alliance
An OSHA Cooperative Program

Elevator Industry Safety Partners

Machine Guarding

OSHA Outreach Training

General Industry

Introduction

Possible machinery-related injuries include:

- Crushed fingers or hands
- Amputations
- Burns
- Blindness

A good rule to remember is:

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

Objectives

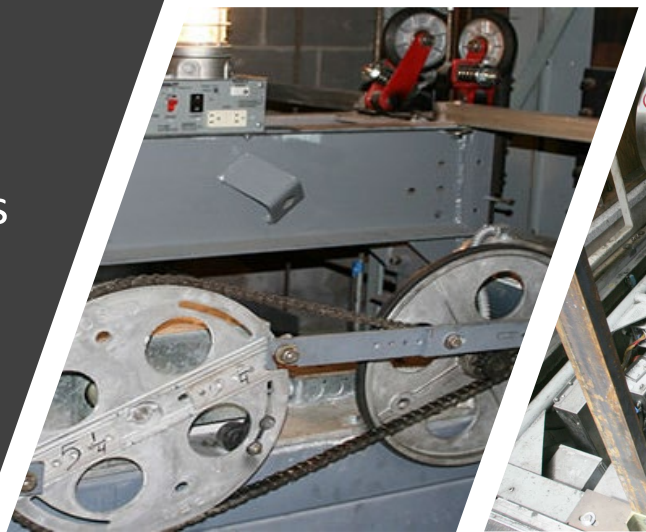
Lesson Objectives:

1. Identify the main causes of elevator machinery accidents
2. Recognize basic machinery parts that expose Elevator Constructors to hazards
3. Recognize workplace situations involving machinery that requires guarding
4. Identify the requirements for safeguards
5. Identify types of machine guards, including types of devices used to safeguard machines

Machinery Accidents

Examples of how elevator machinery and other conveyances accidents can occur include:

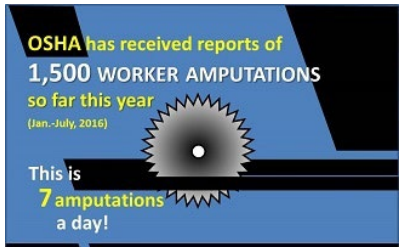
- Reaching in to “clear” equipment
- Not using lockout/tagout
- Unauthorized persons doing maintenance or using the machines
- Missing or loose machine guards



Elevator and Conveyance Machinery Accidents

Amputations:

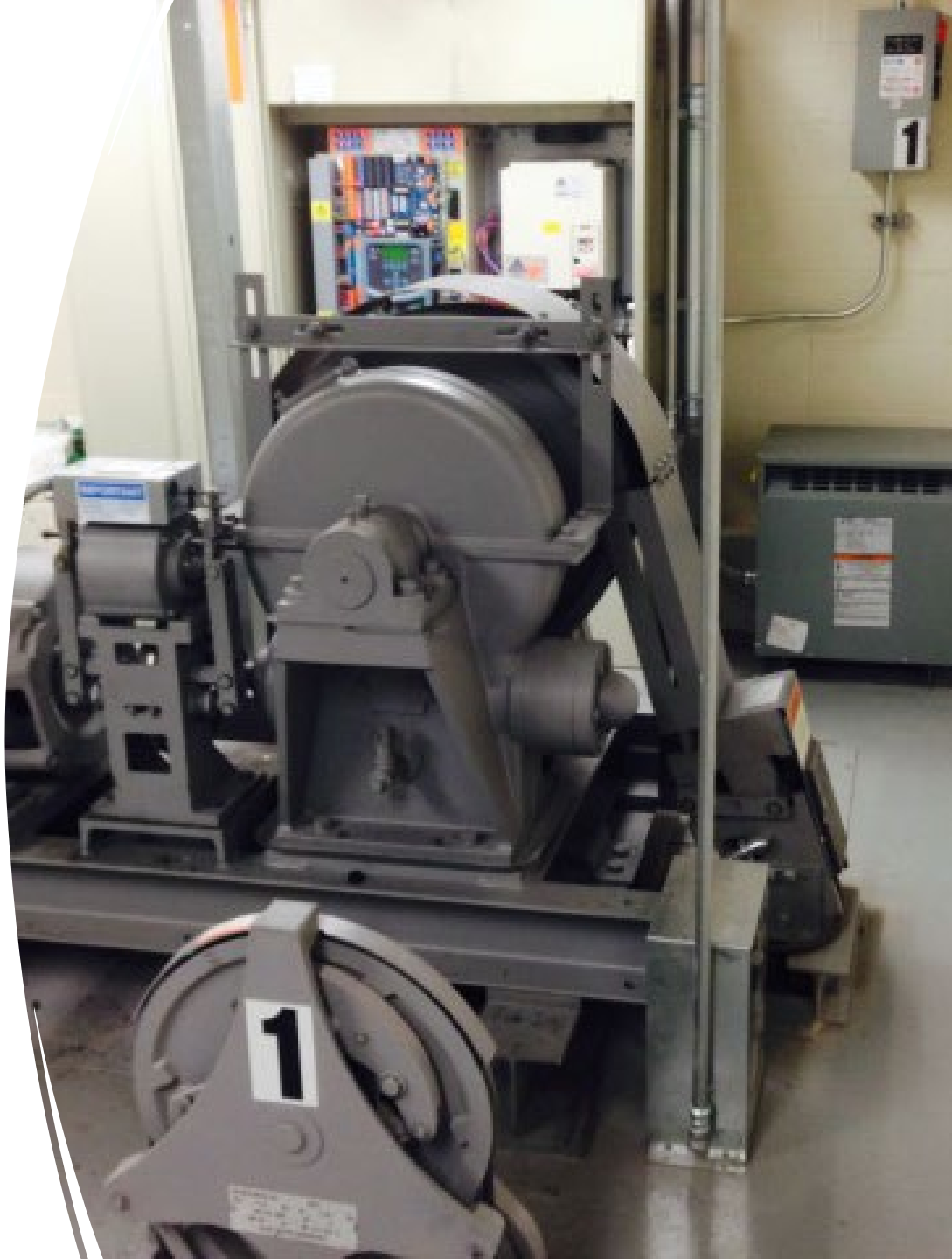
- **Unguarded/inadequately safeguarded machinery**
- **Materials handling activities**
- **Activities involving stationary machines**



Basic Machinery Parts and Hazards

Three fundamental machine areas:

1. Point of operation
2. Power transmission device
3. Operating controls – mechanical or electric power control

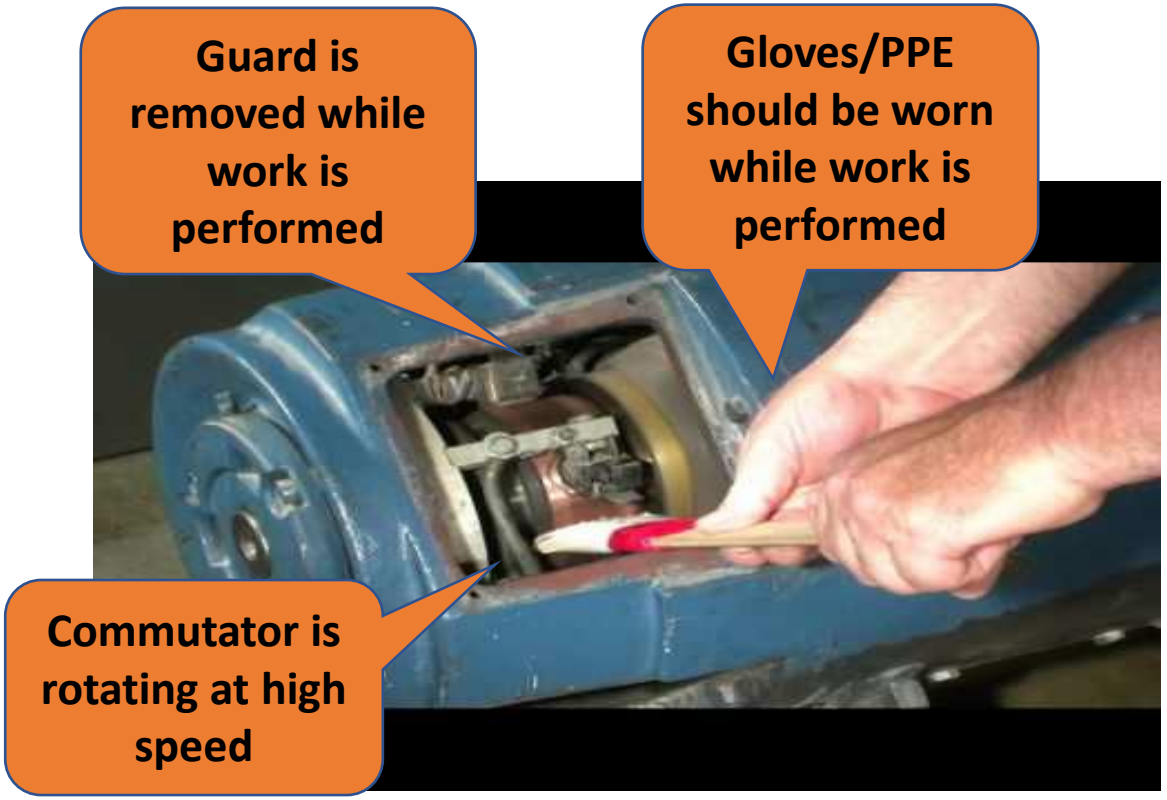


Basic Machinery Parts and Hazards

Point of operation: where work is performed on material

- Examples:
  - Cutting
  - Shaping
  - Boring
  - Forming
  - Polishing

What are the hazards here?



Basic Machinery Parts and Hazards

- Power transmission device:
- Parts that transmit energy to the part of the machine performing work

- Examples
  - Flywheels
  - Pulleys
  - Belts
  - Connecting rods
  - Couplings
  - Cams
  - Spindles
  - Chains
  - Cranks
  - Gears

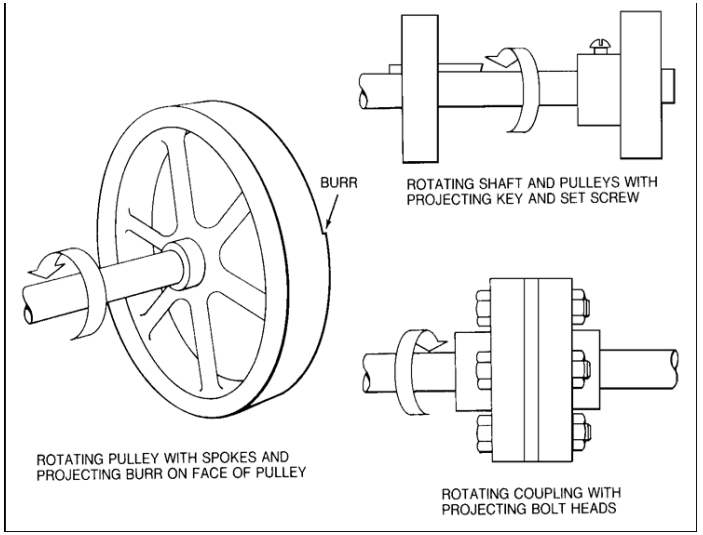
Basic Machinery Parts and Hazards

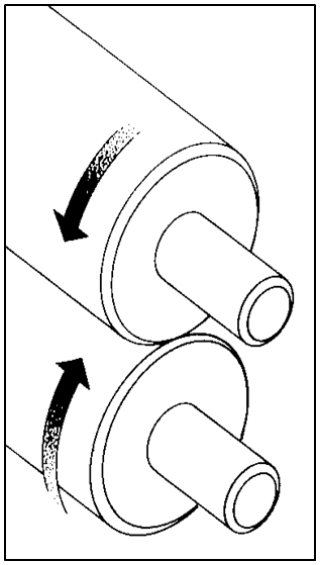
Hazardous motions and actions:

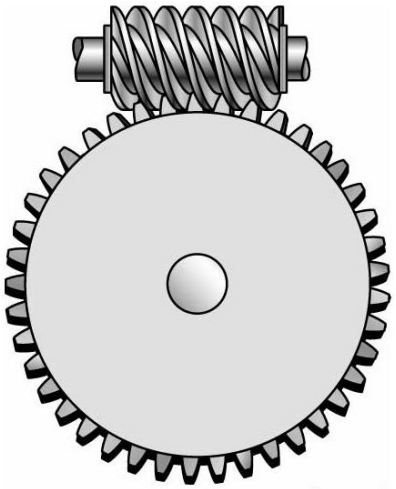
- **Motions**
  - How the machine part moves
  - Examples: rotating, in-running nip points, reciprocating, and transversing
- **Actions**
  - Operation that the machine part performs
  - Examples: cutting, punching, shearing, bending

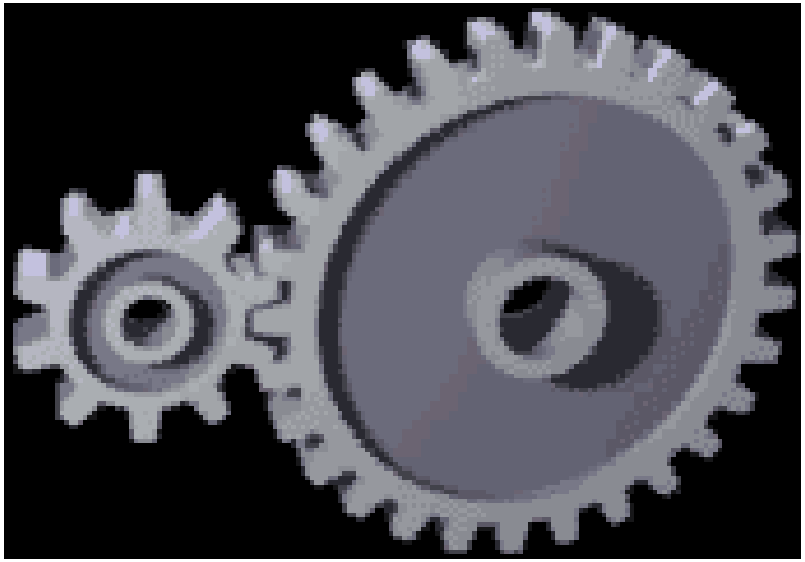
Basic Elevator and Conveyance Machinery Parts and Hazards

- **Rotating parts** with hazardous projections



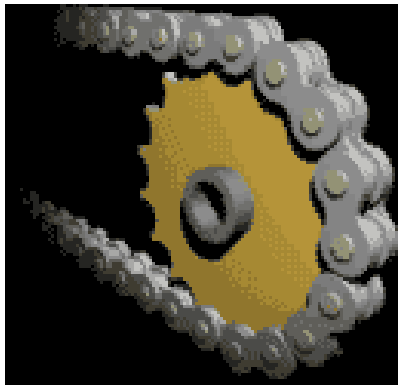


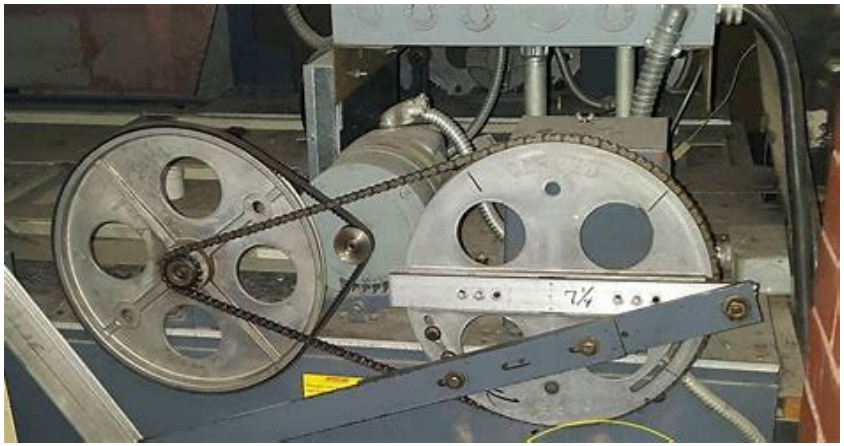




Basic Elevator Machinery and Conveyances Parts and Hazards

- Common **nip points** on rotating parts

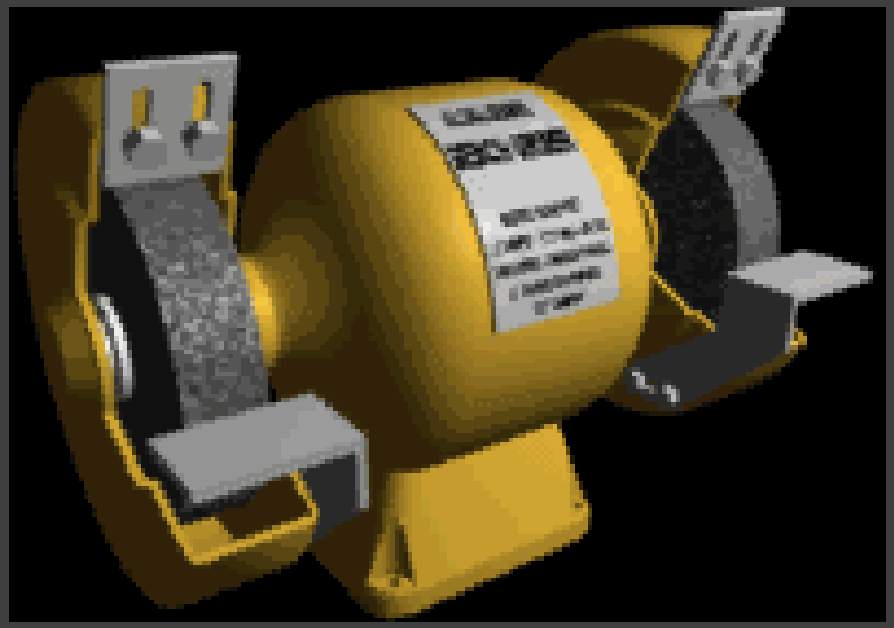




Basic Elevator Machinery and Conveyance Parts and Hazards

- **Nip points** between rotating elements and parts with longitudinal motions

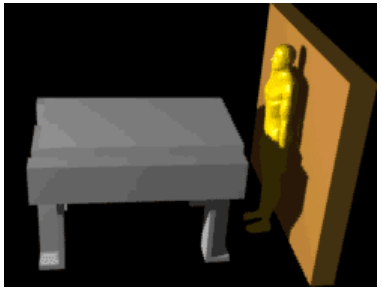
Basic Elevator and Conveyance Machinery Parts and Hazards

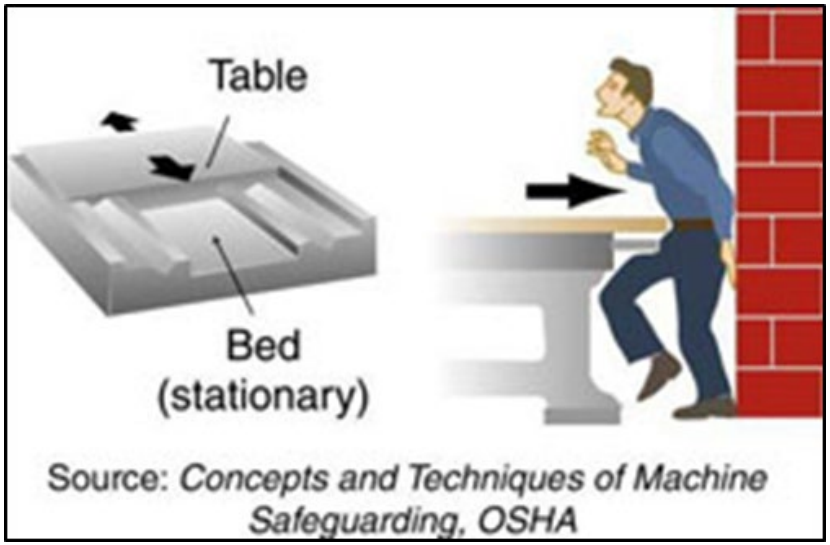


- **Nip points** between rotating machine components

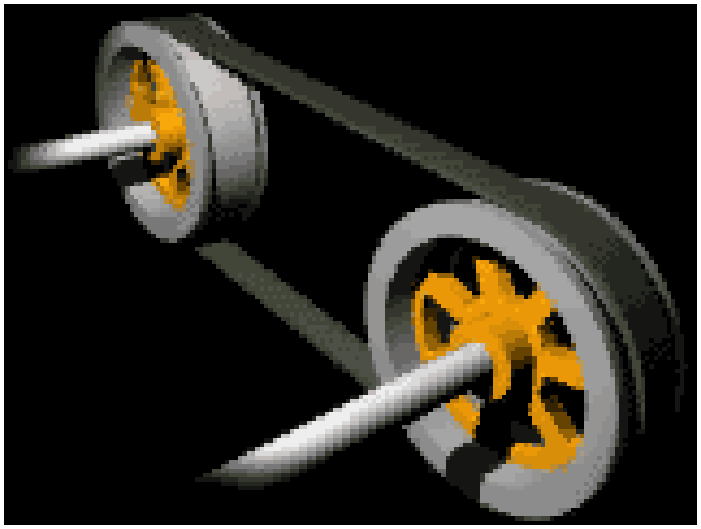
Basic Machinery Parts and Hazards

- **Reciprocating** motions:
  - Back-and-forth
  - Up-and-down

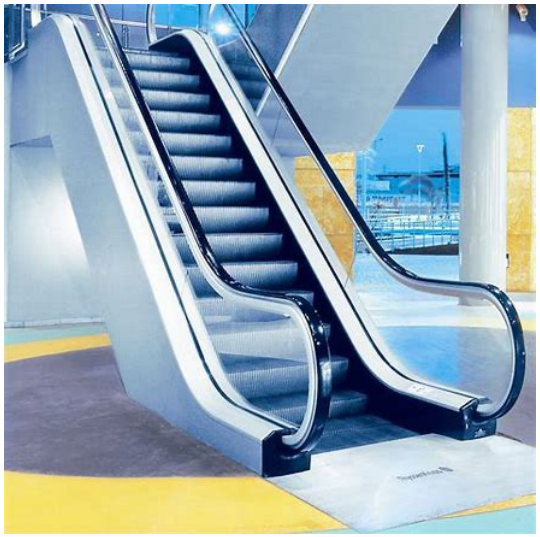




Basic Elevator and Conveyance Machinery Parts and Hazards



- **Transverse motion** – movement in straight, continuous line

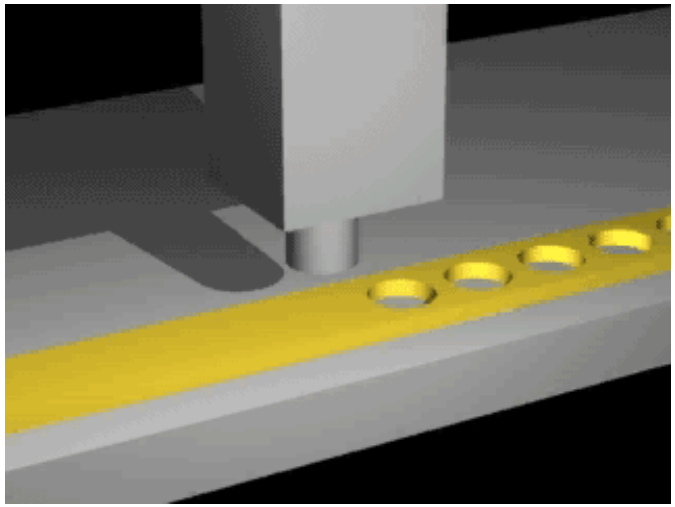


Basic Machinery Parts and Hazards

- **Cutting action** – may involve rotating, reciprocating, or transverse motion

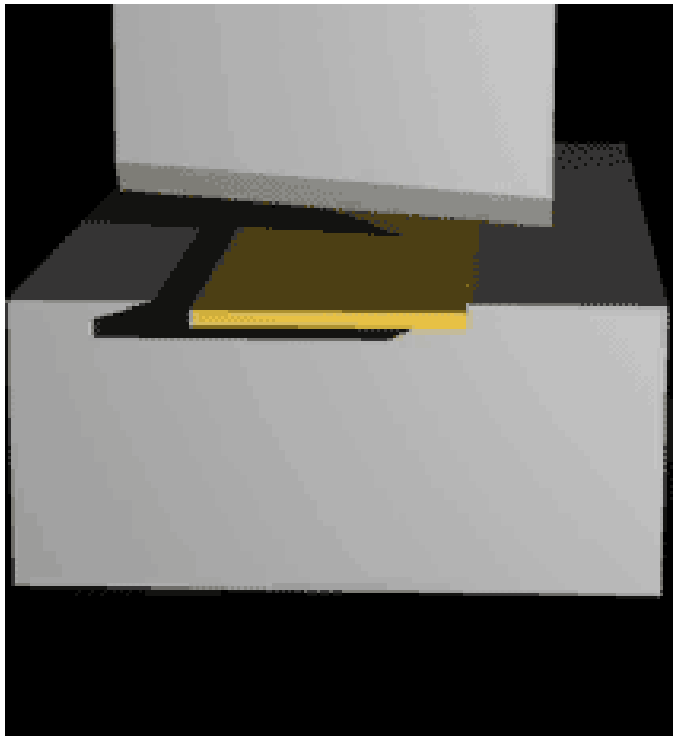
Basic Machinery Parts and Hazards

- **Punching action** – power applied to a slide (ram) for purpose of blanking, drawing, or stamping metal or other materials



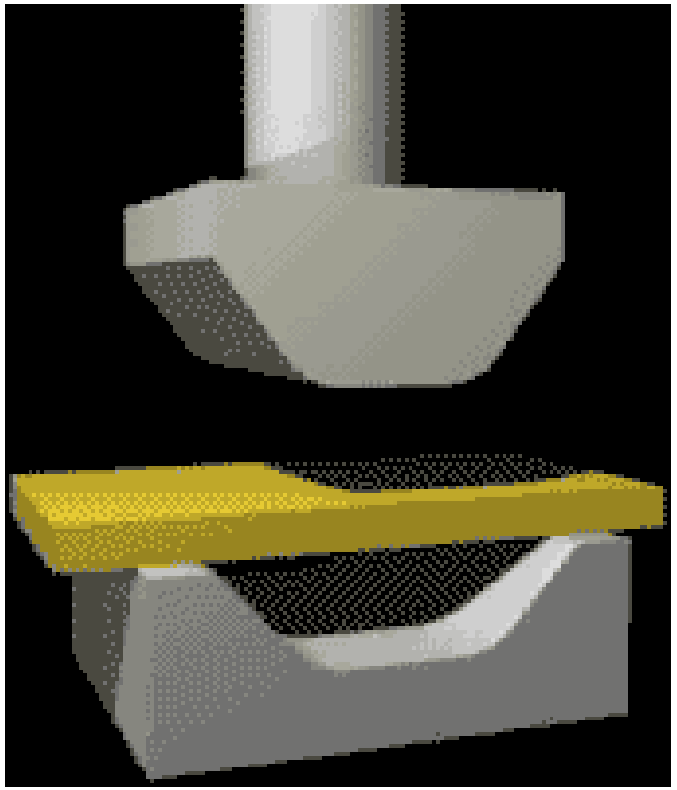
Basic Machinery Parts and Hazards

- **Shearing action** – applying power to a slide or knife in order to trim or shear metal or other materials.



Basic Machinery Parts and Hazards

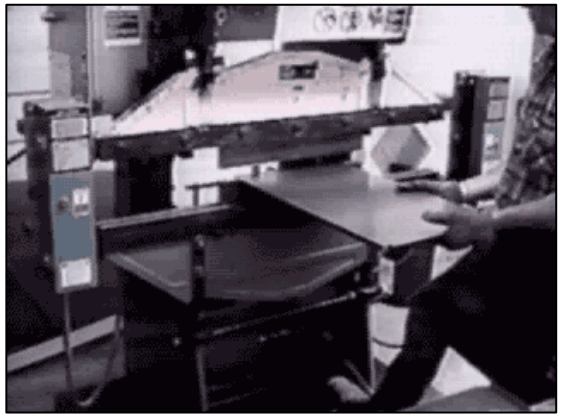
- **Bending action** – applying power to draw or stamp metal or other materials

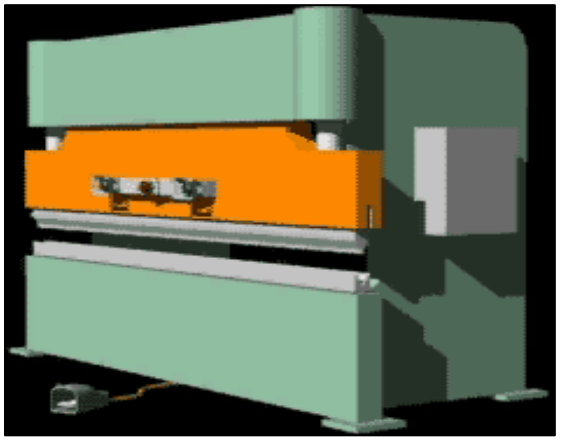


Machinery That Requires Guarding

Machines that require point of operation guarding:

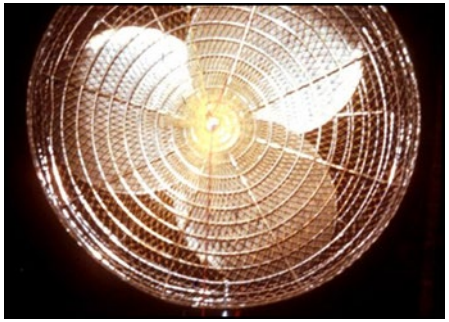
- Guillotine cutters
- Shears
- Alligator shears
- Power presses
- Milling machines
- Power saws
- Jointers
- Portable power tools
- Forming rolls and calendars

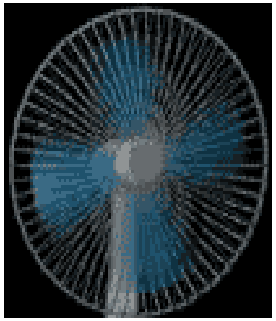


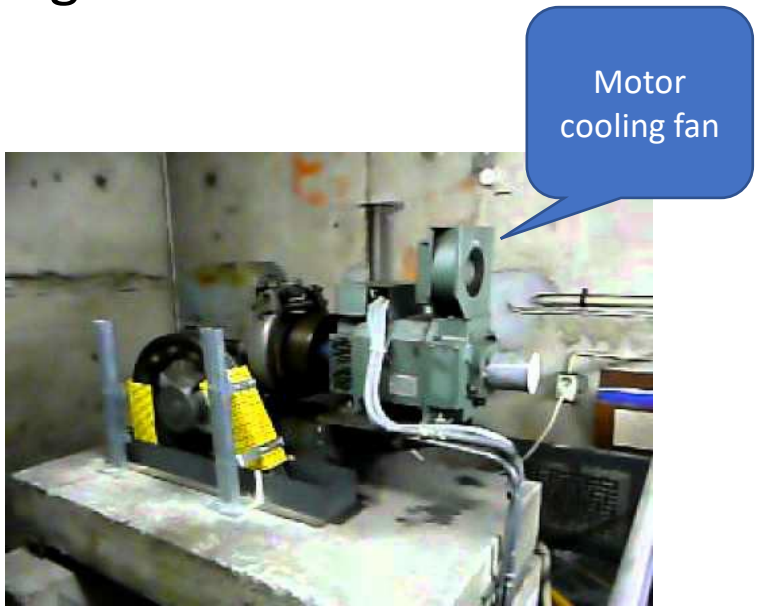


Machinery That Requires Guarding

- Exposure of fan blades:
  - Guard when periphery of blades is less than 7’ above the floor or working level
  - Guards with openings no larger than ½”

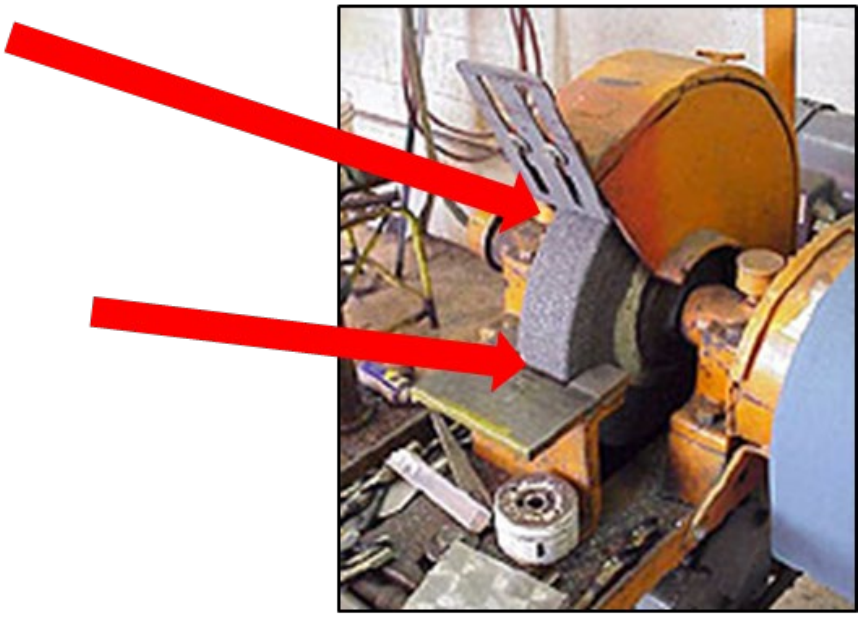






Machinery That Requires Guarding

- Abrasive wheel machinery:
  - Adjustable tongue guard to within ¼” of wheel
  - Work rest with maximum opening of 1/8”
  - Cover spindle end, nut, flange projections



Machinery That Requires Guarding

Revolving barrels, containers, and drums:

- Guard by an enclosure which is interlocked with drive mechanism
- Guards with openings no larger than ½”

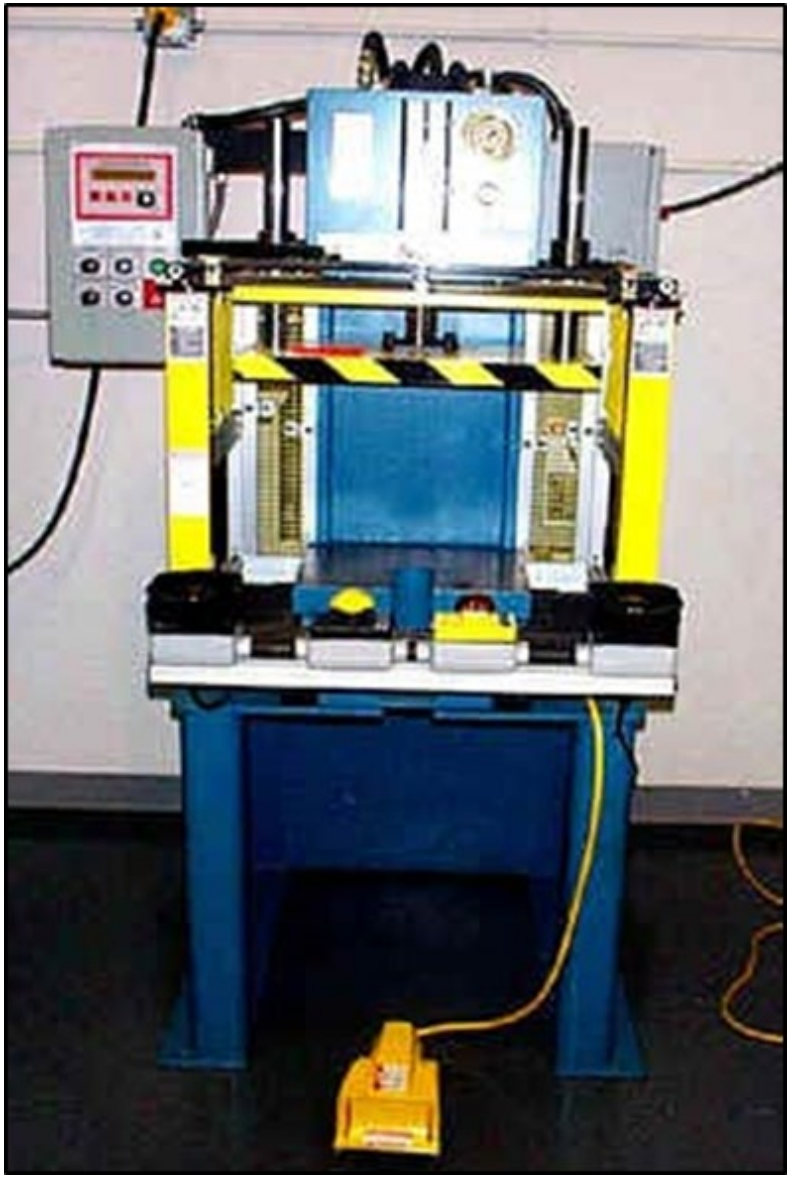
Machinery That Requires Guarding

Power-transmission apparatus:

- Shafting, flywheels, pulleys, belts, chain drives, etc.
- Less than 7 feet from the floor or working platform must be guarded

Machinery That Requires Guarding

Machinery associated with amputations includes:	Mechanical power presses
	Power press breaks
	Powered and non-powered conveyors
	Printing presses
	Roll-forming and roll-bending machines
	Shearing machines
	Food slicers
	Meat grinders
	Meat-cutting band saws
	Drill presses
	Milling machines
	Grinding Slitters
	G machines



Requirements for Safeguards

Safeguards must meet these minimum general requirements:

- Prevent contact
- Be secured
- Protect from falling objects
- Create no new hazards
- Create no interference
- Allow safe lubrication

Types of Machine Safeguards

Safeguarding machinery:

- Primary methods
  - Guards
  - Devices
- Ensure employee protection
  - Properly designed, constructed, and installed
  - Used and maintained in good operating condition

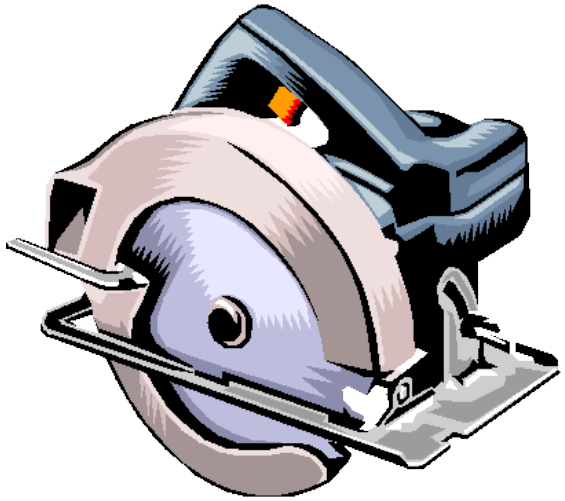
Safeguarding machinery cont:

- Secondary methods
  - Probe detection and safety edge devices
  - Awareness devices
  - Safeguarding methods
    - Safe distance
    - Safe holding
    - Safe opening
  - Safe work practices

Types of Machine Safeguards

Guards:

- Preferable to other control methods
- Provide physical barrier that prevents contact with dangerous machine parts
- Four general types
  - Fixed
  - Interlocked
  - Adjustable
  - Self-adjusting



Fixed guard:

- Provides a barrier
- Permanent part of the machine, preferable to all other types of guards.

Interlocked guard on revolving drum

Types of Machine Safeguards

Interlocked guards:

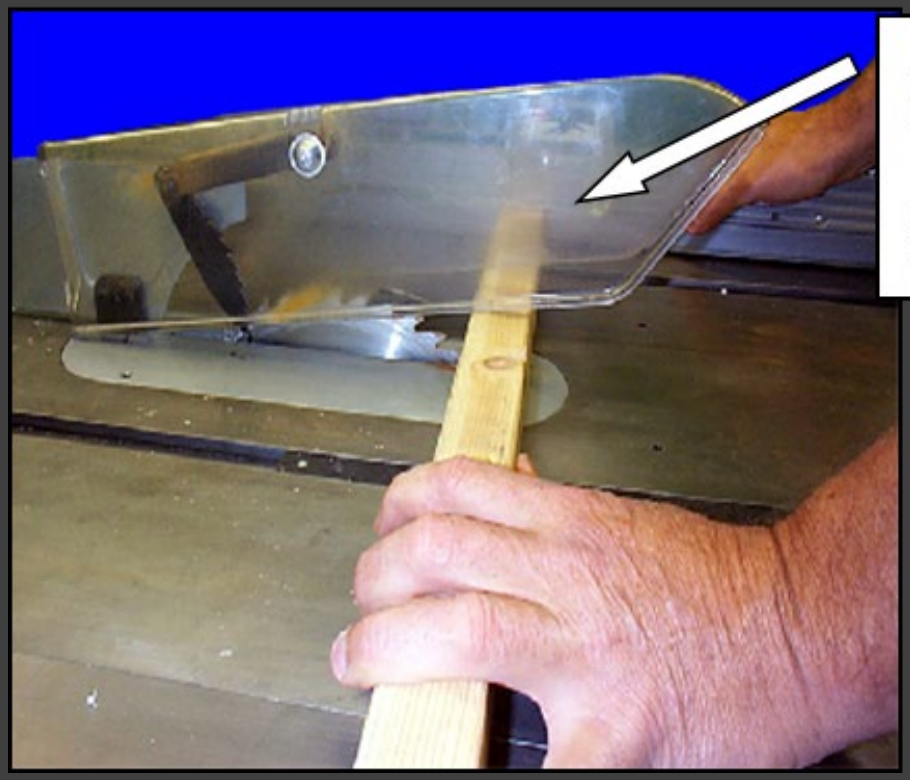
- Shuts off or disengages power, stops moving parts, and prevents starting of machine when guard is open
- May use electrical, mechanical, hydraulic, or pneumatic power, or combination

Bandsaw blade adjustable guard

Types of Machine Safeguards

Adjustable guards:

- Shuts off or disengages power
- Stops moving parts
- Prevents starting of machine when guard is open



Circular table saw self-adjusting guard

Types of Machine Safeguards

Self-adjusting guards:

- Openings of barriers determined by movement of the stock
- Places barrier between danger area and operator

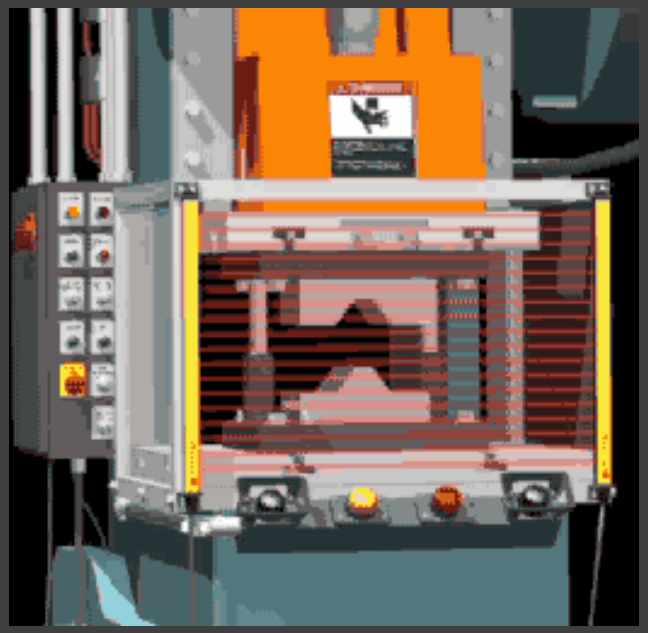
Types of Machine Safeguards

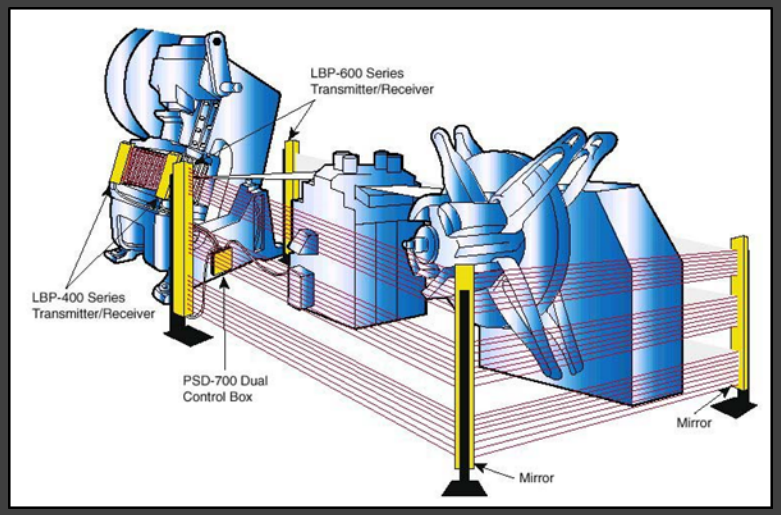
Devices:
Controls or attachments that prevent inadvertent access by employees to hazardous machine areas

Examples:

- Presence sensing
- Photoelectric
- Radiofrequency
- Electromechanical
- Pullback
- Restraint

- Safety trip controls
- Two-hand control
- Two-hand trip
- Gate





Types of Machine Safeguards

Presence-sensing devices:

- Photoelectric
- Radiofrequency
- Electromechanical

Types of Machine Safeguards

Pullback devices:

- Uses a series of cables attached to operator
- Automatically withdraws hands from point of operation when slide/ram begins to descend

Types of Machine Safeguards

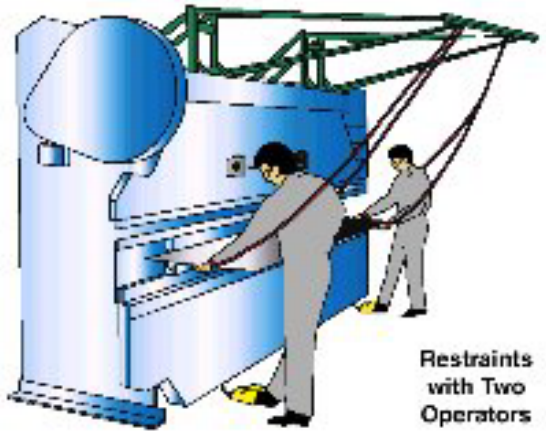
- Hands in die, feeding
- Point of operation exposed
- Pullback device attached and properly adjusted

- Die closed
- Hands withdrawn from point of operation by pullback device

Types of Machine Safeguards

Restraint devices:

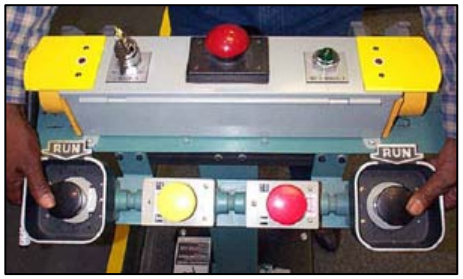
- Use cables/straps attached to operator's hands and a fixed point
- No extending/retracting action involved
- Hand-feeding tools may be necessary



Types of Machine Safeguards

Safety trip controls:

- Deactivates the machine in an emergency situation
- Examples
  - Pressure-sensitive bar
  - Safety tripod
  - Safety tripwire

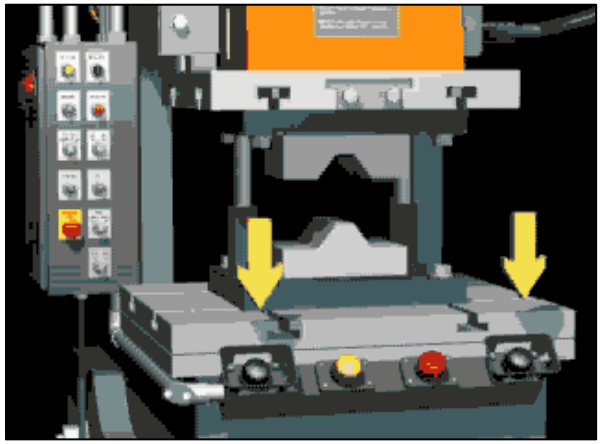


- Positioning is critical; must stop machine before body reaches danger area

Types of Machine Safeguards

Two-hand controls:

- Deactivates the machine in an emergency situation
- Pressure-sensitive
- Positioning is critical; must stop machine before body reaches danger area



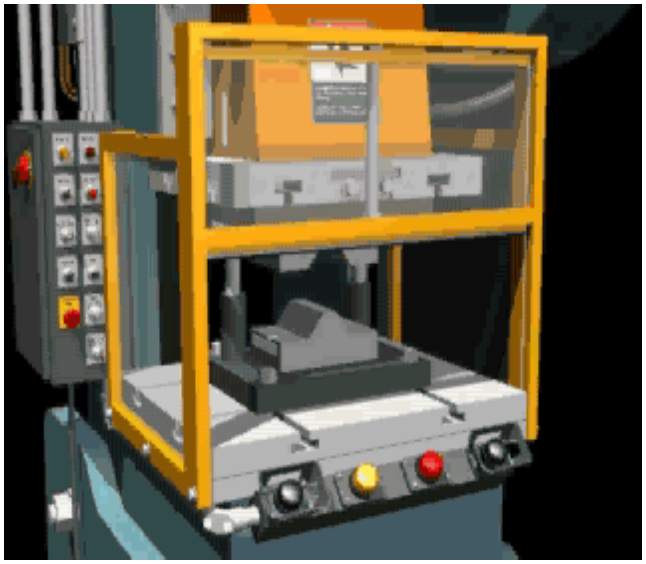
Types of Machine Safeguards

Gate devices:

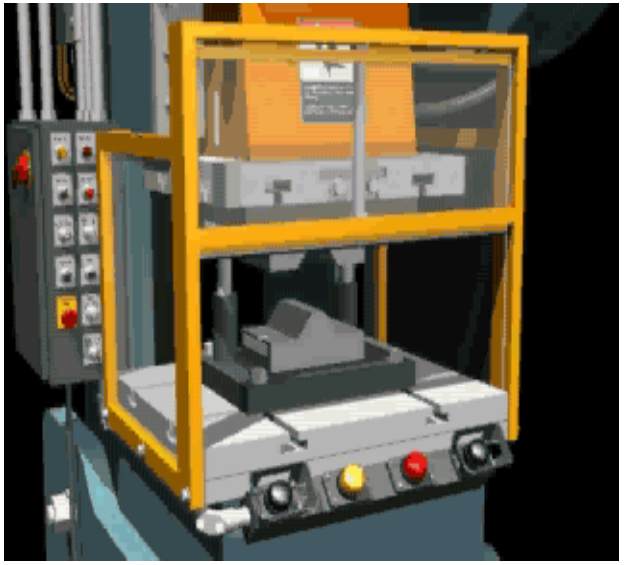
- Moveable barrier that protects operator at point of operation before machine cycle can be started
- Must be interlocked so machine cannot begin cycle unless gate guard is in place
- Must be closed before machine can function
- Types
  - “A” Gate
  - “B” Gate

Types of Machine Safeguards

- Type “A” Gate Operation



Type “B” Gate Operation



Types of Machine Safeguards

Gate devices:

- Moveable barrier that protects operator at point of operation before machine cycle can be started
- Must be interlocked so machine cannot begin cycle unless gate guard is in place
- Must be closed before machine can function

Additional Safeguarding

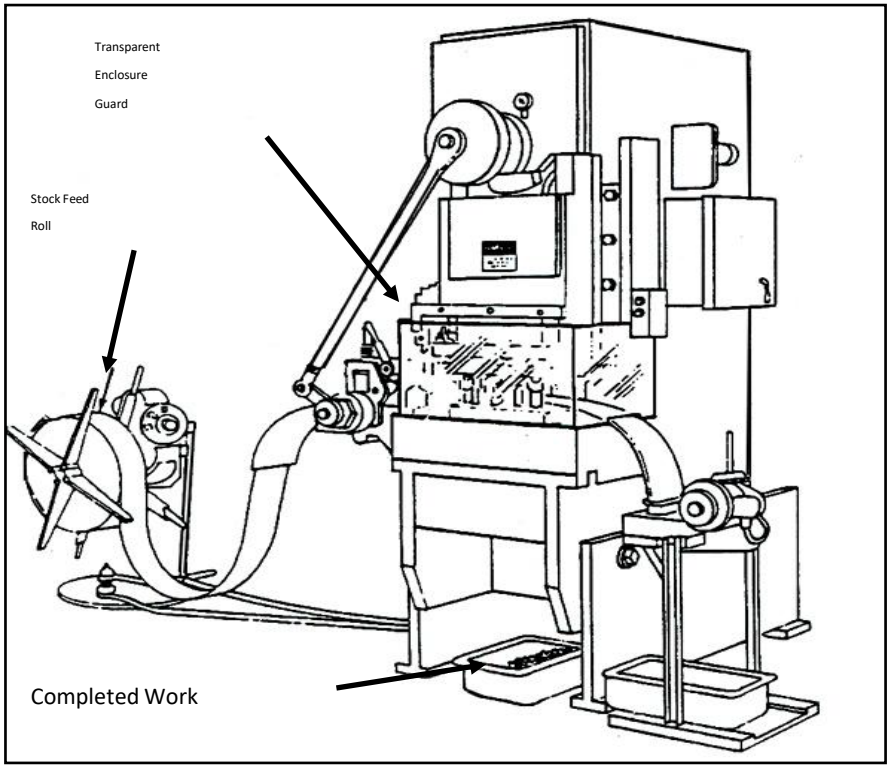
Location/distance:

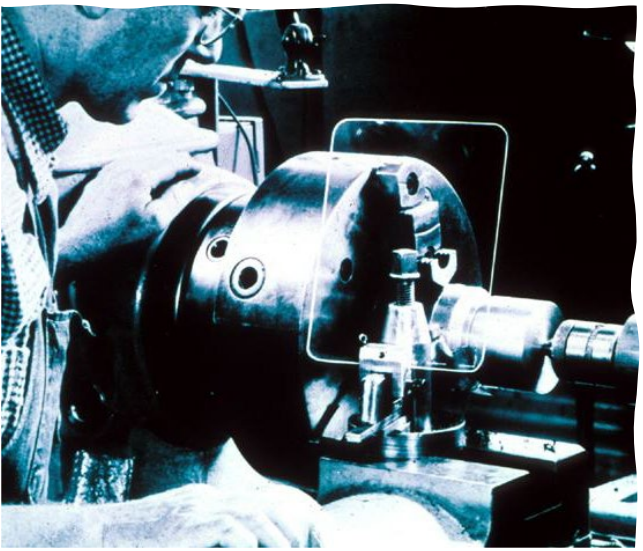
- The dangerous moving part of a machine must be so positioned that those areas are not accessible or do not present a hazard
- Feeding process safeguarded by maintaining safe distance to protect worker
- Operator's controls located safe distance from machine

Additional Safeguarding

Feeding and ejection methods:

- Automatic/ semi-automatic feed
- Automatic/ semi-automatic ejection
- Robots





Additional Safeguarding

Miscellaneous aids:

- Awareness barriers
- Protective shields
- Hand-feeding tools

Identify the Hazard

Unguarded lower blade and arbor end of radial saw

Identify the Hazard

- **Guard removed from chain rail exposing pins on the spiked chain and sprocket mechanism**

Summary

- Safeguards are essential for protecting workers from needless and preventable machinery-related injuries
- The point of operation, as well as all parts of the machine that move while the machine is working, must be safeguarded
- A good rule to remember is: ***Any machine part, function, or process which may cause injury must be safeguarded***

Knowledge Check

1. All machines consist of three fundamental areas, including ___.
   a. Flywheels, connecting rods, and transverse moving parts
   b. Point of operation, power transmission device, and operating controls
   c. Reciprocating parts, rotating parts, and on/off switch
   d. Feed mechanisms, auxiliary machine parts, and nip points

- **Answer**: **b. Point of operation, power transmission device, and operating controls**

Knowledge Check

2. Rotating, in-running nip points, reciprocating, and transversing are types of hazardous ___.
   a. Motions
   b. Actions
   c. Guards
   d. Devices

Answer: a. Motions

Knowledge Check

3. Cutting, punching, shearing, and bending are types of hazardous ___.
   a. Motions
   b. Actions
   c. Guards
   d. Devices

Answer: b. Actions

Knowledge Check

4. Which of the following explains how a guard protects workers?
   a. Stops the machine when a worker enters the danger area
   b. Restrains the worker from entering the danger area
   c. Creates distance to keep the worker from entering the danger area
   d. Provides a barrier to prevent access to the danger area

Answer: d. Provides a barrier to prevent access to the danger area

Knowledge Check

5. Which of the following is an example of a safeguarding device?
   a. Protective shield
   b. Hand-feeding tool
   c. Safety trip control
   d. Awareness barrier

Answer: **c. Safety trip control**

Through the Alliance between OSHA's 10 Regional Offices and the Elevator Contractors of America (ECA), Elevator Industry Work Preservation Fund (EIWPF), International Union of Elevator Constructors (IUEC), National Association of Elevator Contractors (NAEC), National Elevator Industry Educational Program (NEIEP), and National Elevator Industry Inc. (NEII), collectively known as The Elevator Industry Safety Partners, developed this Industry Specific Training for informational purposes only. It does not necessarily reflect the official views of OSHA or the U.S. Department of Labor. May 2021

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Machine Guarding General Industry

Any Questions?