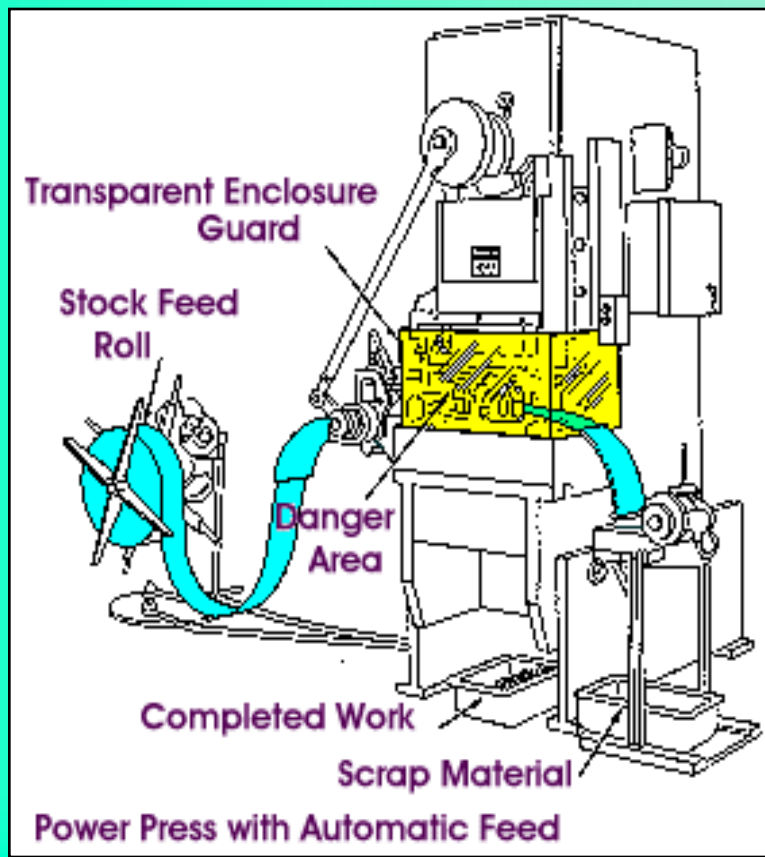




Is this adequate guarding by location?

Another Safeguarding Strategy

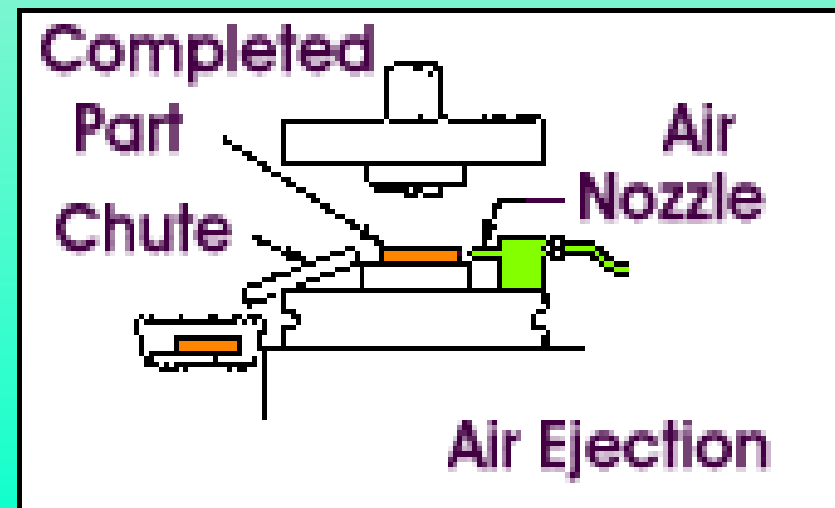
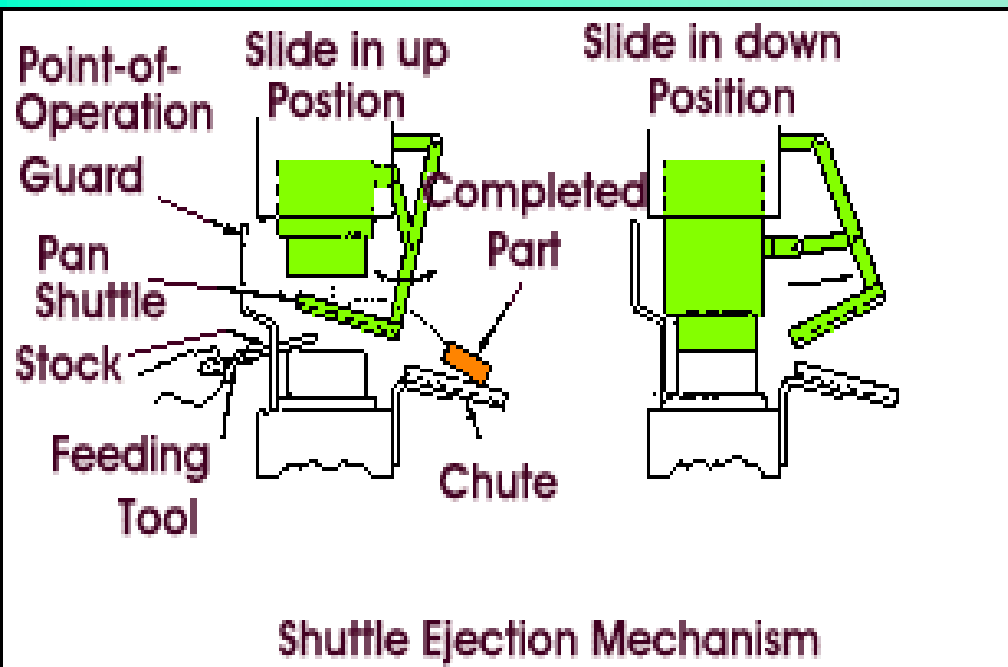
- **Auto/Semi-auto Feeding and Ejection**
 - Automatic and Semi-automatic Feeding



Another Safeguarding Strategy

Feeding and Ejection

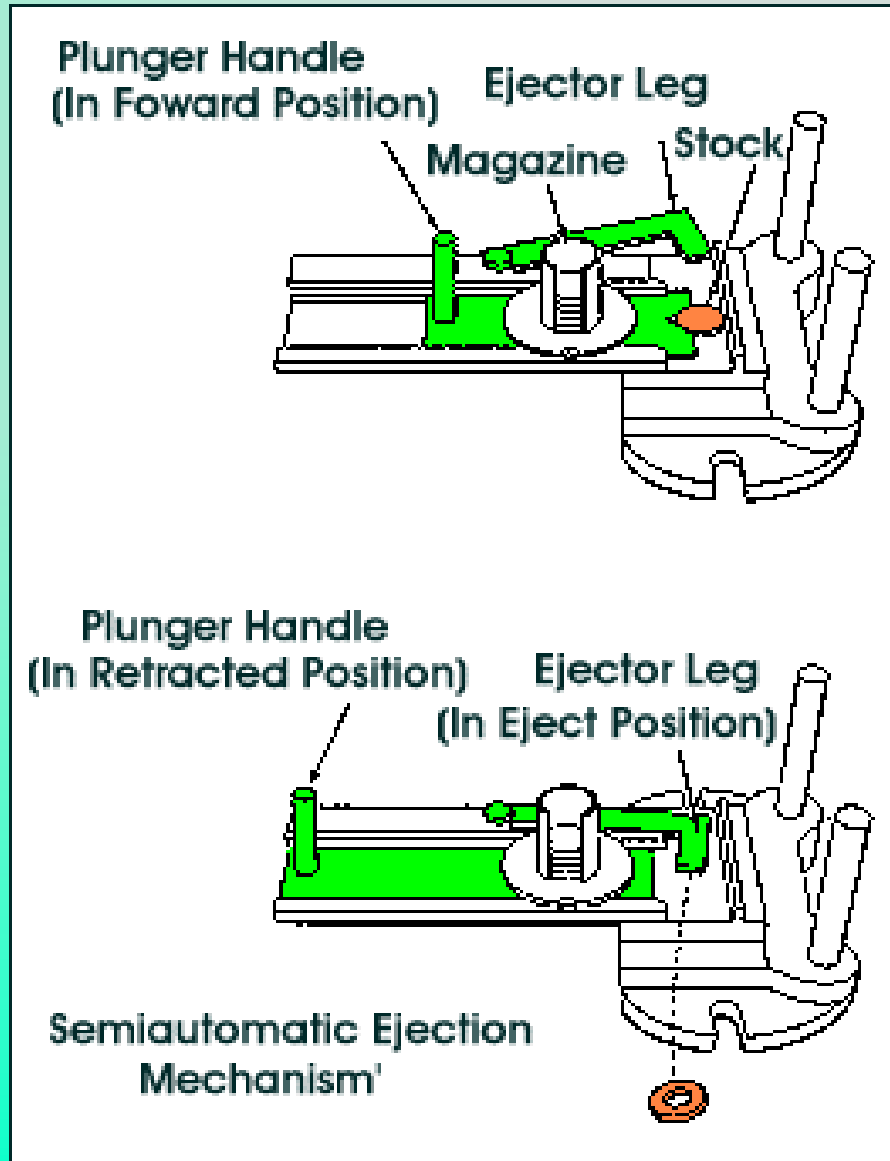
- Automatic Ejection



Another Safeguarding Strategy

Feeding and Ejection

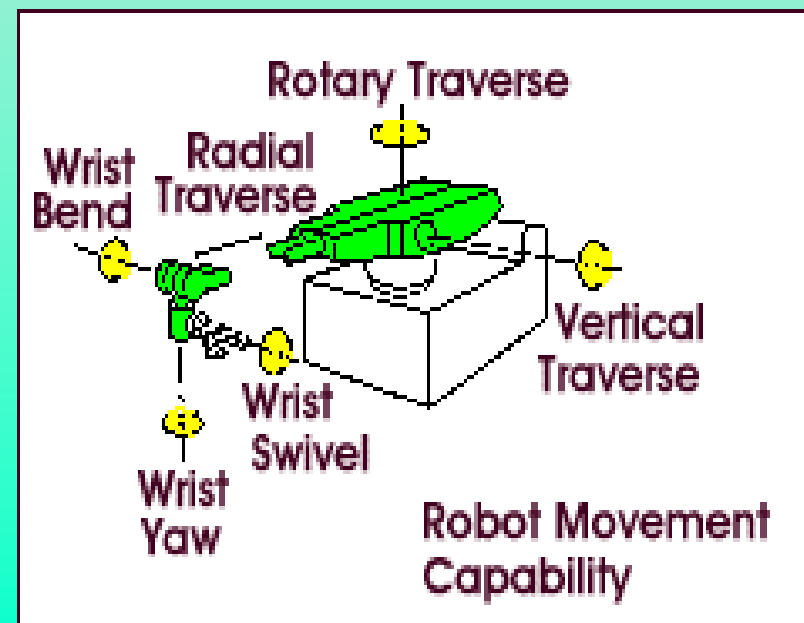
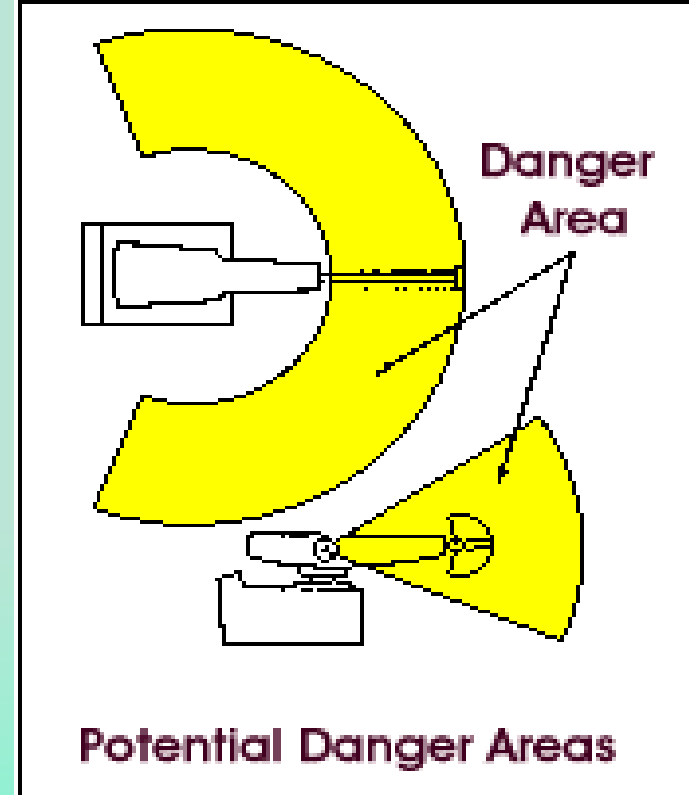
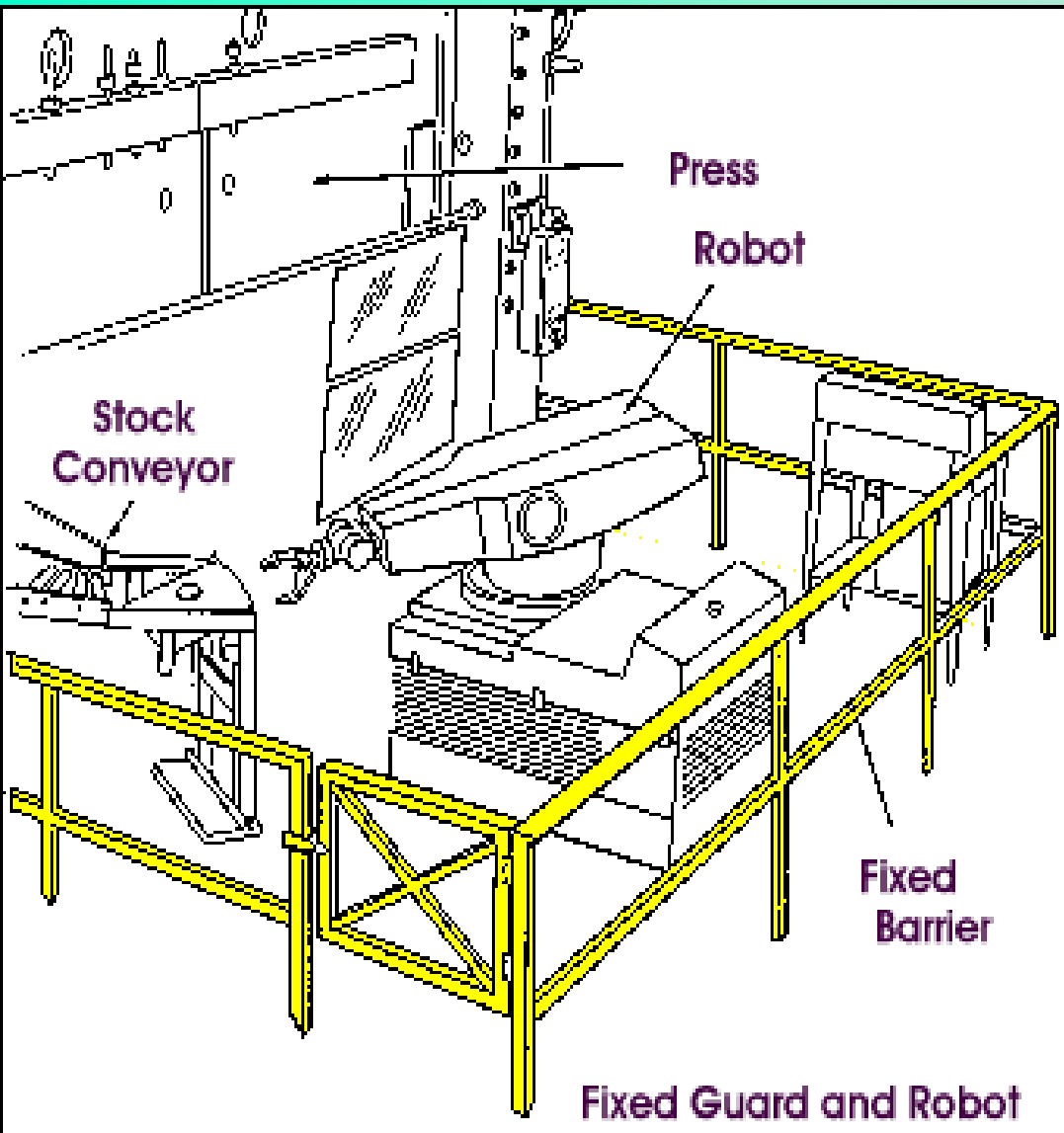
- Semiautomatic Ejection



Another Safeguarding Strategy???

- **Robotics**
 - Machines that load and unload stock, assemble parts, transfer objects, and perform other tasks
 - They perform work otherwise done by the operator
 - Best used in high production processes requiring repeated routines

Robotics



Miscellaneous Aids

Does not give complete protection from machine hazards, but may provide the operator with an extra margin of safety.

Examples:

- Awareness barriers
- Shields
- Holding tools
- Push sticks or blocks

