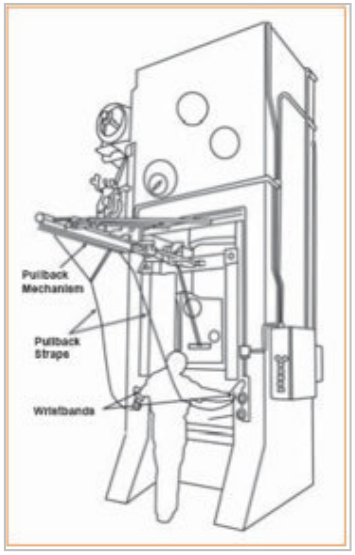
Machinery and Machine Guarding

- ***29 CFR 1910.211–219***
- ***29 CFR 1910.241–244***

Objectives

To enable students to understand the following:

- Basic concepts of machine guarding
- How to identify machine guarding hazards
- Machine guarding abatement methods
- Have a familiarity with OSHA standards




MACHINE SAFETY

Machinery and Machine Guarding

- **1910.211** – Definitions
- **1910.212** – General requirements for all machines
- **1910.213** – Woodworking machinery requirements
- **1910.215** – Abrasive wheel machinery
- **1910.217** – Mechanical power presses
- **1910.219** – Mechanical power-transmission apparatus

Hand and Portable Powered Tools

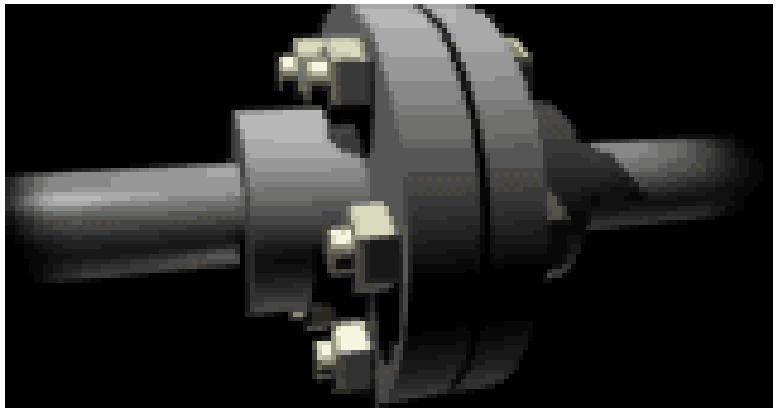
- **1910.241** – Definitions
- **1910.242** – Hand and portable powered tools/equipment
- **1910.243** – Guarding of portable powered tools
- **1910.244** – Other portable tools and equipment

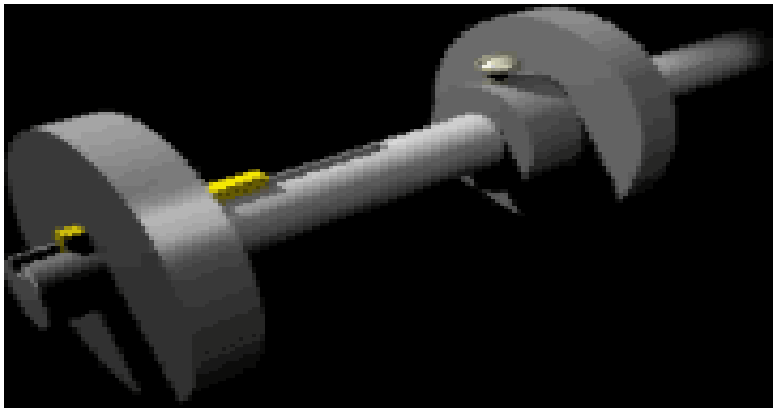
Where Mechanical Hazards Occur

Motions	Actions
Rotating	Cutting
In-running nip points	Punching
Reciprocating	Shearing
Transverse	Bending

Rotating Motion

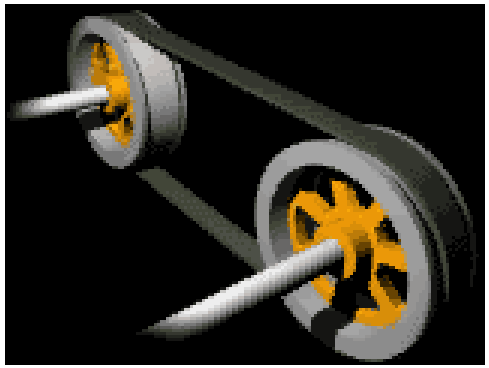
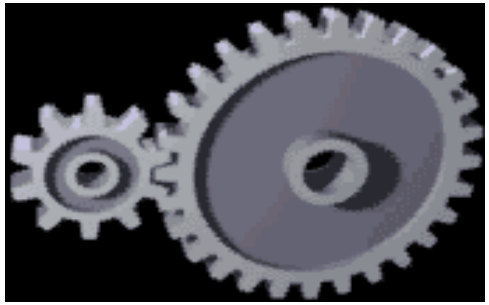
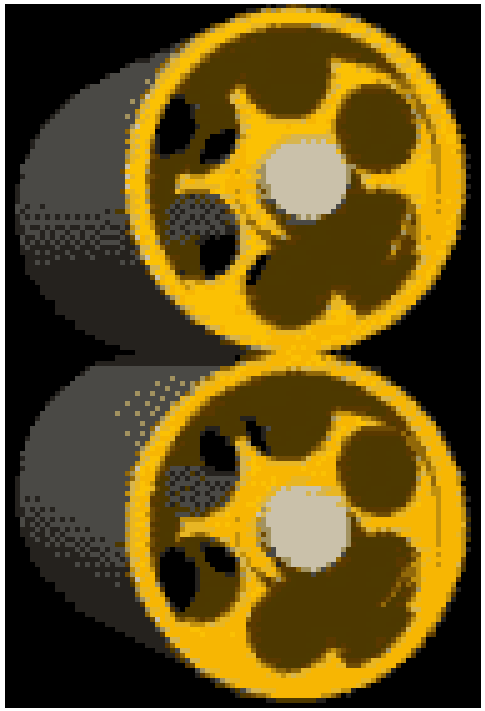
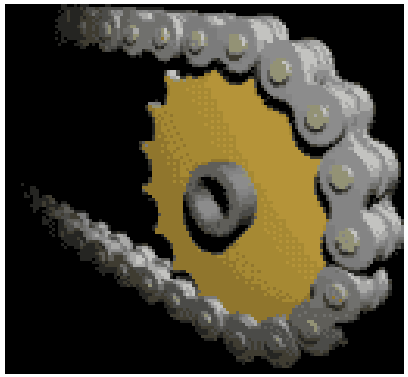
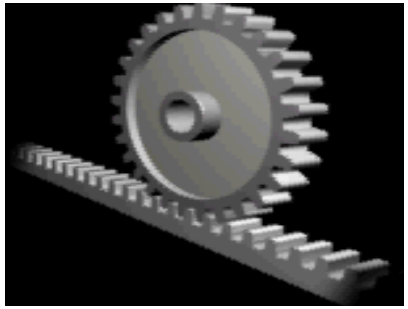
- Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting





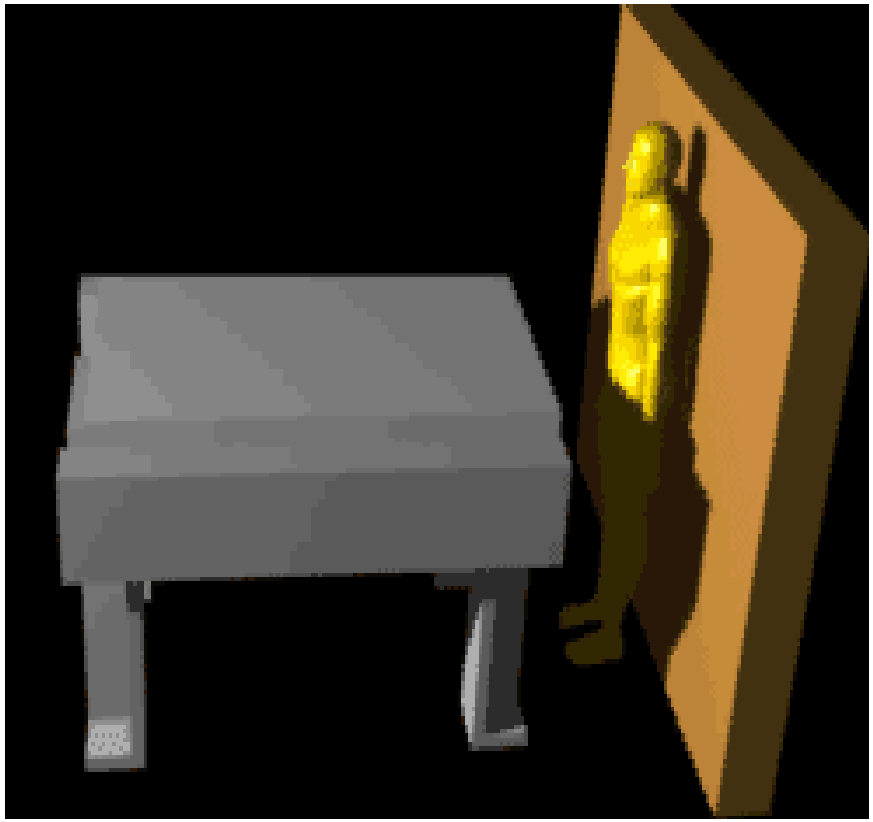
In-Running Nip Points Motion

- Caused by the rotating parts on machinery

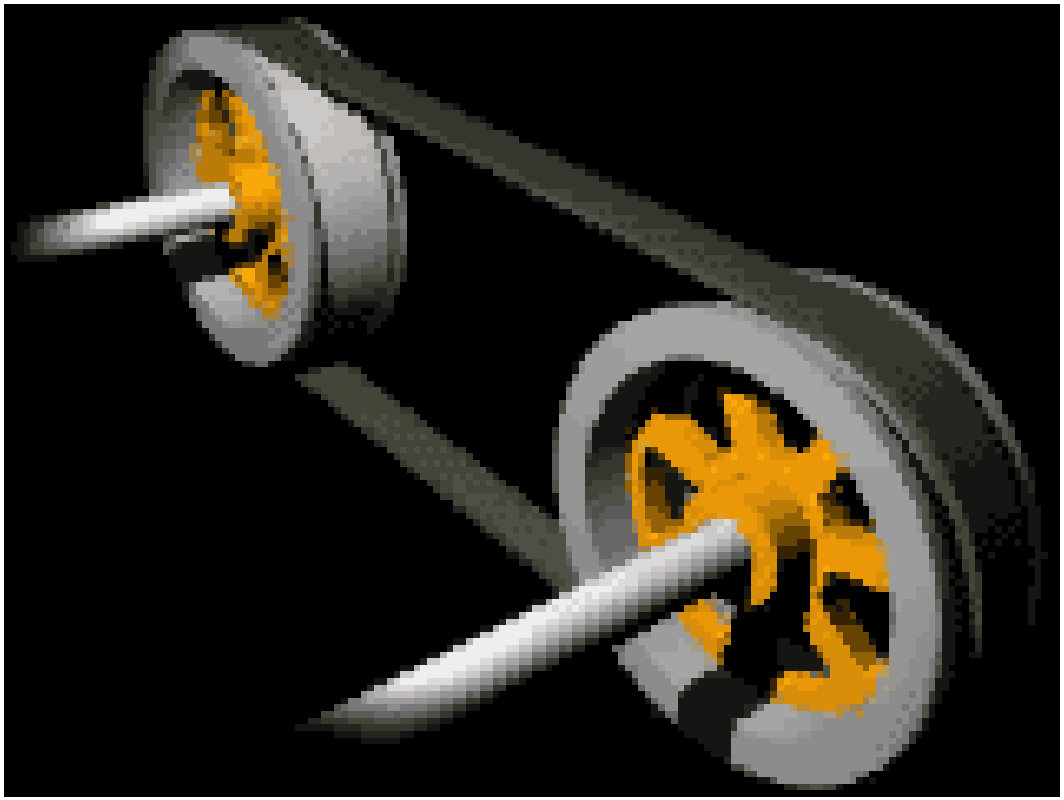
Reciprocating Motion

- Movement in straight, continuous line
  - Struck or caught in pinch point or shear point by moving part



Transverse Motion

- Movement in straight, continuous line

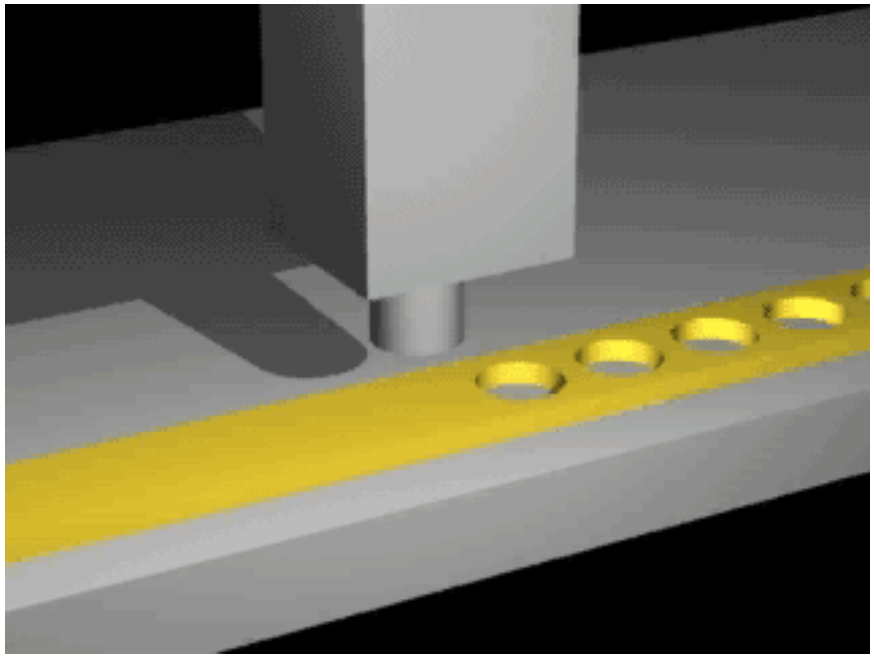


Cutting Action

- Cutting action involves rotating, reciprocating or transverse motion.

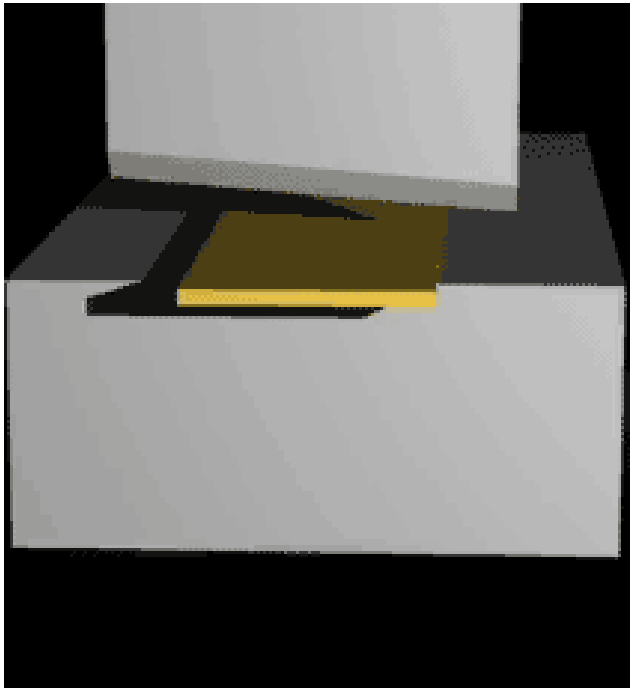
Punching Action

- Power is applied to a slide (ram) for the purpose of blanking, drawing, or stamping metal or other materials.



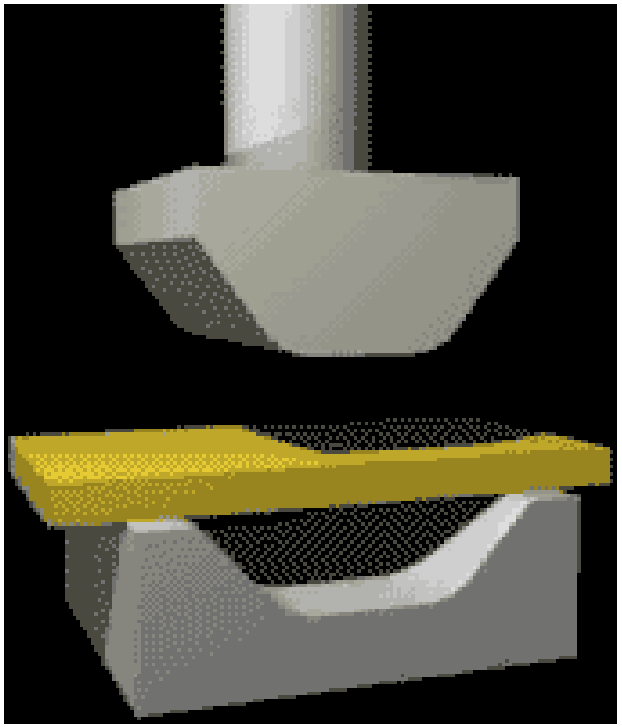
Shearing Action

- Applying power to a slide or knife in order to trim or shear metal or other materials.



Bending Action

- Power is applied to a slide in order to draw or stamp metal or other materials.



Methods of Guarding

- Guards
- Devices
- Location/distance
- Feed mechanisms
- Miscellaneous aids

Machine Guards

- Guards are barriers that prevent access to danger areas
  - Fixed guards
  - Interlocks
  - Adjustable
  - Self-adjusting

Safeguarding Devices

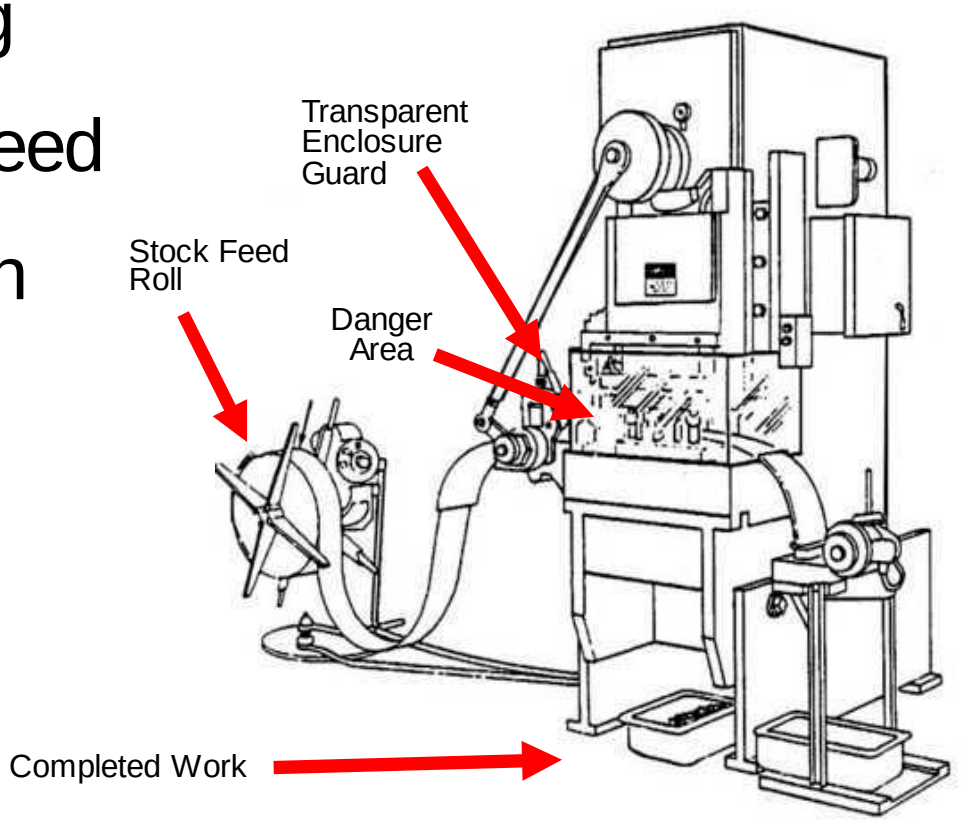
- Photoelectric presence-sensing
- Radiofrequency
- Electromechanical sensing device
- Pullbacks
- Restraints
- Safety trip controls
- Two-hand controls
- Two-hand trip
- Gates

Location/Distance

- Hazard analysis
- Hazards are not accessible
- Walls
- Fences
- Height
- Stock dimension
- Operator's station

Feed Mechanisms

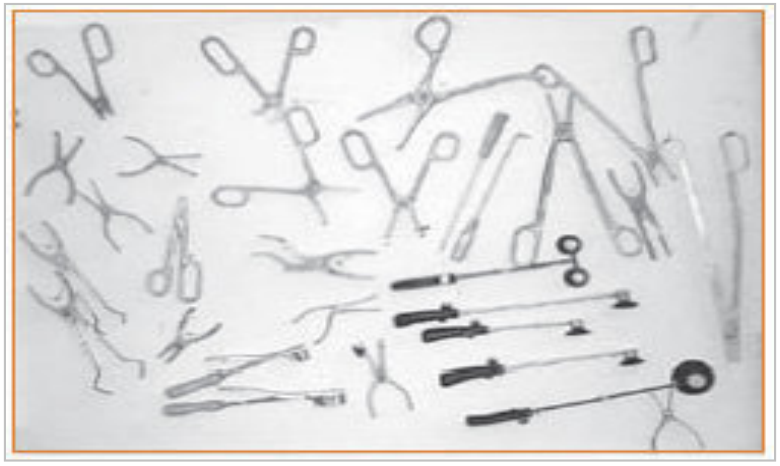
- Automatic feeding
- Semi-automatic feed
- Automatic ejection
- Semi-automatic ejection
- Robots

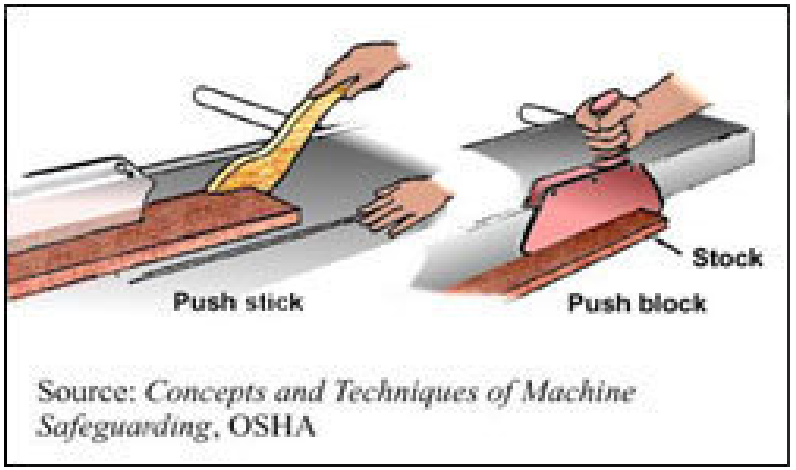


Automatic feed - shown on power press

Miscellaneous Aids

- Awareness barriers
- Shields
- Holding tools
- Push stick or block





Source: *Concepts and Techniques of Machine Safeguarding*, OSHA

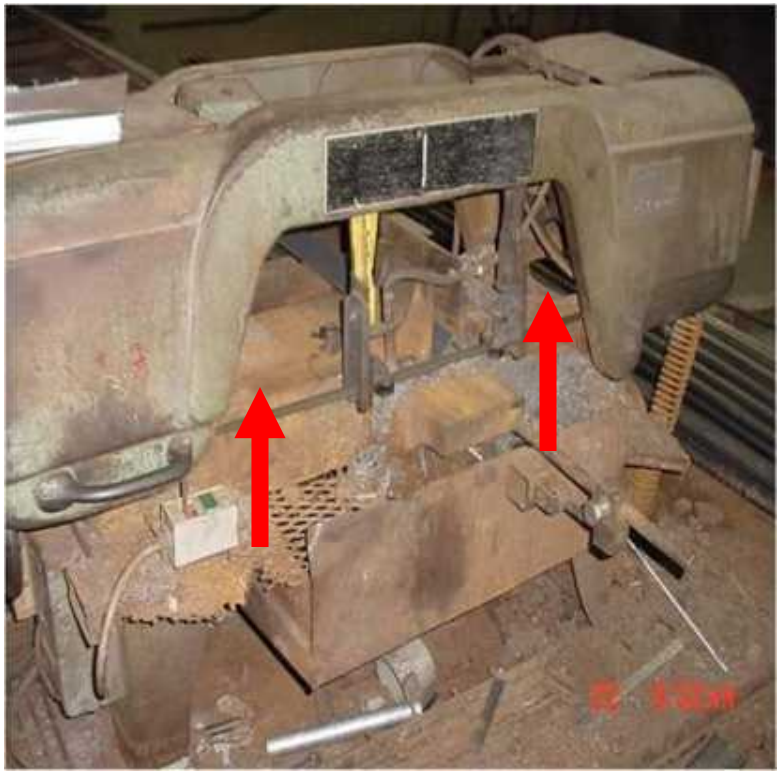
Requirements of Safeguards

- Prevent contact
- Properly secured
- Protect from falling objects
- Create no hazards
- Create no interference (greater hazard)
- Allow safe lubrication (removal of guards)

Machine Guarding

1910.212(a)(1)

- Guarding provided to protect employees from hazards created by:
  - Point of operation
  - Ingoing nip points
  - Rotating parts
  - Flying chips and sparks



Machine Guarding

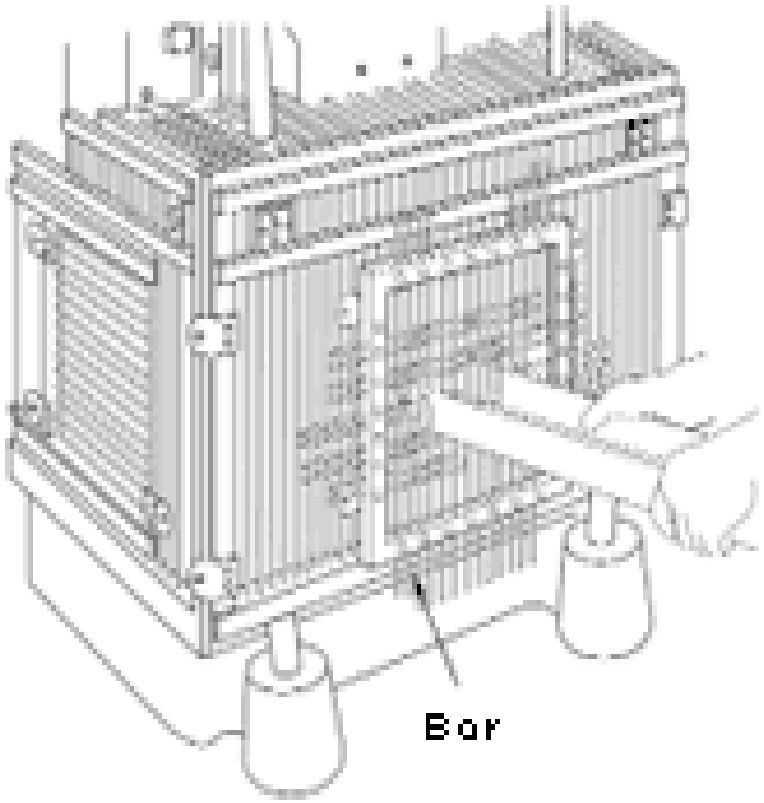
1910.212(a)(1)

- Barrier guards

Machine Guarding

1910.212(a)(1)

- Adjustable barrier guards



Machine Guarding

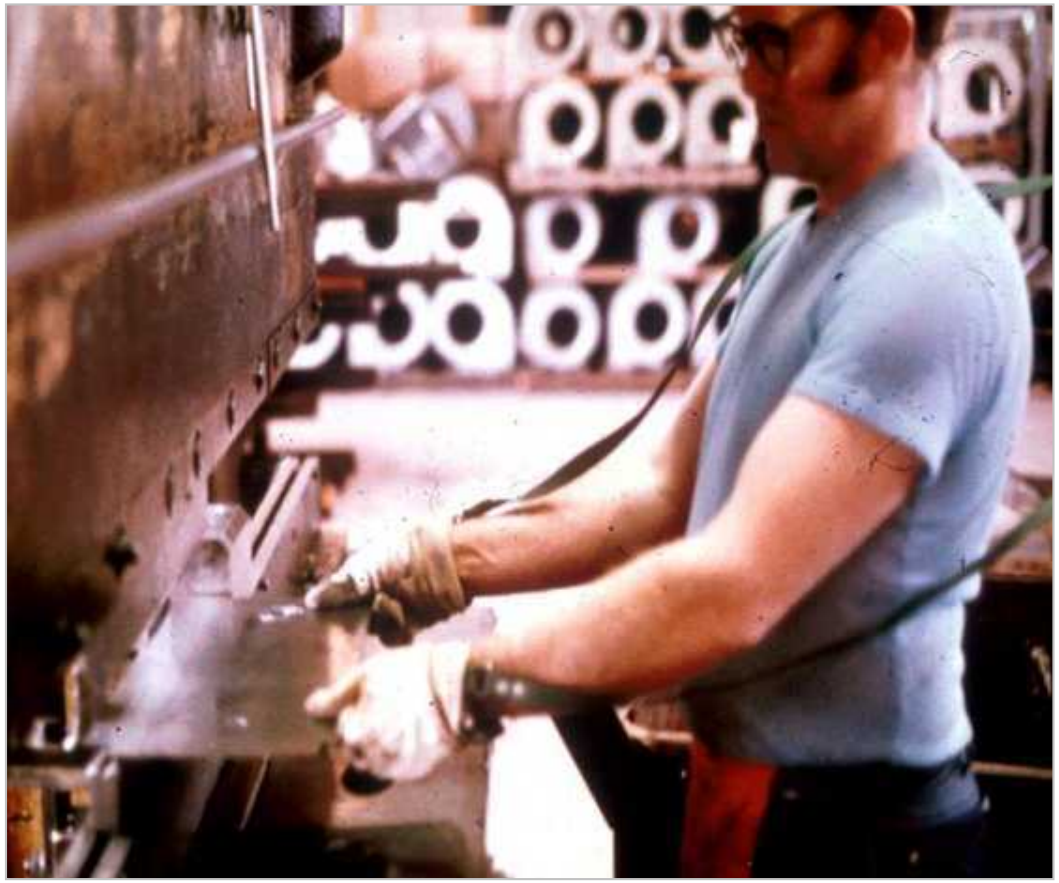
1910.212(a)(1)

- Two-hand tripping devices

Machine Guarding

1910.212(a)(1)

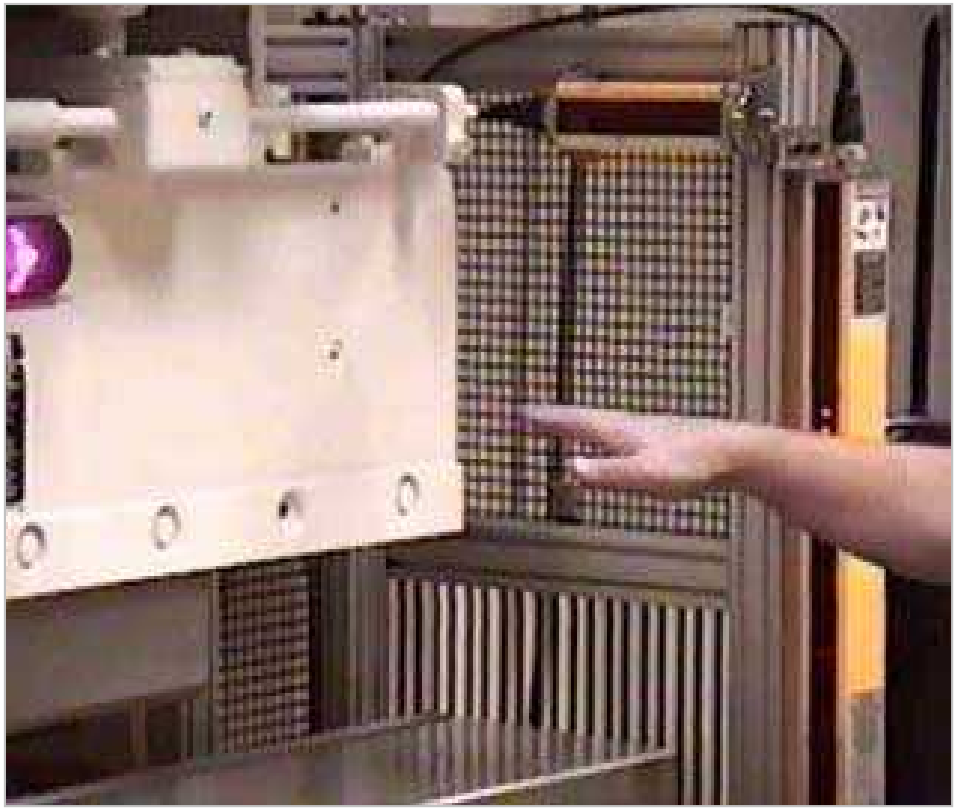
- A holdout or restraint device



Machine Guarding

1910.212(a)(1)

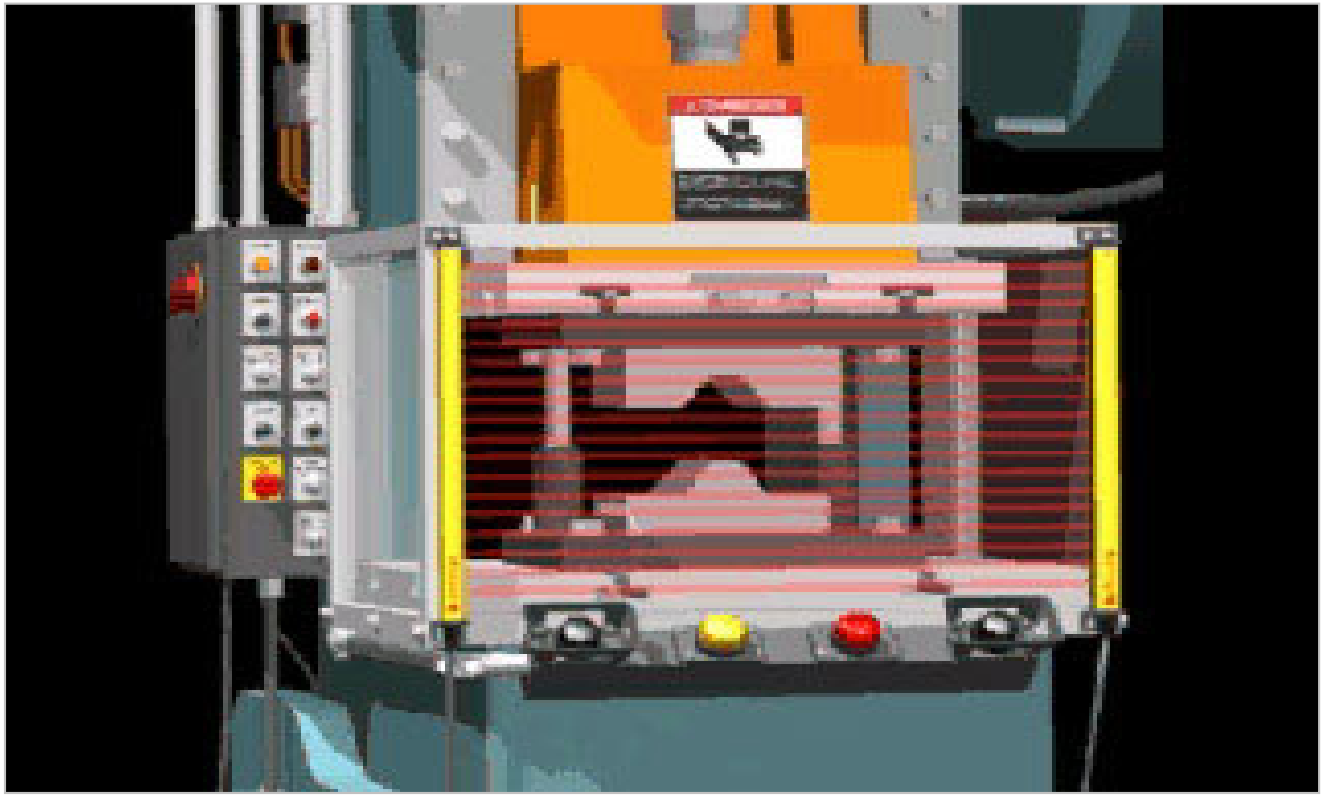
- Presence sensing device



Machine Guarding

1910.212(a)(1)

- Presence sensing device



Machine Guarding

1910.212(a)(1)

- Adjustable guard

Machine Guarding

1910.212(a)(1)

- Pull-out device

General Requirements

1910.212(a)(2)

- Guards affixed to machine where possible
  - Guard shall not offer an accident hazard in itself.

General Requirements

1910.212(a)(3)

- Machine guarding for all machines - point of operation
  - ***Point of operation*** of machines whose operation exposes an employee to injury, shall be guarded.
  - Special handtools for placing and removing material must permit easy handling of material.
    - » Without the operator placing a hand in the danger zone

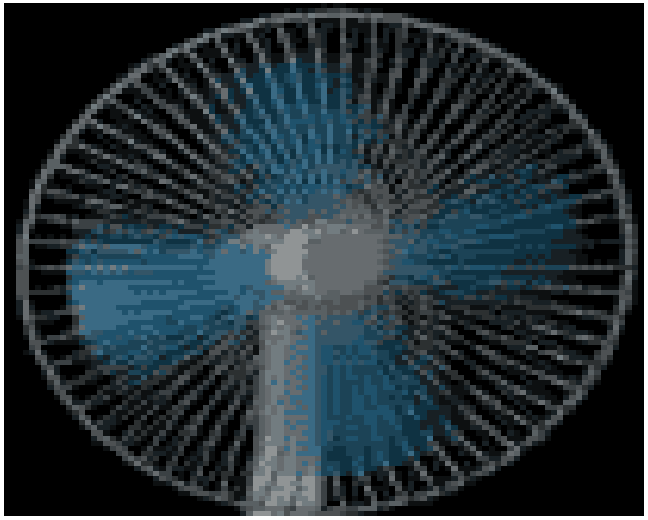
General Requirements

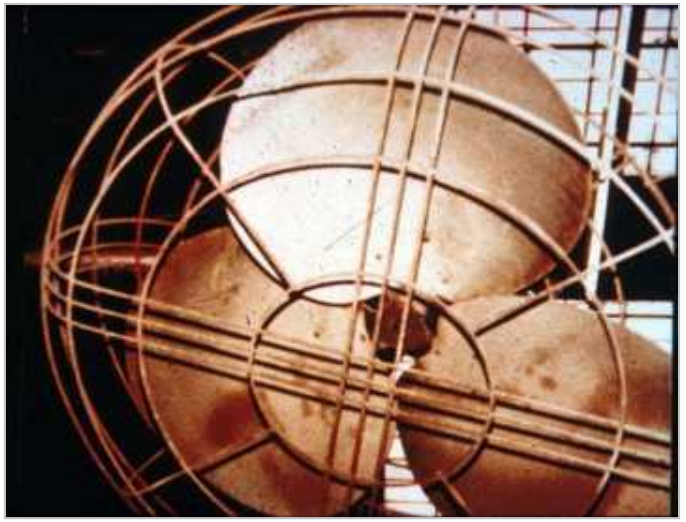
1910.212(a)(5)

- Exposure of blades
  - Blades of fans less than 7 feet above floor must be guarded.
  - Guard openings shall be no larger than ½ inch.

Fan Blades Not Properly Guarded

- **Corrective Action**
  - Install proper guard over fan blades with opening no larger than ½ inch.





General Requirements

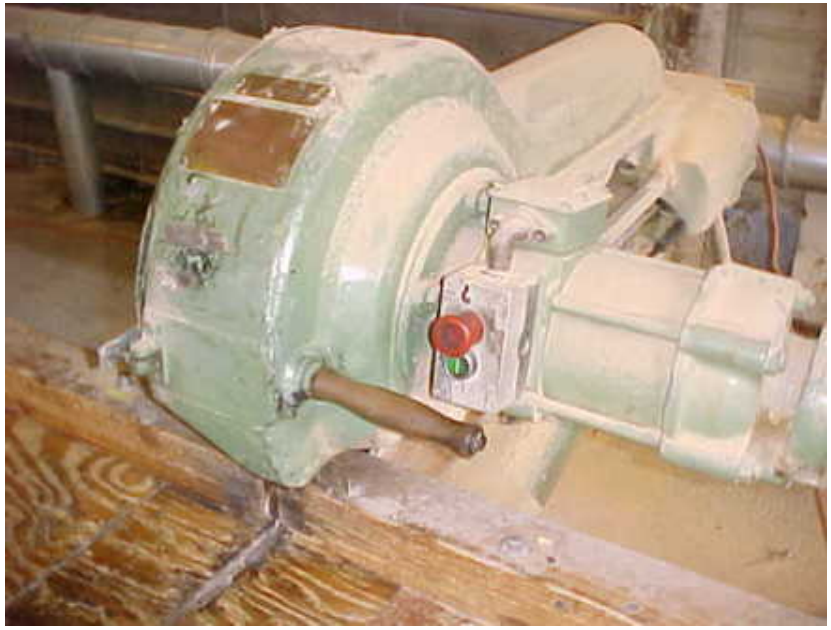
1910.212(b)

- Anchoring fixed machinery
  - Machines designed for a fixed location must be anchored to prevent walking or moving.

Woodworking Machinery

1910.213(b)(1)

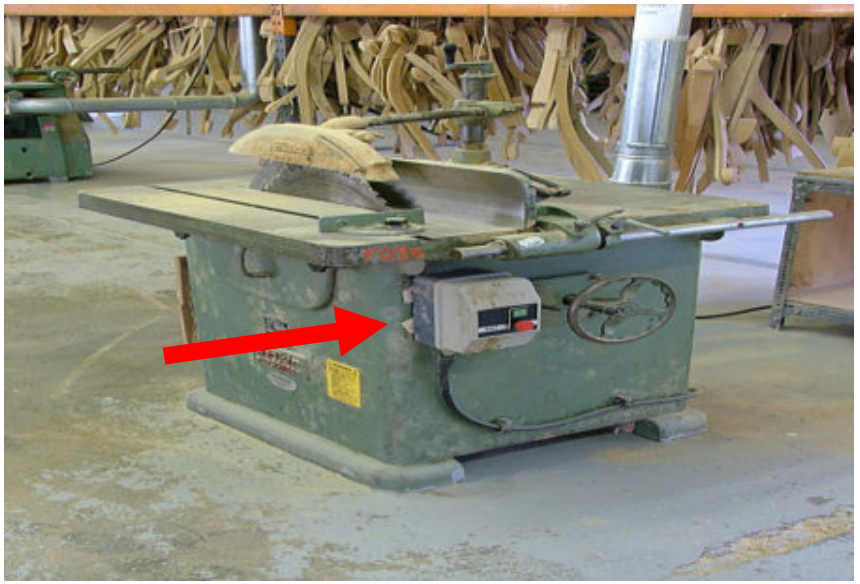
- Machine controls and equipment
  - Mechanical or electrical power control provided for operator to cut off power.
  - Located on machine where operator does not have to leave his position at the point of operation.



Woodworking Machinery

1910.213(b)(3)

- Machine controls and equipment
  - Provision to prevent machines from automatically restarting upon restoration of power.



Woodworking Machinery 1910.213(c)(1)-(3)

- Hand-fed ripsaw
  - Provided with a hood guard
  - Provided with a spreader
  - Provided with non-kickback fingers or dogs

Woodworking Machinery

1910.213(c)(1)

- Hand-fed ripsaw
  - Hood guard must automatically adjust itself to thickness of material being cut.
    - » Remain in contact with material

Woodworking Machinery Requirements

Woodworking Machinery

1910.213(h)(1)

- Radial saws
  - Upper hood must completely enclose upper portion of blade.
    - » Must include the end of the saw arbor.

Woodworking Machinery

1910.213(h)(1)

- Radial saws
  - Lower portion of blade must be guarded on both sides.
    - » Guarded to the full diameter of the blade.
    - » Will adjust itself to the thickness of the stock.

Woodworking Machinery 1910.213(h)(2), (h)(5)

- Radial saws
  - Saw used for ripping provided with non-kickback fingers or dogs.
  - Ripping shall be against the direction which the saw turns.

Woodworking Machinery

1910.213(h)(3)

- Radial saws
  - Adjustable stops preventing forward travel of blade beyond position necessary to complete cut.

Woodworking Machinery

1910.213(h)(4)

- Radial saws
  - Cutting head must return to starting position when released.

Woodworking Machinery

1910.213(i)(1)

- Bandsaws and band resaws
  - All portions of saw blade must be enclosed or guarded.
    - » Except working portion between guide rollers and the table.

Woodworking Machinery

1910.213(i)(1)

- Bandsaws and band resaws
  - Bandsaw wheels must be fully encased.

Woodworking Machinery

1910.213(j)(3)

- Jointers
  - Hand-fed jointer with horizontal cutting head must have an automatic guard.
    - » Must cover the working side of the fence or gage.
    - » Automatically adjust and cover the unused portion of the head.

Woodworking Machinery

1910.213(j)(4)

- Jointers
  - Hand-fed jointer with horizontal cutting head must have a guard.
    - » Must cover the section of head back of the gage or fence.

Woodworking Machinery

1910.213(p)(3)

- Disk sanding machine
  - Exhaust hood or guard arranged to enclose revolving disk.
    - » Except portion above table

Woodworking Machinery

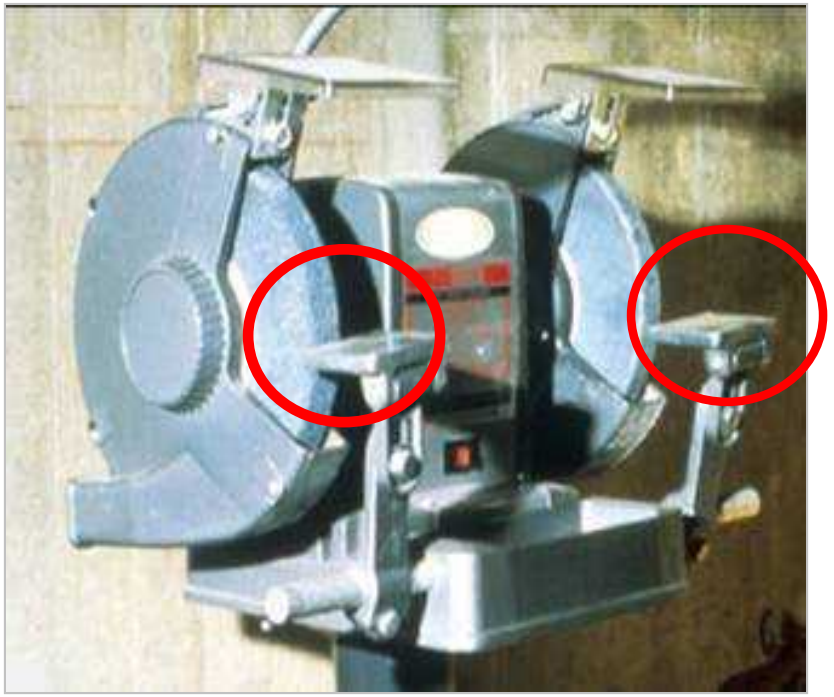
1910.213(p)(4)

- Belt sanding machines
  - Guards provided at each nip point where sanding belt runs on to a pulley.

Abrasive Wheel Machinery

1910.215(a)(4)

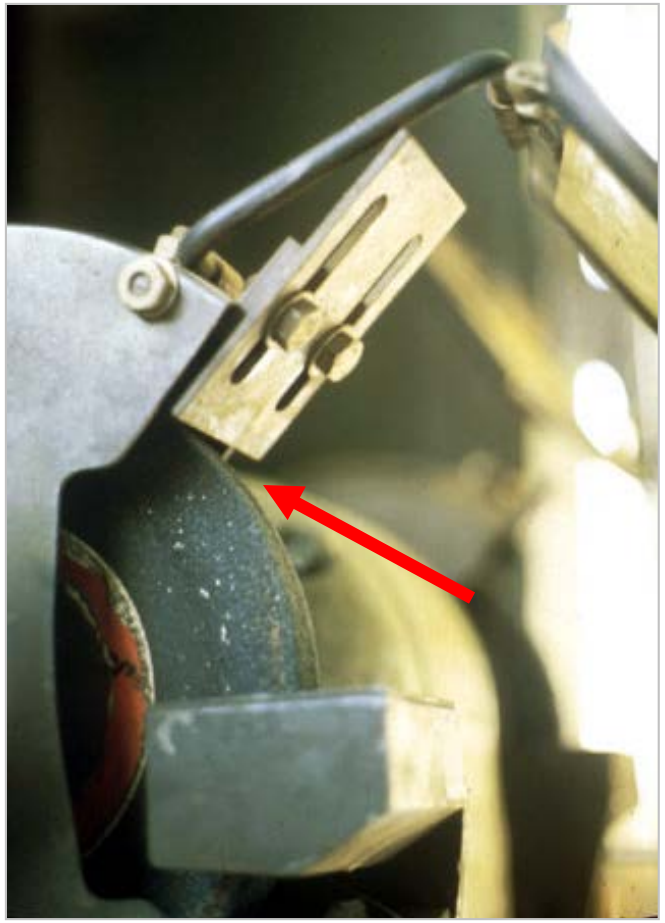
- Work rests must be adjusted closely to the wheel with a ***maximum opening of ⅛ inch***.



Abrasive Wheel Machinery

1910.215(b)(9)

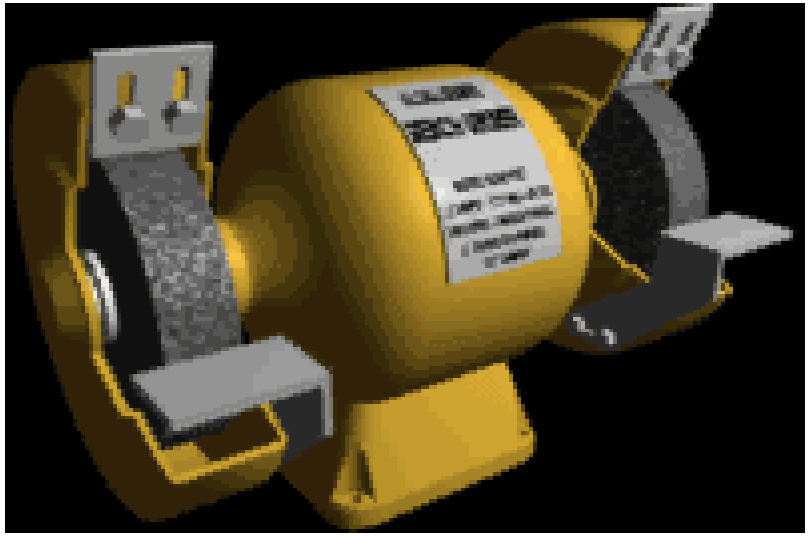
- The distance between the wheel periphery and the adjustable tongue ***must not exceed ¼ inch***.



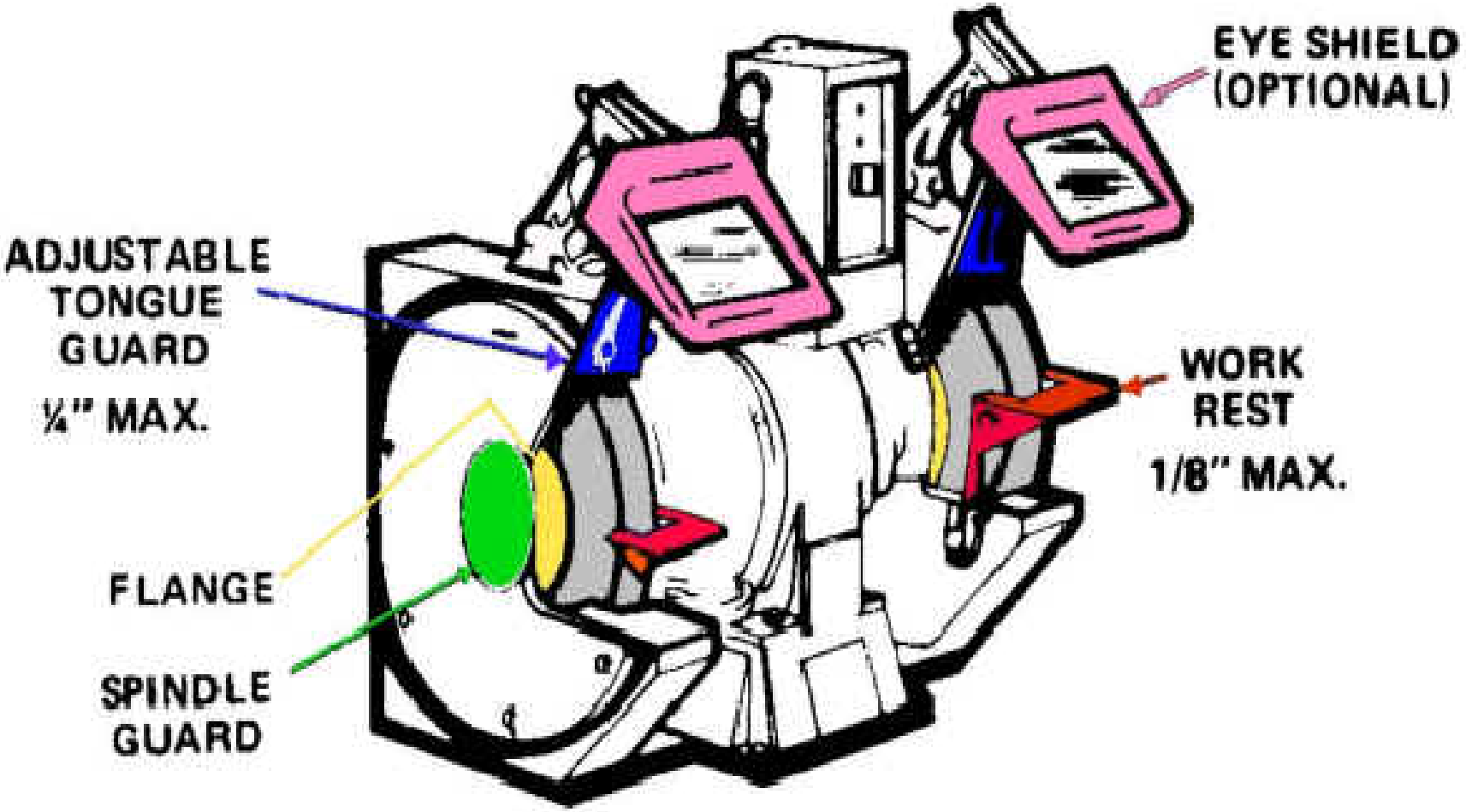
Abrasive Wheel Machinery

1910.215(b)(9)

- **Corrective Action**
  - Properly adjust the work rest and tongue guard to allowable openings.



Abrasive Wheel Machinery



Checklist for Abrasive Wheel Grinders

Standard 29 CFR 1910	Description	YES	NO[2]
	From the Abrasive Wheel standard		
215(a)(2)	Do side guards cover the spindle, nut and flange and 75% of the wheel diameter?		
215(a)(4)	Is the work rest used and kept adjusted to within 1/8-inch (0.3175cm) of the wheel?		
215(b)(9)	Is the adjustable tongue guard on the top side of the grinder used and kept to within 1/4-inch (0.6350cm) of the wheel?		
215(d)(1)	Is the maximum RPM rating of each abrasive wheel compatible with the RPM rating of the grinder motor?		
215(d)(1)	Before new abrasive wheels are mounted, are they visually inspected and ring tested?		
	From other OSHA standards		
22(a)	Is cleanliness maintained around grinders?		
94(b)(2)	Are dust collectors and powered exhausts provided on grinders used in operations that produce large amounts of dust?		
133(a)(1)	Are goggles or face shields always worn when grinding?		
212(b)	Are bench and pedestal grinders permanently mounted?		
304(f)(4)	Is each electrically operated grinder effectively grounded?		
305(g)(1)(iii)(A)	Are fixed or permanently mounted grinders connected to their electrical supply system with metallic conduit or other permanent method?		
305(j)(4)(ii)(F)	Does each grinder have an individual on and off control switch?		

Abrasive Wheel Machinery

1910.215(b)(3)

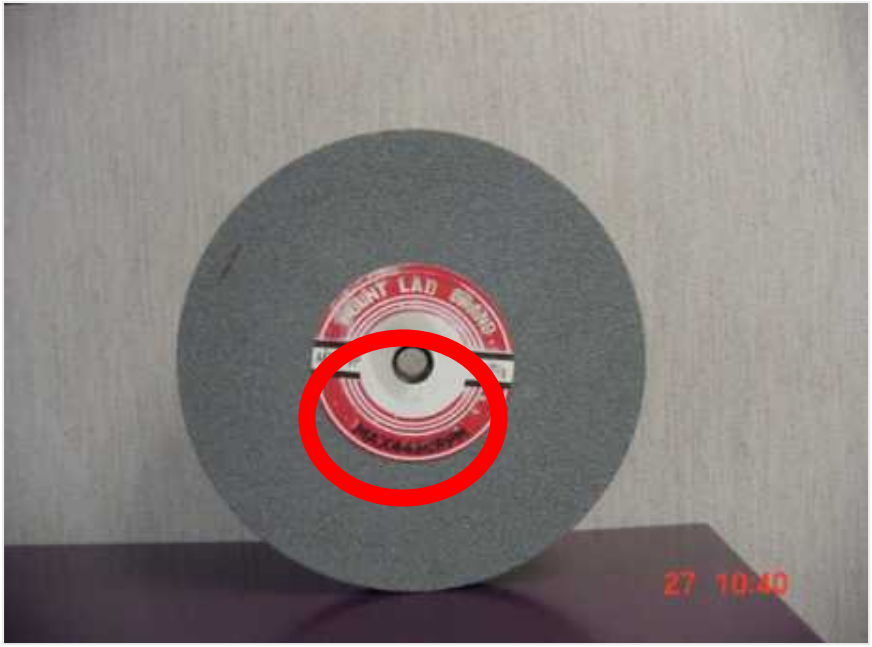
- Bench and floor stands
  - The angular exposure of the grinding wheel periphery and sides for safety guards used on machines should not exceed ***90 degrees or ¼ of the periphery***.

Abrasive Wheel Machinery

1910.215(d)(1)

- Inspection
  - All abrasive wheels must be closely ***inspected and ring-tested*** before mounting to ensure that they are free from cracks and defects.

Abrasive Wheel Machinery



Mechanical Power Presses

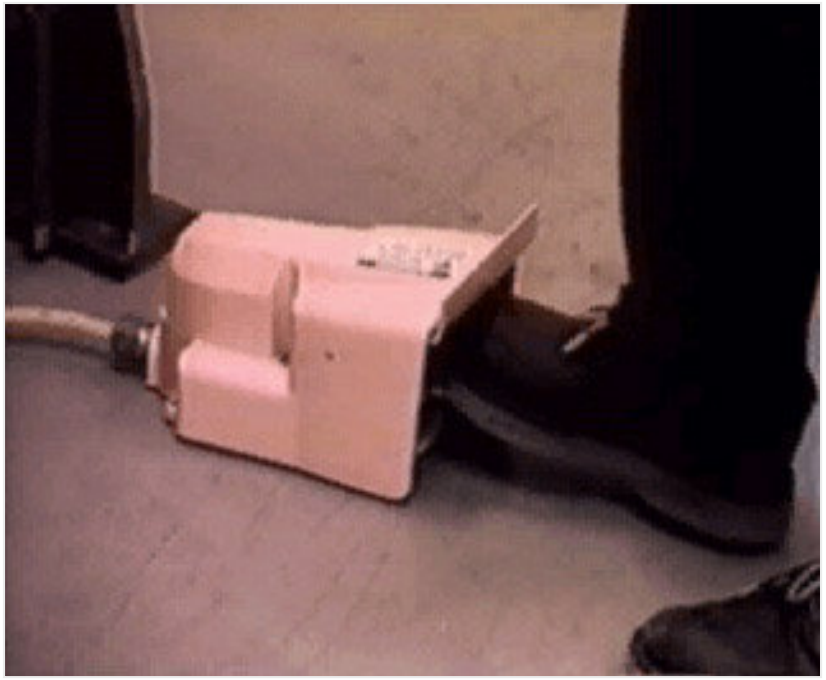
1910.217

SAFEGUARDED FULL REVOLUTION CLUTCH PRESS
(INCLUDES SINGLE STROKE TRIP CONTROL SYSTEM)

Right Side of Press

Mechanical Power Presses 1910.217(b)(4)(i)

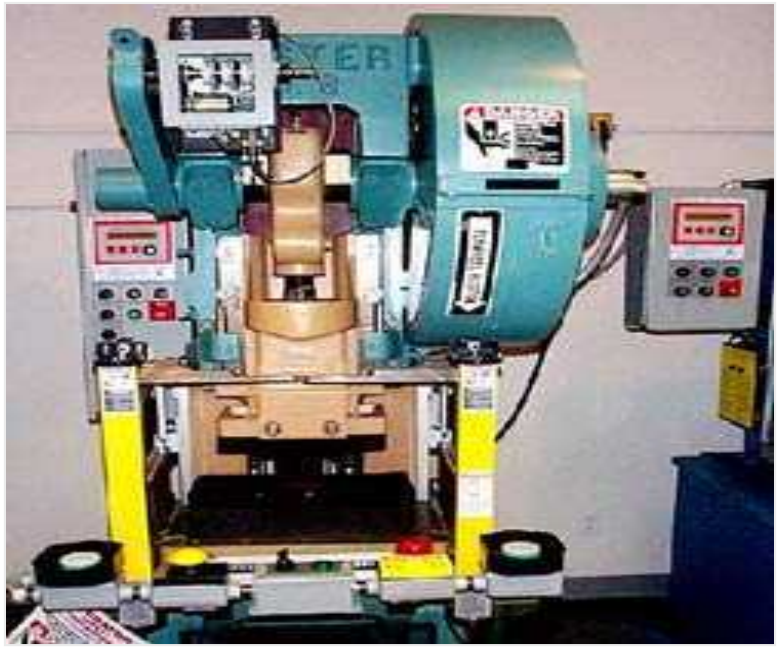
- Foot pedals (treadle)
  - Pedal mechanism shall be protected to prevent unintended operation
    - » From falling or moving objects
    - » Accidental stepping onto the pedal



Mechanical Power Presses

1910.217(c)(1)

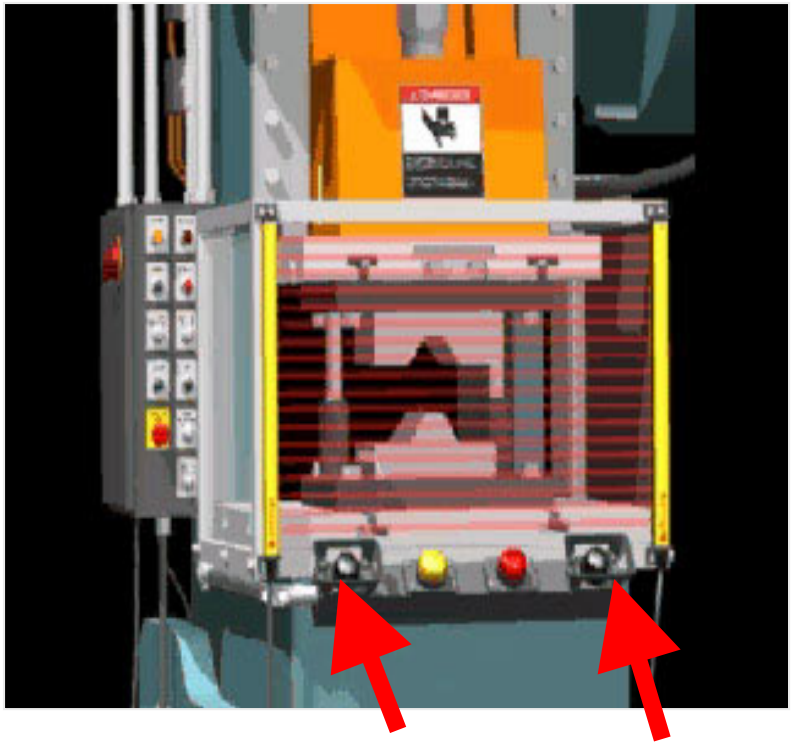
- Safeguarding the point of operation
  - Point of operation must be provided with guards or point of operation devices.



Part revolution mechanical press

Mechanical Power Presses 1910.217(c)(3)(iii)

- Presence sensing point of operation device
  - Must be interlocked into the control circuit to prevent or stop slide motion if part of operator's body is within sensing field during downstroke of press slide.



Light curtains

Mechanical Power Presses 1910.217(c)(3)(iii)(a)

- Presence sensing point of operation device
  - Presence sensing devices can not be used on machines using full revolution clutches.

Mechanical Power Presses 1910.217(c)(3)(iv)

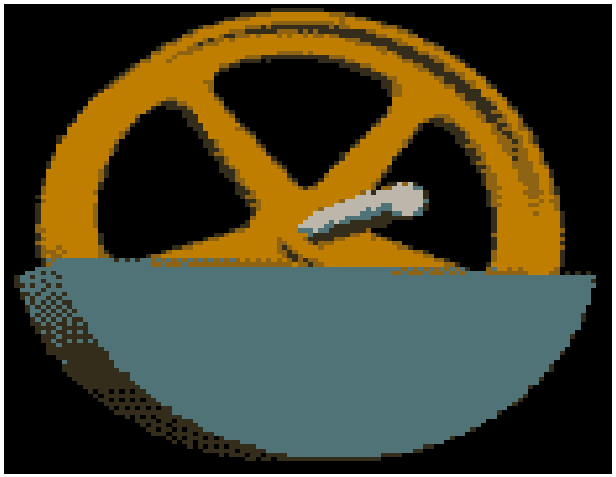
- Pull-out device shall include attachments for each of operator's hands.
  - Connected to and operated only by press slide of upper die
  - Properly adjusted
  - Visually inspected and properly adjusted at start of each operator shift

Mechanical Power Presses 1910.217(c)(3)(vi)

- Restraint devices
- Device must protect operator
- Attachments for each hand
- Adjusted to restrain operator from reaching into point of operation

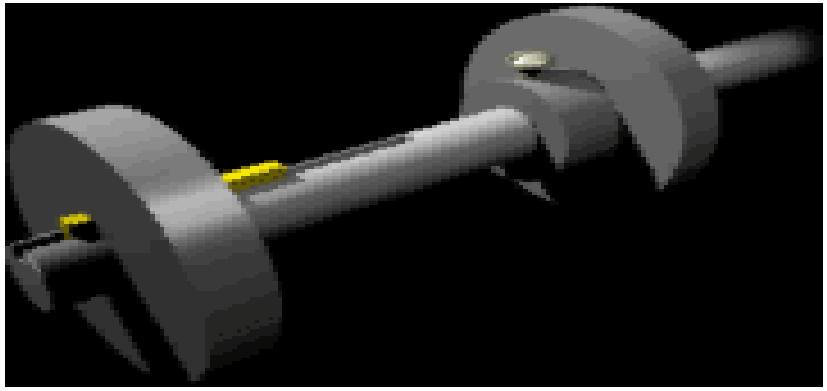
Mechanical Power-Transmission Apparatus 1910.219(b)(1)

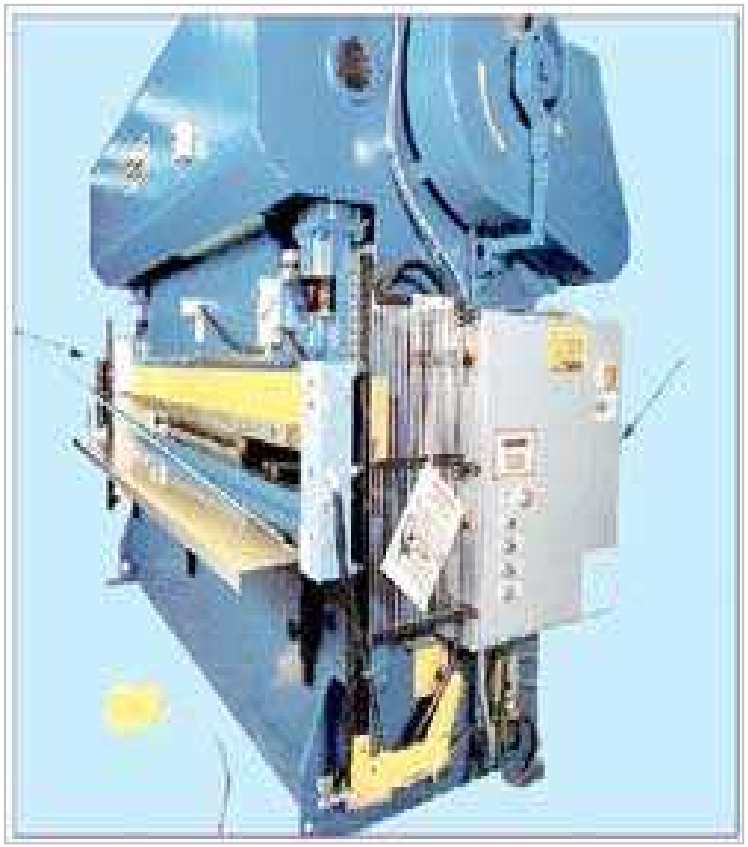
- Prime-mover guards
  - Flywheels with any part 7 feet or less above floor or platform must be guarded.



Mechanical Power-Transmission Apparatus 1910.219(c)(2)(i)

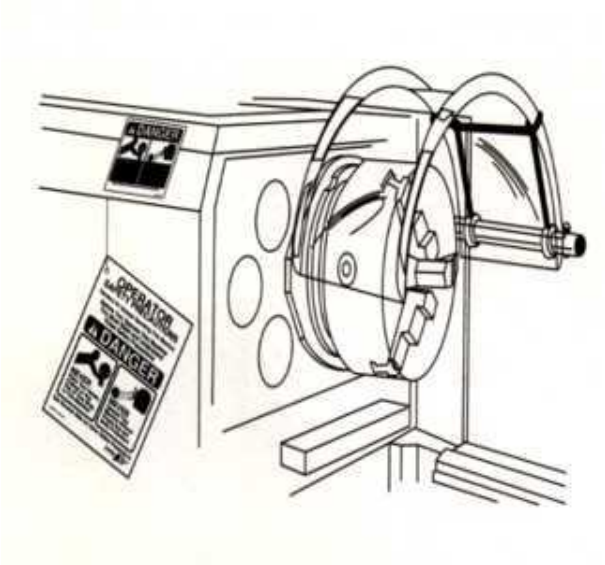
- Shafting
  - Exposed parts of horizontal shafting 7 feet or less from floor or working platform must be guarded.





Mechanical Power-Transmission Apparatus 1910.219(c)(4)(i)

- Projecting shaft ends
  - Must not project more than ***½ the diameter*** of the shaft
    - » Unless guarded by non-rotating caps or safety sleeves



Mechanical Power-Transmission Apparatus 1910.219(d)(1)

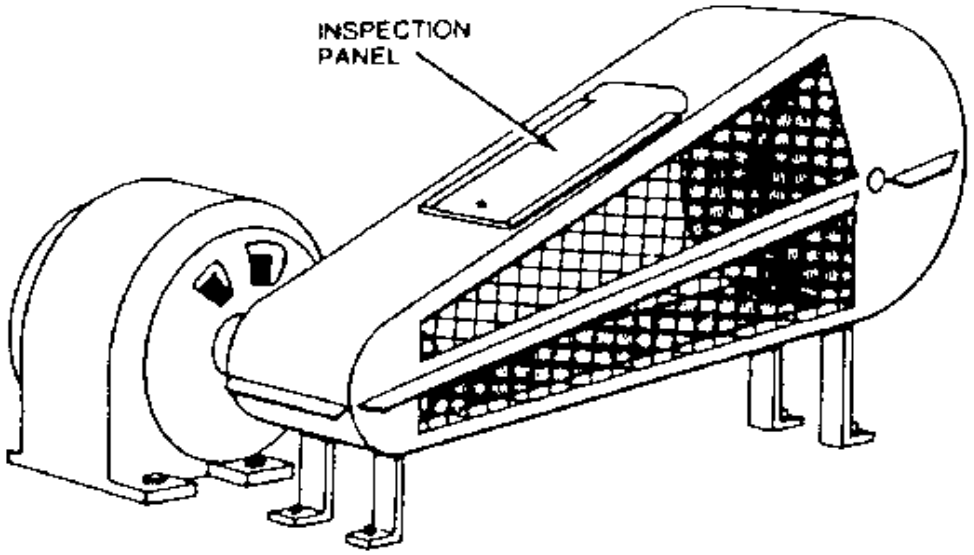
- Pulleys
  - Any parts of pulleys which are 7 feet or less from floor or working platform must be guarded

Mechanical Power-Transmission Apparatus 1910.219(e)(1)(i)

- Where both runs of horizontal belts are ***7 feet or less*** from floor level must be guarded.
  - Guard must extend at least 15 inches above the belt.

Mechanical Power-Transmission Apparatus 1910.219(e)(1)(i)

- Horizontal belt with both runs ***42 inches or less*** from floor must be fully enclosed.

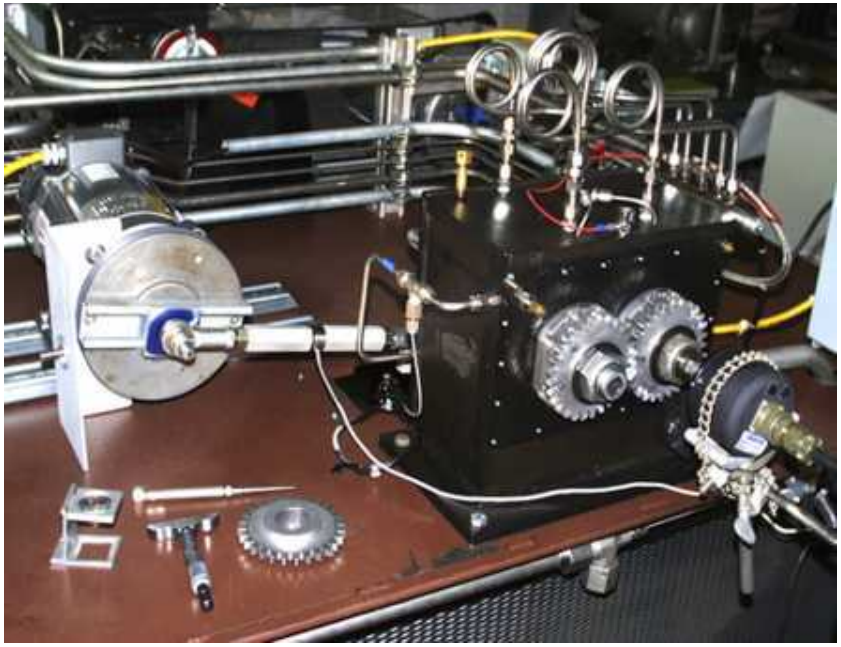


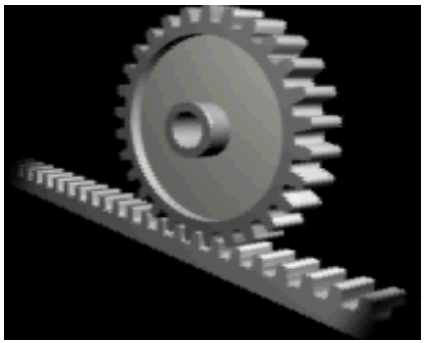
Mechanical Power-Transmission Apparatus 1910.219(e)(3)(i)

- Vertical and inclined belts must be enclosed by a guard.

Mechanical Power-Transmission Apparatus 1910.219(f)(1)

- Gears must be guarded by complete enclosures or standard guard.





Mechanical Power-Transmission Apparatus 1910.219(f)(3)

- Sprockets and chains
  - Sprocket wheels and chains located ***7 feet or less*** above the floor or platform must be enclosed.

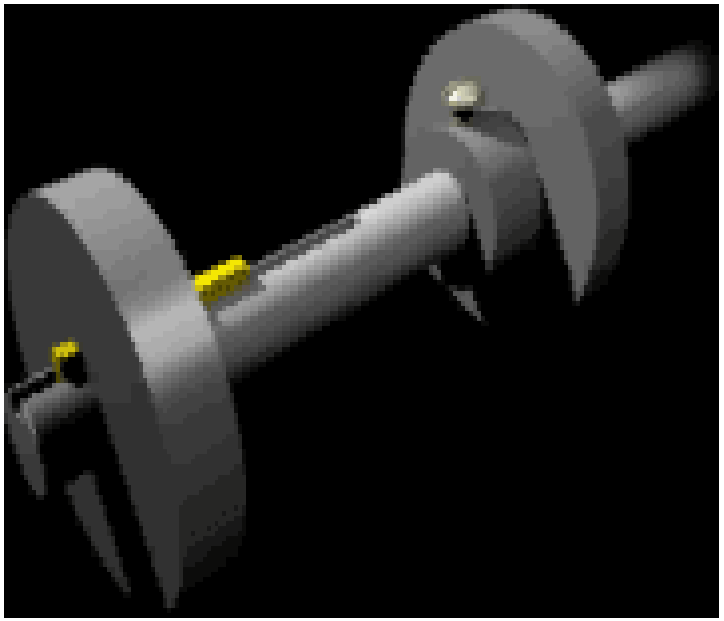
Roller conveyor with unguarded chain and sprocket drives

Exposed Sprocket and Chain Drive

- **Corrective Action**
  - Enclose the sprocket and chain drive to avoid contact with moving parts and ingoing nip points.

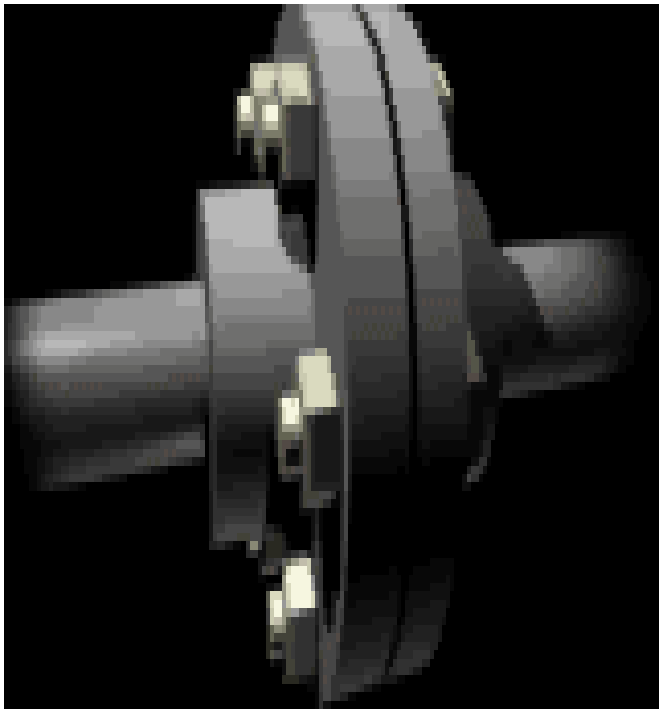
Mechanical Power-Transmission Apparatus 1910.219(h)(1)

- Keys, setscrews, and other projections
  - Projecting keys, setscrews, and other projections in revolving parts must be removed, made flush, or guarded.



Mechanical Power-Transmission Apparatus 1910.219(i)(2)

- Shaft couplings must be constructed as to present no hazard from bolts, nuts, setscrews, or revolving surfaces.
  - Permitted where they are covered with safety sleeves or countersunk and do not extend beyond the flange of the coupling.



Portable Powered Tools

1910.243(a)(1)(i)

- Portable circular saws
  - Must be equipped with guards above and below the base plate or shoe.
  - The lower guard must cover the saw to the depth of the teeth.

Portable Powered Tools

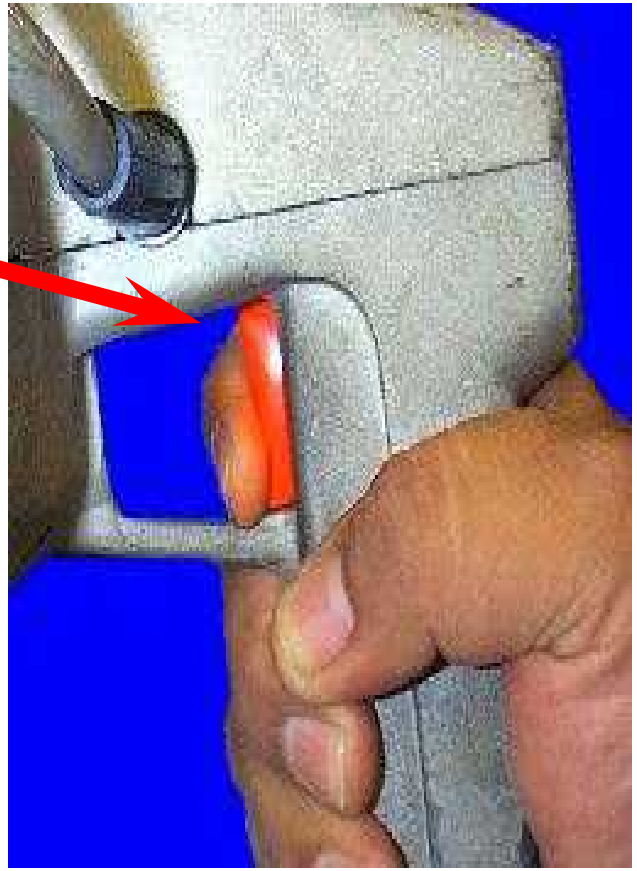
1910.243(a)(1)(i)

- Portable circular saws
  - The lower guard must automatically return to the covering position over the blade teeth.
    - » When tool is withdrawn from the work

Portable Powered Tools

1910.243(a)(2)(i)

- Switches and controls
  - All hand-held powered circular saws must be equipped with a constant pressure switch or control.
    - » Will shut off the power when the pressure is released.



Portable Powered Tools

1910.243(a)(2)(ii)

- Electric tools must be equipped with switches that must be equipped with a constant pressure switch, ***or***

- Turnoff can be accomplished by a single motion of same finger or fingers that turn it **on.**

Portable Powered Tools

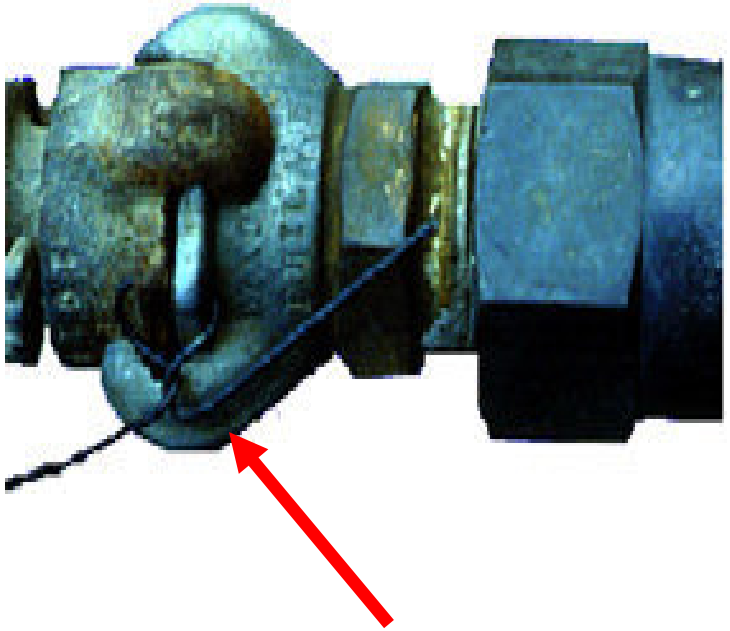
1910.243(a)(3)

- Portable belt sanding machines
  - Must have guards at nip points where belt runs onto a pulley
  - Unused portion of the belt must be guarded

Portable Powered Tools

1910.243(b)(2)

- Pneumatic powered tools and hose
  - Hose and hose connections designed for pressure and service which they are subjected.

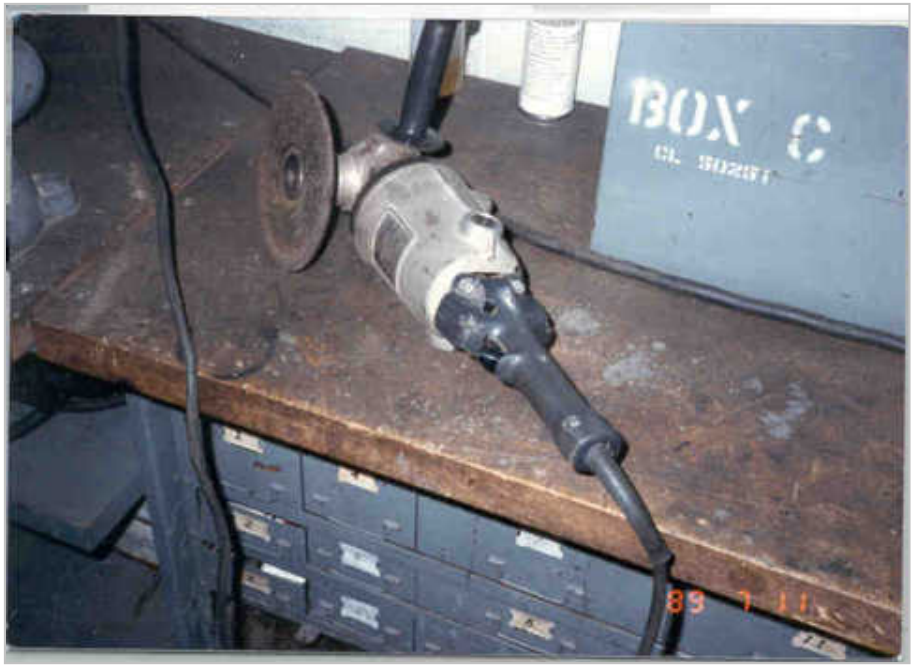


Wire used to secure hose

Portable Powered Tools

1910.243(c)(3)

- Vertical portable grinders
  - Must have safety guard on tool with a maximum exposure angle of 180 degrees.



Portable Powered Tools

- **Corrective Action**
  - Install proper type of guard
    - » Guard must be located so as to be between the operator and the wheel during use.

Summary

Students should now have a basic understanding of the following:

- Basic concepts of machine guarding
- Identification of machine guarding hazards
- Machine guarding abatement methods
- Familiarity with machine guarding standards

Thank You For Attending!

Final Questions?

Checklist for Abrasive Wheel Grinders

Standard 29 CFR 1910	Description	YES	NO[2]
	From the Abrasive Wheel standard		
215(a)(2)	Do side guards cover the spindle, nut and flange and 75% of the wheel diameter?		
215(a)(4)	Is the work rest used and kept adjusted to within 1/8-inch (0.3175cm) of the wheel?		
215(b)(9)	Is the adjustable tongue guard on the top side of the grinder used and kept to within 1/4-inch (0.6350cm) of the wheel?		
215(d)(1)	Is the maximum RPM rating of each abrasive wheel compatible with the RPM rating of the grinder motor?		
215(d)(1)	Before new abrasive wheels are mounted, are they visually inspected and ring tested?		
	From other OSHA standards		
22(a)	Is cleanliness maintained around grinders?		
94(b)(2)	Are dust collectors and powered exhausts provided on grinders used in operations that produce large amounts of dust?		
133(a)(1)	Are goggles or face shields always worn when grinding?		
212(b)	Are bench and pedestal grinders permanently mounted?		
304(f)(4)	Is each electrically operated grinder effectively grounded?		
305(g)(1)(iii)(A)	Are fixed or permanently mounted grinders connected to their electrical supply system with metallic conduit or other permanent method?		
305(j)(4)(ii)(F)	Does each grinder have an individual on and off control switch?		