Machine Guarding

OSHA 10-hour 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.

Introduction

Lesson objectives:

1. Identify the main causes of machinery accidents.
2. Recognize basic machinery parts that expose workers 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 machine accidents can occur:

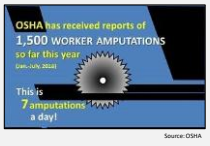
- Reaching-in to "clear" equipment
- Not using Lockout/Tagout
- Unauthorized persons doing maintenance or using the machines
- Missing or loose machine guards

Machinery Accidents

Amputations:

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

Source: OSHA

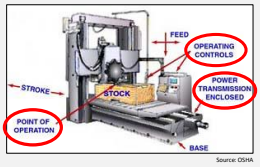


Source: OSHA

Basic Machinery Parts and Hazards

Three fundamental machine areas:

- Point of operation
- Power transmission device
- Operating controls – mechanical or electric power control



Source: OSHA

Basic Machinery Parts and Hazards

Point of operation:

- Where work is performed on material
- Examples
  - Cutting
  - Shaping
  - Boring
  - Forming

Source: OSHA DTE

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

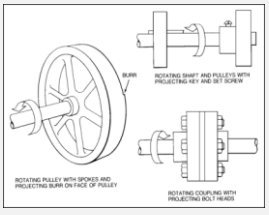
Basic Machinery Parts and Hazards

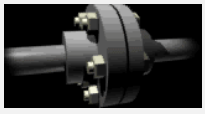
Hazardous motions and actions:

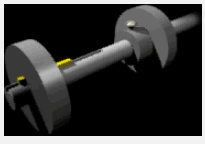
- **Motions**
  - How the machine part moves
  - Examples: rotating, in-running nip points, reciprocating, and transversing
- **Actions**
  - Operation that the machine part performs
  - Examples: cutting, punching, shearing, bending

Basic Machinery Parts and Hazards

- **Rotating parts** with hazardous projections







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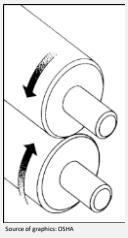
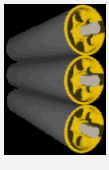
Basic Machinery Parts and Hazards

- Common **nip points** on rotating parts





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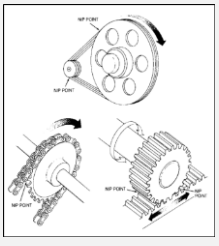
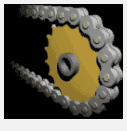
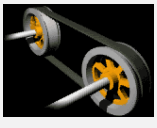
Basic Machinery Parts and Hazards

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







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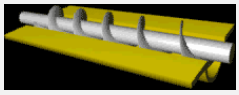
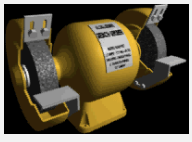
Basic Machinery Parts and Hazards

- **Nip points** between rotating machine components





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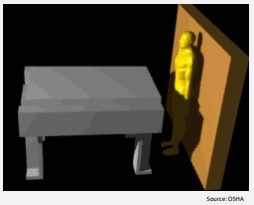
Basic Machinery Parts and Hazards

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



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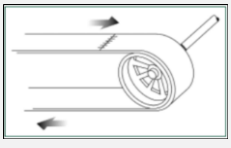
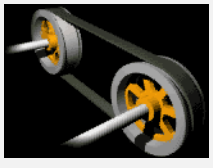
Basic Machinery Parts and Hazards

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





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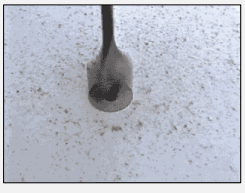
Basic Machinery Parts and Hazards

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



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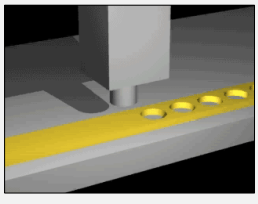
Basic Machinery Parts and Hazards

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



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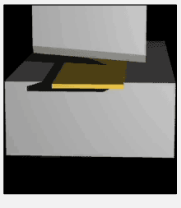
Basic Machinery Parts and Hazards

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



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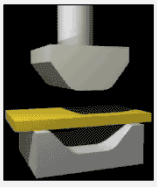
Basic Machinery Parts and Hazards

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

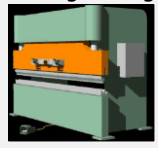


Source: OSHA

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 calenders



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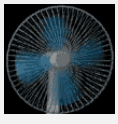
Machinery That Requires Guarding

- 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″



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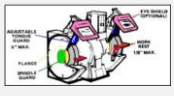
Machinery That Requires Guarding

- 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



Source of graphics: OSHA

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″

Source: OSHA

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

Unguarded belt and pulley

Source: OSHA

Machinery That Requires Guarding

Machinery associated with amputations – examples:

1. Mechanical power presses
2. Power press breaks
3. Powered and non-powered conveyors
4. Printing presses
5. Roll-forming and roll-bending machines
6. Shearing machines
7. Food slicers
8. Meat grinders
9. Meat-cutting band saws
10. Drill presses
11. Milling machines
12. Grinding machines
13. Slitters

Source of graphics: OSHA

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

Source: OSHA

Types of Machine Safe Guards

Safeguarding machinery:

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

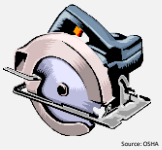
Types of Machine Safe Guards

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

Types of Machine Safe Guards

Guards:

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



Source: OSHA

Types of Machine Safe Guards

Fixed guard:

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

Source of photos: OSHA

Types of Machine Safe Guards

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

Interlocked guard on revolving drum

Source: OSHA

Types of Machine Safe Guards

Adjustable guards:

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

Bandsaw blade adjustable guard

Source: OSHA

Types of Machine Safe Guards

Self-adjusting guards:

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

Circular table saw self-adjusting guard

Source: OSHA

Types of Machine Safe Guards

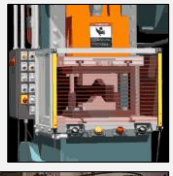
Devices:

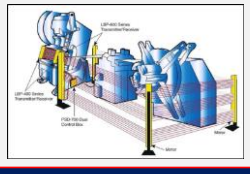
- Controls or attachments that prevent inadvertent access by employees to hazardous machine areas
- Examples
  - Presence sensing
    - Photoelectric
    - Radiofrequency
    - Electromechanical
  - Pullback
  - Restraint
  - Safety trip controls
  - Two-hand control
  - Two-hand trip
  - Gate

Types of Machine Safe Guards

Presence-sensing devices:

- Photoelectric
- Radiofrequency
- Electromechanical





Source: OSHA

Types of Machine Safe Guards

Pullback devices:

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

Source: OSHA

Types of Machine Safe Guards

Source: OSHA

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

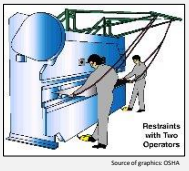
Source: OSHA

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

Types of Machine Safe Guards

Restraint devices:

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



Source of graphics: OSHA

Types of Machine Safe Guards

Safety trip controls:

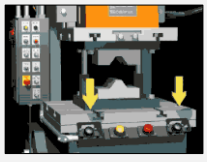
- Deactivates the machine in an emergency situation
- Examples
  - Pressure-sensitive bar
  - Safety tripod
  - Safety tripwire
- Positioning is critical; must stop machine before body reaches danger area

Source of graphics: OSHA

Types of Machine Safe Guards

Two-hand controls:

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



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Types of Machine Safe Guards

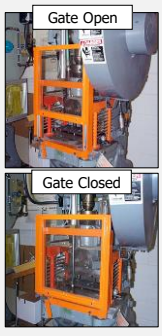
Gate devices:

- 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 Safe Guards

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



Source of graphics: OSHA

Types of Machine Safe Guards

Type "A" Gate Operation

Type "B" Gate Operation

Source of graphics: OSHA

Additional Safeguarding

Location/distance:

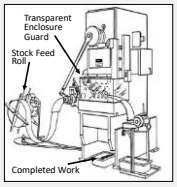
- The dangerous moving part of a machine must be so positioned that those areas are not accessible or do not present a hazard
- Feeding process safeguarded by maintaining safe distance to protect worker
- Operator's controls located safe distance from machine

Source: OSHA

Additional Safeguarding

Feeding and ejection methods:

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



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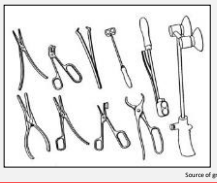
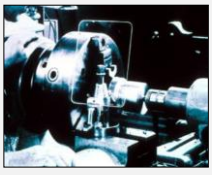
Additional Safeguarding

Miscellaneous aids:

- Awareness barriers
- Protective shields
- Hand-feeding tools





Source of graphics: OSHA

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