MACHINE GUARDING

29 CFR 1910.211-222
COURSE OBJECTIVES

☑ Accident Prevention.
☑ Introduce Machine Guarding and Establish Its Role in Today’s Industry.
☑ Introduce Basic Concepts and Techniques of Machine Safeguarding.
☑ Provide Machine Safeguarding Skills for Maintenance Workers and Floor Supervisors.
BASIS FOR THIS COURSE

- Proper Machine Guarding Results in Accident Reduction
- Elimination of Workplace Injuries & Illnesses Where Possible
- Reduction of Workplace Injuries & Illnesses Where Possible
- Development of Efficient Machine Guarding Techniques
- OSHA Safety Standards Require:
  - Machines Be Properly Guarded
  - Training Be Conducted
  - Hazards and Precautions Be Explained
  - A “Safety” Program Be Established
  - Job Hazards Be Assessed and Controlled
APPLICABLE REGULATIONS

29CFR - Safety and Health Standards

1910 - Industrial Safety

212 - General Requirements for All Machines
213 - Woodworking Machinery
214 - Cooperage Machinery
215 - Abrasive Wheel Machinery
216 - Mills and Calenders in the Rubber Industry
217 - Mechanical Power Presses
218 - Forging Machines
219 - Mechanical Power Transmission Apparatus
REMEMBER

Any machine part, function, or process which may cause injury must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated.
Where Mechanical Hazards Occur

- The Point of Operation:
- Power Transmission Apparatus:
- Other Moving Parts:
BASICS OF MACHINE GUARDING

Where Mechanical Hazards Occur

☑️ The Point of Operation: Where work is performed on the material, such as:

☑️ Cutting
☑️ Shaping
☑️ Boring
☑️ Forming of stock
BASICS OF MACHINE GUARDING

Where Mechanical Hazards Occur

☑ Power Transmission Apparatus: All components of the mechanical system which transmit energy to the part of the machine performing the work.
Where Mechanical Hazards Occur

☑ Other Moving Parts: Any part of the machine which moves while the machine is working.

☑ Rotating parts
☑ Feed mechanisms
☑ Reciprocating parts
☑ Transverse moving parts
☑ Auxiliary parts of the machine
BASICS OF MACHINE GUARDING

Hazardous Mechanical Motions and Actions

A wide variety of mechanical motions and actions may present hazards to the worker:

- Rotating members
- Reciprocating arms
- Moving belts
- Meshing gears
- Cutting teeth
- Any parts that impact or shear
Recognition of these hazards is the first step toward protecting workers from the danger they present.
BASICS OF MACHINE GUARDING

Hazardous Mechanical Motions

**Motions**

- Rotating
- Reciprocating
- Transversing

NIP POINT
BASICS OF MACHINE GUARDING

Hazardous Mechanical Actions

**Actions**
- ✔ Cutting
- ✔ Punching
- ✔ Shearing
- ✔ Bending
BASICS OF MACHINE GUARDING

Hazardous Mechanical Motions

- Rotating Motions
  - Collars
  - Clutches
  - Spindles
  - Vertical shafts
  - Couplings
  - Flywheels
  - Meshing gears
  - Cams
  - Shaft ends
  - Horizontal shafts
Hazardous Mechanical Motions

Rotating Motions

Rotating motions can grip clothing, and through mere skin contact force a limb into a dangerous position. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts.
BASICS MACHINE GUARDING OF

Hazardous Mechanical Motions

☑ Reciprocating Motions
Hazardous Mechanical Motions

☑️ Reciprocating Motions

CAUGHT “IN-BETWEEN” OR “STRUCK-BY”
BASICS OF MACHINE GUARDING

Hazardous Mechanical Motions

- Transversing Motions

TRAVEL

IN-RUNNING NIP POINTS
BASICS OF MACHINE GUARDING

Hazardous Mechanical Motions

✓ Rotating Motions

NIP POINTS
Hazardous Mechanical Actions

☑ Cutting Actions

- Rotating motions
- Reciprocating motions
- Transversing motions

The danger of cutting action exists at the point of operation where finger, arm and bodily injuries can occur and where flying chips or scrap material can strike the head, particularly in the area of the eyes or face.
BASICS OF MACHINE GUARDING

Hazardous Mechanical Actions

☑ Cutting Actions

☑ Bandsaws
☑ Circular saws
☑ Boring machines
☑ Drilling machines
☑ Turning machines (lathes)
☑ Milling machines
Hazardous Mechanical Actions

- Punching Actions
  - Power presses
  - Iron workers

- The principle hazard occurs at the point of operation where stock is inserted, held or withdrawn.
BASICS OF MACHINE GUARDING

Hazardous Mechanical Actions

☑ Shearing/Bending Actions
  ✓ Mechanical shears
  ✓ Hydraulic shears
  ✓ Pneumatic shears

☑ The principle hazard occurs at the point of operation where stock is inserted, held or withdrawn.
BASICS OF MACHINE GUARDING

☑ Requirements for Safeguards

☑ Be securely attached
☑ Create no new hazards
☑ Withstand operational conditions
☑ Allow for safe routine maintenance
☑ Allow for safe operator adjustments
☑ Withstand environmental conditions
☑ Provide protection from falling objects
☑ Prevent contact with hazardous conditions
☑ Create no interference in the conduct of work
BASICS OF MACHINE GUARDING

☑ Nonmechanical Hazard Considerations:
- Power sources are potential sources of danger
- How will guarding affect equipment operation
- Ensure proper grounding of systems
- Replace frayed, exposed, or old wiring
- Consider effects of
  - High pressure systems
  - Extreme temp conditions
  - Pulsation, vibration, or leaks
  - Noise or unwanted sounds
  - Cutting fluids and coolants
BASICS OF MACHINE GUARDING

☑ Operator Training Considerations:
  ✓ Provide instruction and or hands-on training
  ✓ Discuss the purpose of safeguards
  ✓ Cover associated hazards thoroughly
  ✓ Involve guard designers in the training
  ✓ Describe how to properly use safeguards
  ✓ Describe how safeguards provide protection
  ✓ Describe circumstances for safeguard removal
  ✓ Explain what to do if safeguards are damaged
  ✓ Explain what to do if safeguards are missing
Defeating, altering, or removing safeguards can cause injury to co-workers and can leave the person performing such actions liable under the OSHA Act of 1970.
# BASICS OF MACHINE GUARDING

**Protective Clothing and Equipment Considerations:**

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<th><strong>ENGINEERING CONTROLS</strong></th>
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<td>✓ Work Station Design</td>
<td>✓ Tool Selection and Design</td>
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<td>✓ Process Modification</td>
<td>✓ Mechanical Assist</td>
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<th><strong>ADMINISTRATIVE CONTROLS</strong></th>
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<td>✓ Training Programs</td>
<td>✓ Job Rotation/Enlargement</td>
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<td>✓ Pacing</td>
<td>✓ Policy and Procedures</td>
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<th><strong>PERSONNEL PROTECTIVE EQUIPMENT</strong></th>
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<tr>
<td>✓ Gloves</td>
<td>✓ Wraps</td>
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<tr>
<td>✓ Shields</td>
<td>✓ Eye Protection</td>
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<tr>
<td>✓ Non-Slip Shoes</td>
<td>✓ Aprons</td>
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Protective Clothing and Equipment Considerations:

- Appropriate for the particular hazard(s)
- Maintained in good condition
- Properly stored when not in use
- Kept clean, fully functional, and sanitary
METHODS OF MACHINE GUARDING

☑ Guarding Method Dependant on:

☑ Type of material
☑ Type of operation
☑ Method of handling
☑ Size or shape of stock
☑ Physical layout of the work area
☑ Production requirements or limitations
Manufacturers Recommendation:

Before beginning the process of guard procurement, design, or installation, the equipment manufacturer should be consulted for advice.
METHODS OF MACHINE GUARDING

☑ Generally:

☑ Power transmission apparatus is best protected by fixed guards that enclose the danger areas

☑ Point of operation hazard guarding will vary
METHODS OF MACHINE GUARDING

✓ Safeguards Are Grouped Under 5 Classifications:
  ✓ Guards
  ✓ Devices
  ✓ Locations/Distance
  ✓ Feeding and ejection methods
  ✓ Miscellaneous aids
Guards: Guards are barriers which prevent access to danger areas, there are four general types:

- Fixed guards
- Interlocked guards
- Adjustable guards
- Self-Adjusting guards
METHODS OF MACHINE GUARDING

☑ Fixed Guards:

☑ Fixed guards are a permanent part of the machine and not dependent upon moving parts to perform its intended function.
METHODS OF MACHINE GUARDING

☑ Fixed Guards:

ADVANTAGES

☑ Can be constructed to suit many different applications
☑ In-plant construction is often possible
☑ Can provide maximum protection
☑ Usually requires minimum maintenance
☑ Can be suitable to high production operations
☑ Can be suitable to high repetition operations
METHODS OF MACHINE GUARDING

☑ Fixed Guards:

LIMITATIONS

☑ May interfere with visibility
☑ Can be limited to specific operations
☑ Machine adjustments and repair often require guard removal, thereby necessitating other means of protection for maintenance personnel
METHODS OF MACHINE GUARDING

☑ Interlocked Guards:
☑ Interlocked guards are designed to automatically shut off or disengage the machine if the guard is opened or removed.
METHODS OF MACHINE GUARDING

✓ Interlocked Guards:

✓ Interlocked guards may use:

- Electrical power
- Mechanical power
- Hydraulic power
- Pneumatic power

OR ANY COMBINATION OF POWER SOURCES
METHODS OF MACHINE GUARDING

☑ Interlocked Guards:

☑ Interlocks should not prevent “inching” by remote control if required

☑ Replacing guards should not automatically restart the machine

IMPORTANT
METHODS OF MACHINE GUARDING

✓ Adjustable Guards:

✓ Typically adjusted by the operator
✓ Accommodate various sizes of stock
✓ May require additional operator training
✓ Adjustable guards are typically used on:

- Bandsaws
- Tablesaws
- Power presses
- Routers
- Similar equipment
METHODS OF MACHINE GUARDING

☑ Adjustable Guards:

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 can be defeated by the operator
☑ May interfere with visibility
METHODS OF MACHINE GUARDING

☑ Self-Adjusting Guards:
  ✓ Adjusts automatically to the work
  ✓ Accommodate various sizes of stock
  ✓ May require additional operator training
  ✓ Self-Adjusting guards are typically used on:

  - Radial arm saws
  - Tablesaws
  - Circular saws
  - Routers
  - Jointers
  - Similar equipment
METHODS OF MACHINE GUARDING

☑️ Self-Adjusting Guards:

ADVANTAGES
- Off-the-shelf guards are often commercially available

LIMITATIONS
- Protection may not be complete at all times
- May require frequent maintenance and or adjustment
- May interfere with visibility
METHODS OF MACHINE GUARDING

☑ Devices:

☑ Devices fall into four general types:

- Presence-Sensing devices
- Pullback devices
- Restraint devices
- Safety trip controls
METHODS OF MACHINE GUARDING

☑ Devices:

☑ Devices may perform one of several functions:

- Stop a machine if a body part is in danger
- Restrained or withdraw a hand if it is in danger
- Require activation by the use of both hands
- Provide a barrier synchronized to the operation
METHODS OF MACHINE GUARDING

☑ Presence-Sensing:
☑ Photoelectric
☑ Radiofrequency
☑ Electromechanical
METHODS OF MACHINE GUARDING

☑ Restraint Devices:
  ✓ Uses Cables or Straps
  ✓ Affixes to Hands
  ✓ May Need Feeding Tools
  ✓ Adjustment Critical
  ✓ Positioning Critical
  ✓ Maintenance Critical
  ✓ Training Critical
  ✓ Must Restrain Body Part From Hazard!
METHODS OF MACHINE GUARDING

☑ Safety Trip Controls:
  ✓ Body Trip Bars
  ✓ Hand/Arm Trip Bars
  ✓ Tripwire Cables
  ✓ Positioning Critical
  ✓ Adjustment Critical
  ✓ Maintenance Critical
  ✓ Training Critical
  ✓ Manual Reset Needed
  ✓ Must Stop Machine Immediately!
METHODS OF MACHINE GUARDING

☑ Two-Hand Control:
  ✓ Needs Constant Pressure
  ✓ Needs Concurrent Pressure
  ✓ Positioning Critical
  ✓ Adjustment Critical
  ✓ Maintenance Critical
  ✓ Training Important
  ✓ Must Stop Machine Immediately!
METHODS OF MACHINE GUARDING

✔ Location/Distance Safeguarding:
  ✔ Position Dangerous Areas of Machines So That They Are Not Assessable During Normal Operations. Examples Include:

  ❖ Position Hazard Areas Against a Wall
  ❖ Locate Hazards Out of Reach of Operators
  ❖ Add Enclosures or Fences to Restrict Access
  ❖ Design Stock Feeding Openings Away From Hazards
  ❖ Position the Operators Control Station Away From Hazards
METHODS OF MACHINE GUARDING

☑️ Guard Construction:

☑️ Many Machines Come With Safeguards
☑️ Many Older Machines Now Have Safeguards Available
☑️ Manufacturers Are Increasingly More Concerned With Liability
☑️ Companies Not Specialized in Guarding Issues
METHODS OF MACHINE GUARDING

☑ Point-of-Operations Guards:
Defined as: “The area on a machine where work is actually performed upon the material being processed.”

☑ Complicated by the Number and Complexity of Machines in Use
☑ Must Fully Safeguard the Employee
☑ Must Allow Production to Continue
☑ Hazard Analysis Is Usually Required
☑ If Poorly Designed, Built, or Installed Guards May Create a Hazard Rather Than Eliminating One.
METHODS OF MACHINE GUARDING

☑ Mechanical Power Transmission Apparatus Guards:

☑ The only openings usually needed are for:

- Lubrication
- Adjustment
- Repair
- Inspection

300 RPM