

# **Machine Guarding & Safety in the Use of Stationary Power Tools**

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U. S. DEPARTMENT OF ENERGY



# Training Objectives

- Provide basic safety rules for working with power tools
- Describe potential accidents arising from use of power tools
- Provide a general understanding of hazards of power tools
- Review requirements for machine guarding

# **M&C Experience in 2003**

## **Two Occurrences**

- Both resulted in emergencies
- Student caught hand on drill press
- Technician seriously injured on band saw
- Review Safety Flash

# SAFETY FLASH

## Background

On October 29, 2003, a serious injury was sustained while performing routine activities in a high bay area. A technician was preparing metallic samples for routine research activities. The technician was using a saw to place identification notches on the sample, prior to the next step in processing. The saw blade “caught” the sample, pulling the technician’s hand into the saw blade, causing serious injury to the hand. A formal investigation is underway to determine the causes and form the basis for corrective actions and lessons learned. There are obvious lessons, based on the available facts, that must be shared immediately.

## Known Facts

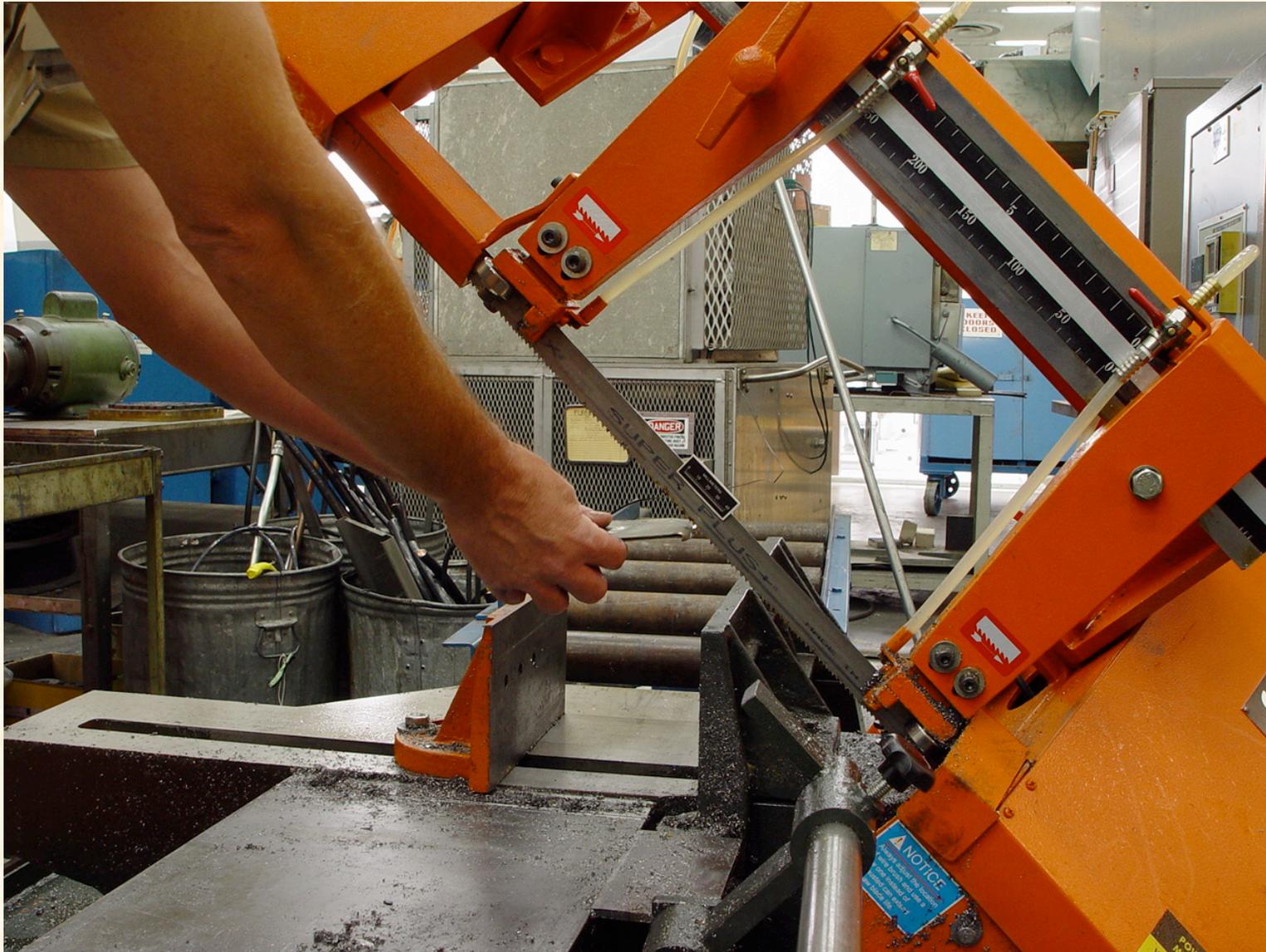
- A small vertical band saw was available for the task but had been intermittently operating improperly.
- A larger horizontal band saw was used for the “notching” task.
- The horizontal band saw was used in an upright, 45° angle. Also, the machine guarding was not adjusted for that position.
- The horizontal band saw had no work rest for use in this position.
- The technician was wearing a watch, contrary to the manufacturer’s and RSS recommendation “no jewelry.”
- The technician was wearing leather gloves, contrary to the RSS recommendations to NOT wear leather gloves when using rotating equipment.
- The saw blade was “too coarse” for the thinner material being sawed.
- The technician’s injuries required surgery and hospitalization.

## Immediate Lessons

Always consider the suitability of the tools selected for a task.

Manufacturer’s and company’s safety recommendations should always be followed.

Always adjust equipment guards to the size of the part being worked.



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# General Shop Rules

- A. Machines and tools shall be cleaned after each use.
- B. Tools shall be returned to the appropriate storage area clean and in good condition. Damaged tools shall be reported to the supervisor and taken out of service.
- C. Users shall select the proper size and type of tool for the work.

# General Shop Rules (cont.)

- D. Floors shall be kept clear of scrap and excessive litter. Spills shall be cleaned up immediately.
- E. Work shall be mounted in a vise, clamp, or holder whenever possible.
- F. Edged tools shall be handled carefully and shall be sharpened regularly.

# General Shop Rules (cont.)

- G. Machines shall be stopped when making adjustments or measurements. Lockout/tagout procedures shall be followed when repairing machines or changing blades.
  
- H. Cuttings and chips shall be removed by using brushes or pliers, never by hands.
  
- I. Machine users shall not wear jewelry or gloves. Long hair shall be tied up; long sleeves shall be rolled up.

# General Shop Rules (cont.)

- J. Ear protection shall be worn when noisy machines are operating.
- K. Eye protection shall be worn by all persons in the work area.
- L. Compressed air shall not be used to clean tools, machines, or persons.
- M. Persons shall not engage in horseplay or cause distractions.

## **General Shop Rules (cont.)**

- N. Group Leaders shall have final authority over access to tools and equipment (i.e., Group Leaders authorize use of equipment).
- O. All injuries and "near misses" shall be reported immediately to the Group Leader.
- P. Read and follow manufacturer instructions, SOPS/SOGs, and RSS.

# Introduction - Machine Guarding

Crushed hands and arms, severed finger, blindness - the list of possible machinery-related injuries is as long as it is horrifying. Safeguards are essential for protecting workers from needless and preventable injuries.

A good rule to remember is: Any machine part, function, or process which may cause injury must be safeguarded.

# **Introduction - Machine Guarding (cont.)**

Where the operation of a machine can injure the operator or other workers, the hazard must be controlled or eliminated.

# Causes of Machine Accidents

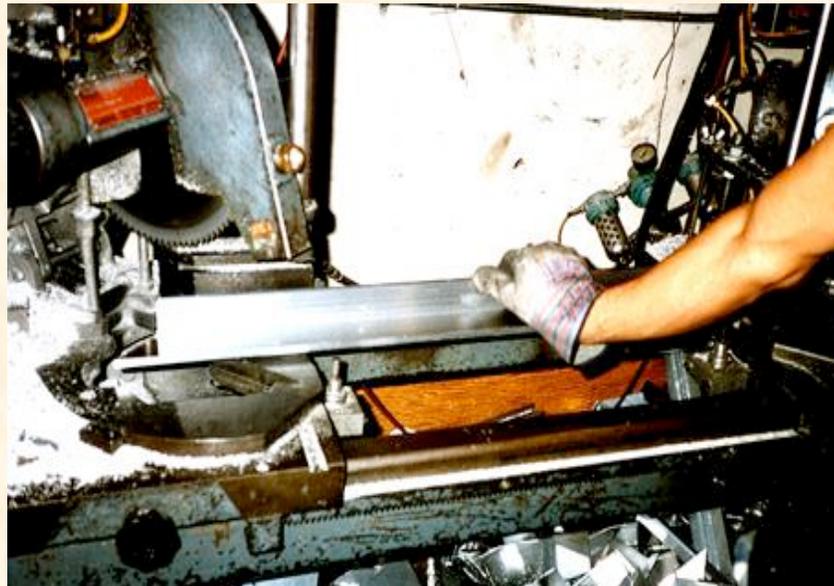
- Reaching in to “clear” equipment
- Not using Lockout/Tagout
- Unauthorized persons doing maintenance or using the machines
- Missing or loose machine guards

# Where Mechanical Hazards Occur

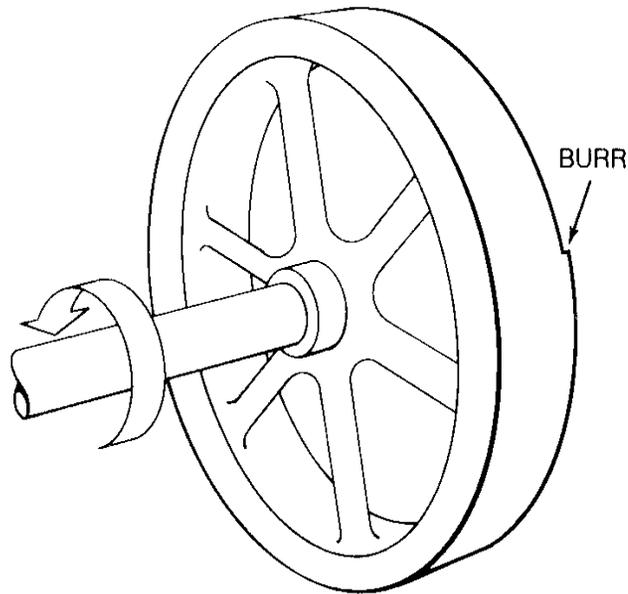
- Point of operation
- All parts of the machine which move, such as:
  - flywheels, pulleys, belts, couplings, chains, cranks, gears, etc.
  - feed mechanisms and auxiliary parts of the machine
- In-running nip points

# Point of Operation

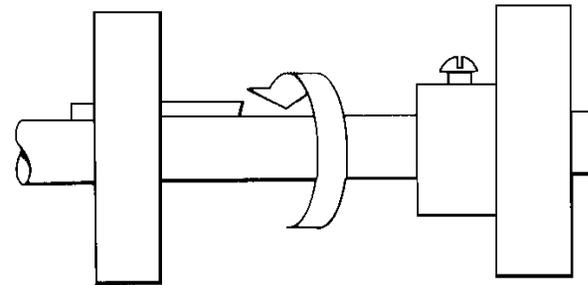
That point where work is performed on the material, such as cutting, shaping, boring, or forming of stock must be guarded.



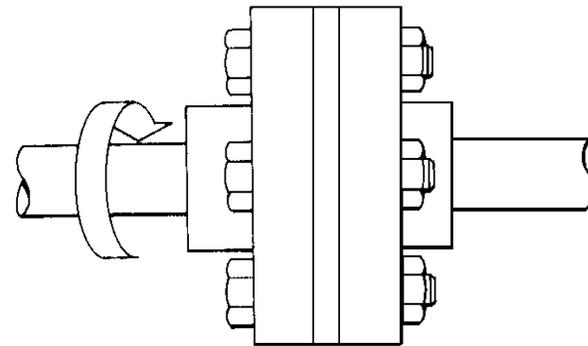
# Rotating Parts



ROTATING PULLEY WITH SPOKES AND PROJECTING BURR ON FACE OF PULLEY



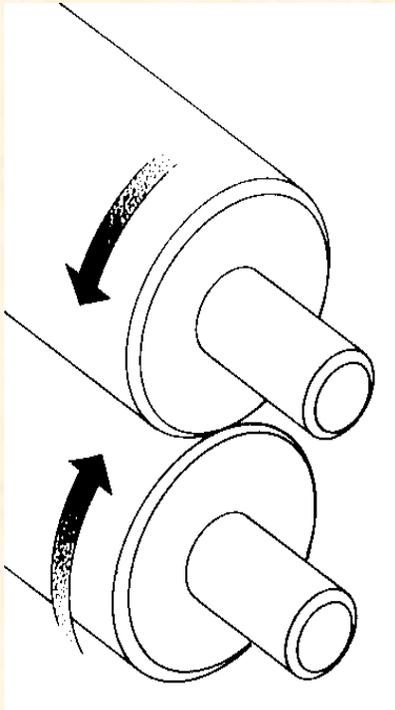
ROTATING SHAFT AND PULLEYS WITH PROJECTING KEY AND SET SCREW



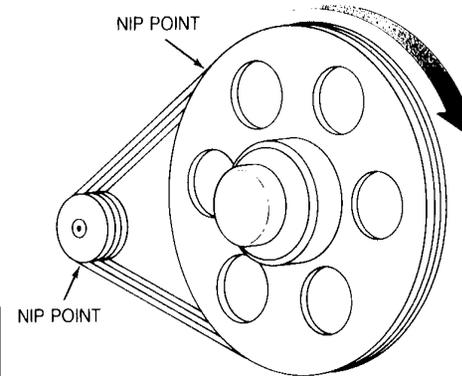
ROTATING COUPLING WITH PROJECTING BOLT HEADS

# In-Running Nip Points

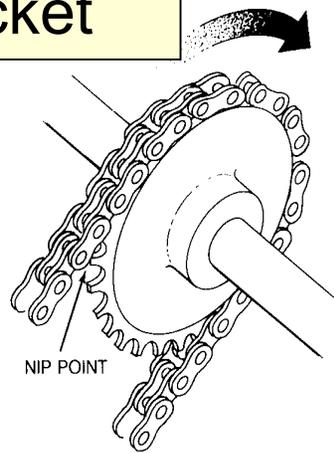
Rotating cylinders



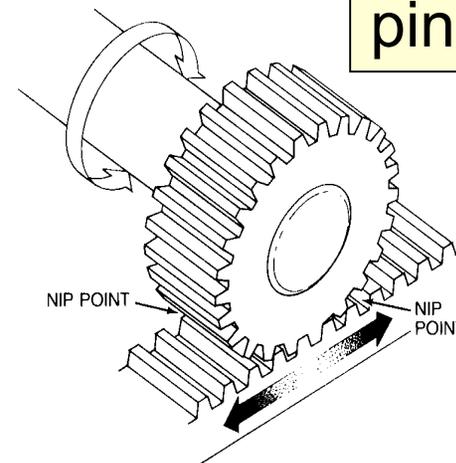
Belt and pulley



Chain and sprocket



Rack and pinion



# Requirements for Safeguards

- Prevent contact - prevent worker's body or clothing from contacting hazardous moving parts. **Never work within 4 inches of an unguarded point of operation.**
- Secure - firmly secured to machine and not easily removed.
- Protect from falling objects - ensure that no objects can fall into moving parts.
- Create no new hazards - must not have shear points, jagged edges, or unfinished surfaces.

# Requirements for Safeguards (cont.)

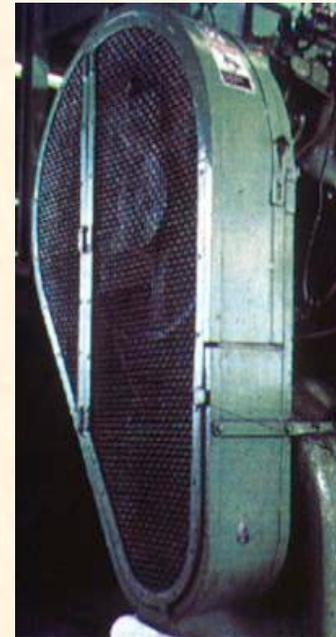
- Create no interference - must not prevent worker from performing the job quickly and comfortably.
- Allow safe lubrication - if possible, be able to lubricate the machine without removing the safeguards.

# Methods of Machine Safeguarding

- Guards
  - fixed
  - interlocked
  - adjustable
  - self-adjusting
- Devices
  - presence sensing
  - pullback
  - restraint
  - safety controls (tripwire cable, two-hand control, etc.)
  - gates
- Location/distance
- Feeding and ejection methods
  - automatic and/or semi-automatic feed and ejection
  - robot
- Miscellaneous aids
  - awareness barriers
  - protective shields
  - hand-feeding tools

# Fixed Guard

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



# Interlocked Guard

When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place.



Interlocked  
guard on  
revolving drum

# Adjustable Guard

Provides a barrier which may be adjusted to facilitate a variety of production operations.



Bandsaw blade  
adjustable guard

# Self-Adjusting Guard

Provides a barrier which moves according to the size of the stock entering the danger area.



Circular table saw self-adjusting guard

# Pullback Device

- Utilizes a series of cables attached to the operator's hands, wrists, and/or arms
- Primarily used on machines with stroking action
- Allows access to the point of operation when the slide/ram is up
- Withdraws hands when the slide/ram begins to descend



## Pullback Device (cont.)



- 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

# Restraint Device

- Uses cables or straps attached to the operator's hands and a fixed point
- Must be adjusted to let the operator's hands travel within a predetermined safe area
- Hand-feeding tools are often necessary if the operation involves placing material into the danger area



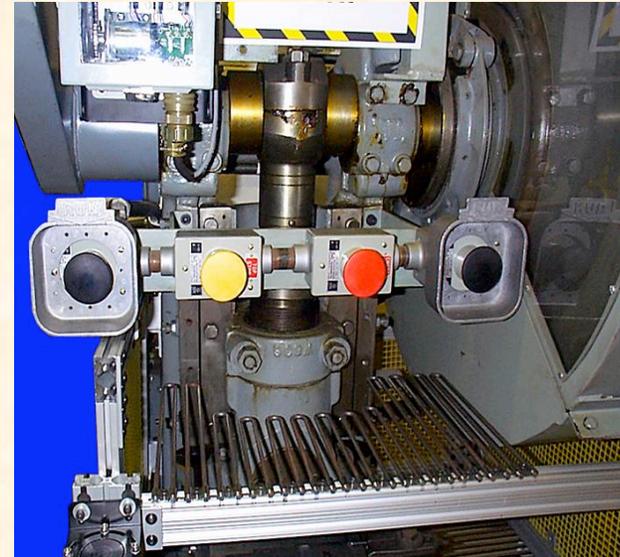
# Safety Tripwire Cables

- Device located around the perimeter of or near the danger area
- Operator must be able to reach the cable to stop the machine



# Two-Hand Control

- Requires constant, concurrent pressure to activate the machine
- The operator's hands are required to be at a safe location (on control buttons) and at a safe distance from the danger area while the machine completes its closing cycle



# Gate

- Movable barrier device which protects the operator at the point of operation before the machine cycle can be started
- If the gate does not fully close, machine will not function



Gate Open



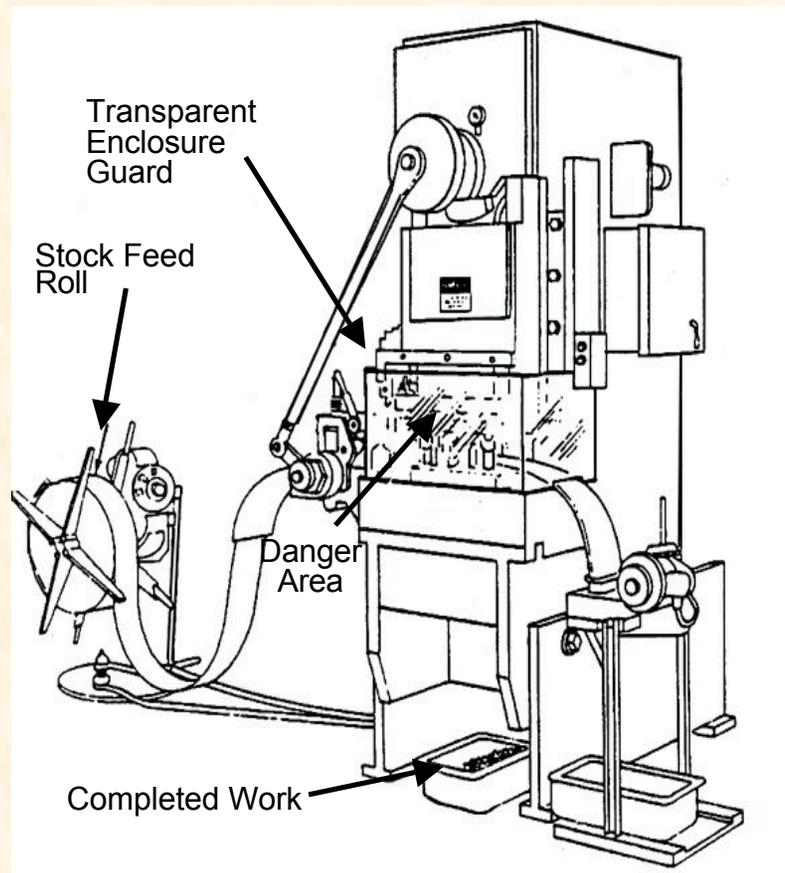
Gate Closed

# Safeguarding by Location/Distance

- Locate the machine or its dangerous moving parts so that they are not accessible or do not present a hazard to a worker during normal operation
- Maintain a safe distance from the danger area

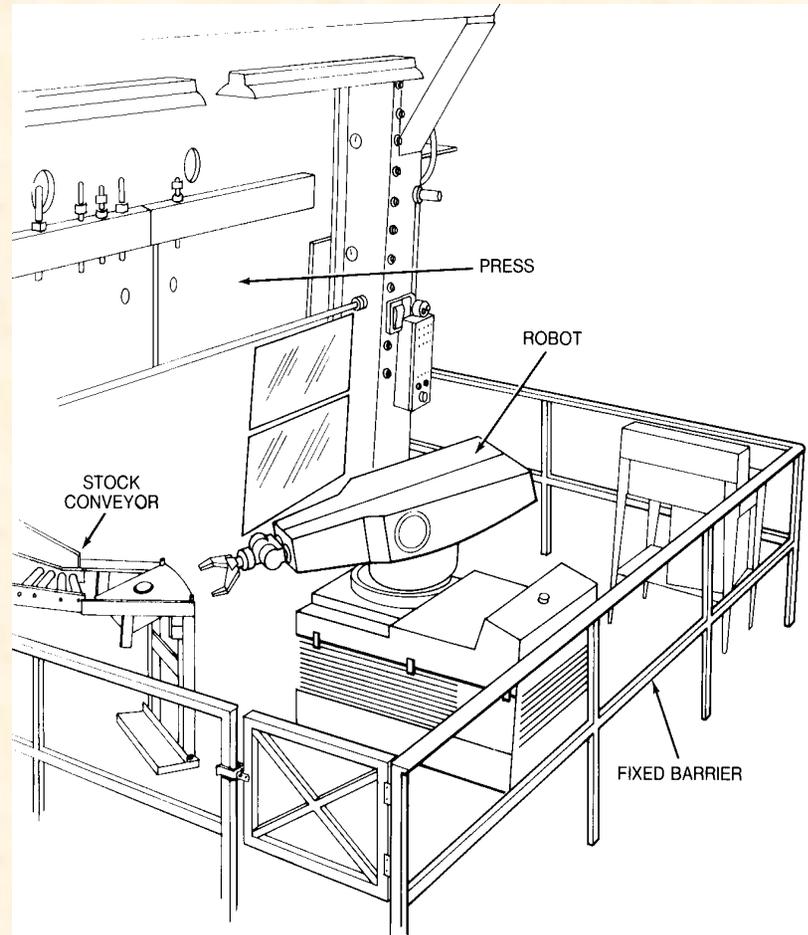


# Automatic Feed (shown on power press)



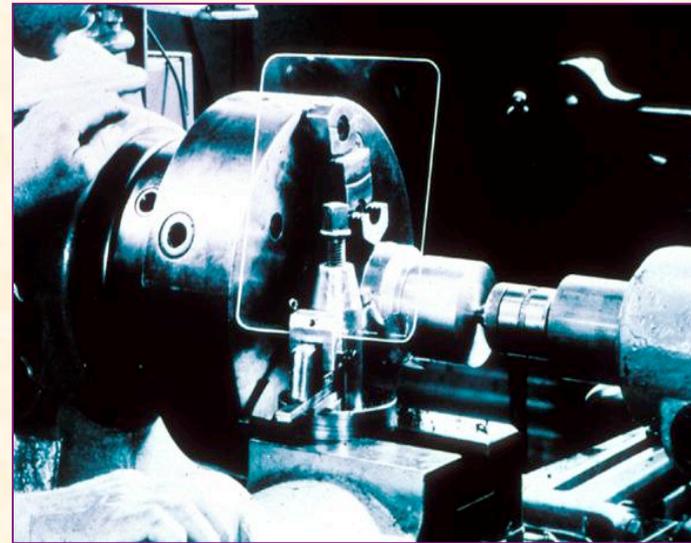
# Robots

- Machines that load and unload stock, assemble parts, transfer objects, or perform other tasks
- Best used in high-production processes requiring repeated routines where they prevent other hazards to employees



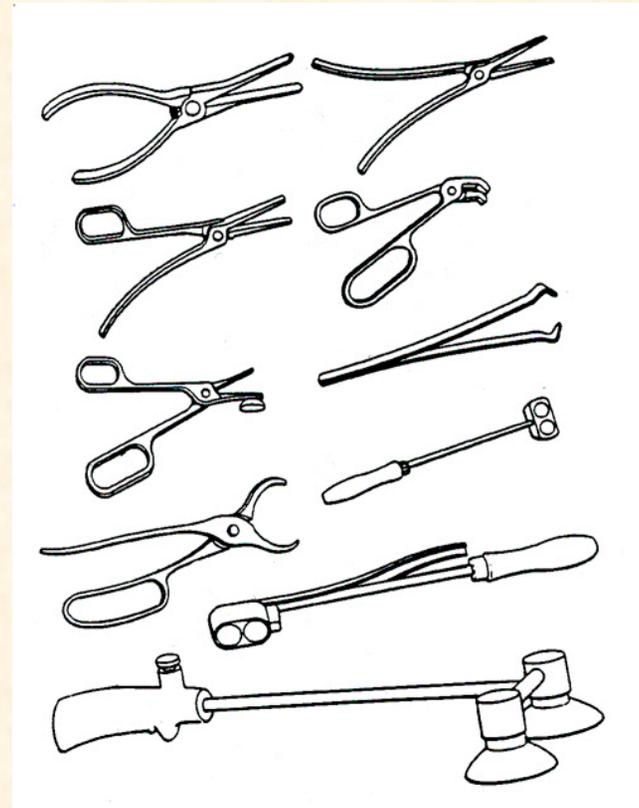
# Protective Shields

These do not give complete protection from machine hazards, but do provide some protection from flying particles, splashing cutting oils, or coolants.

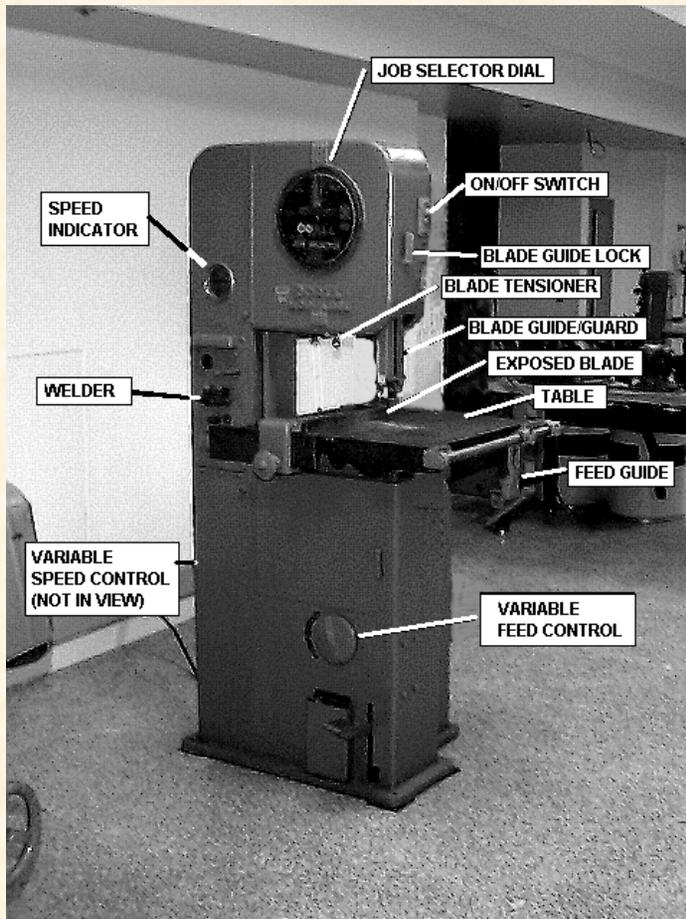


# Holding Tools

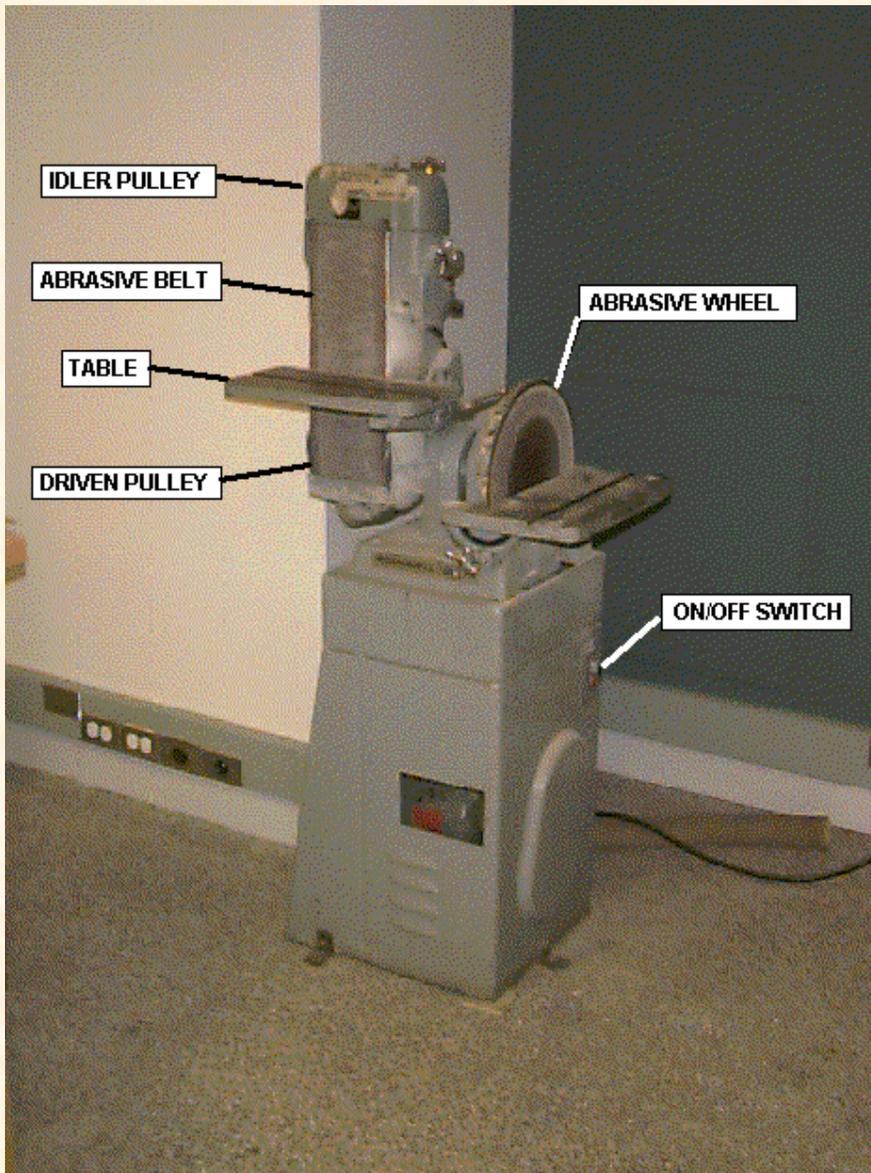
- Used to place and remove stock in the danger area
- Not to be used instead of other machine safeguards, but as a supplement



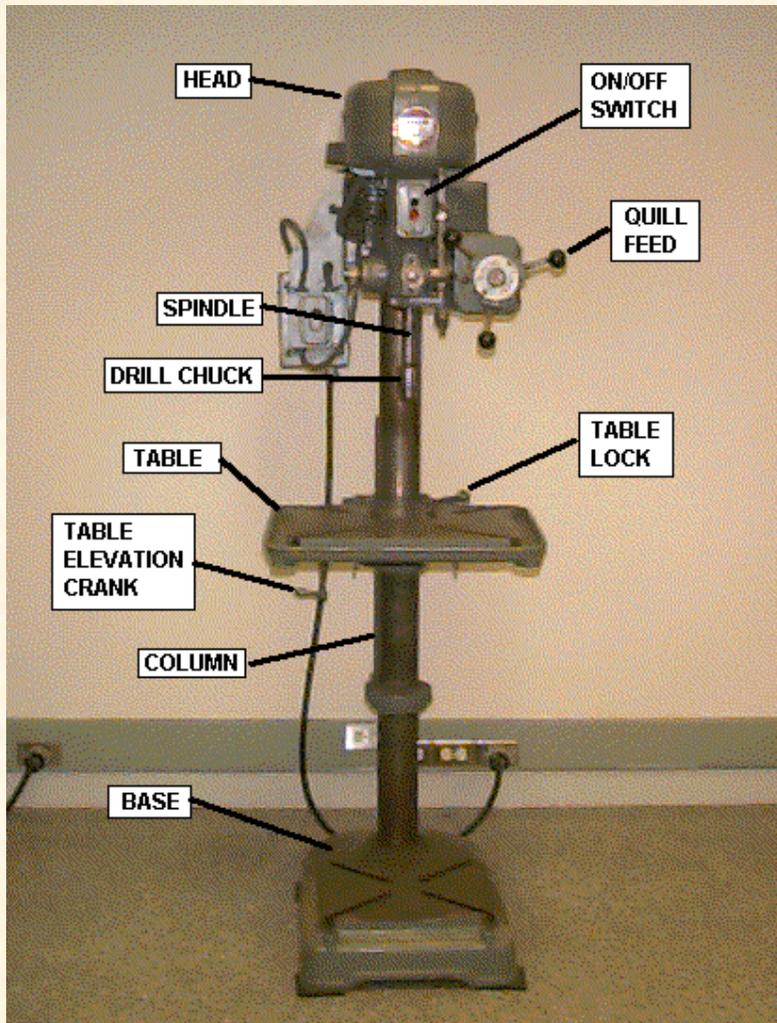
# EXAMPLES OF STATIONARY POWER TOOLS IN M&C



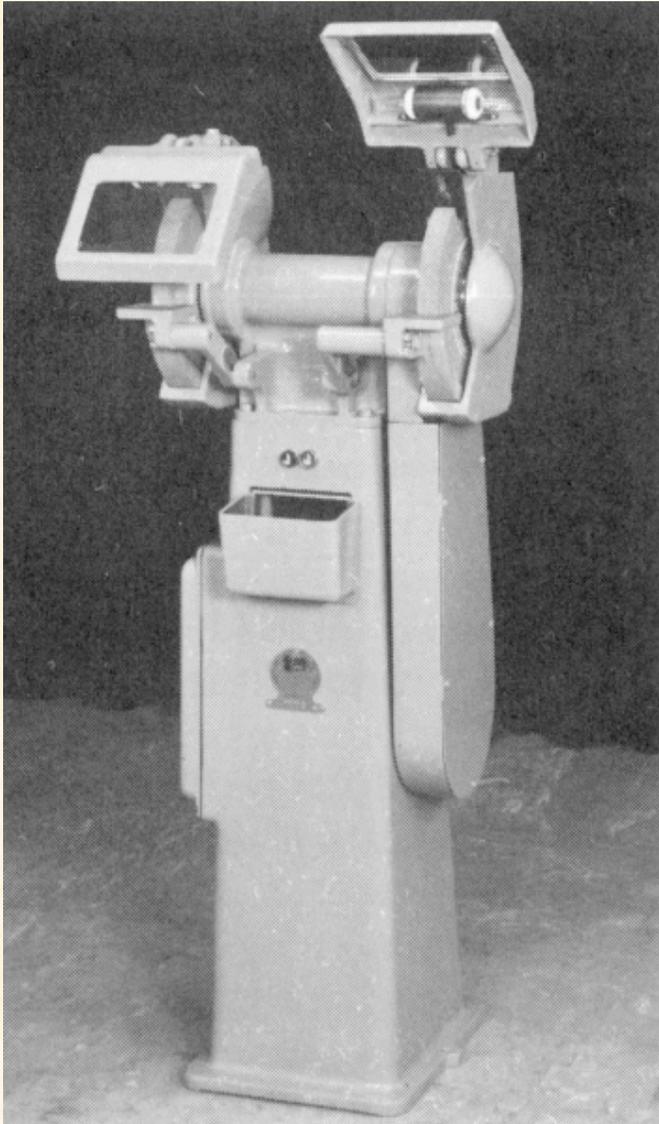
Adjust Guard  
No Gloves  
>3 teeth wide part



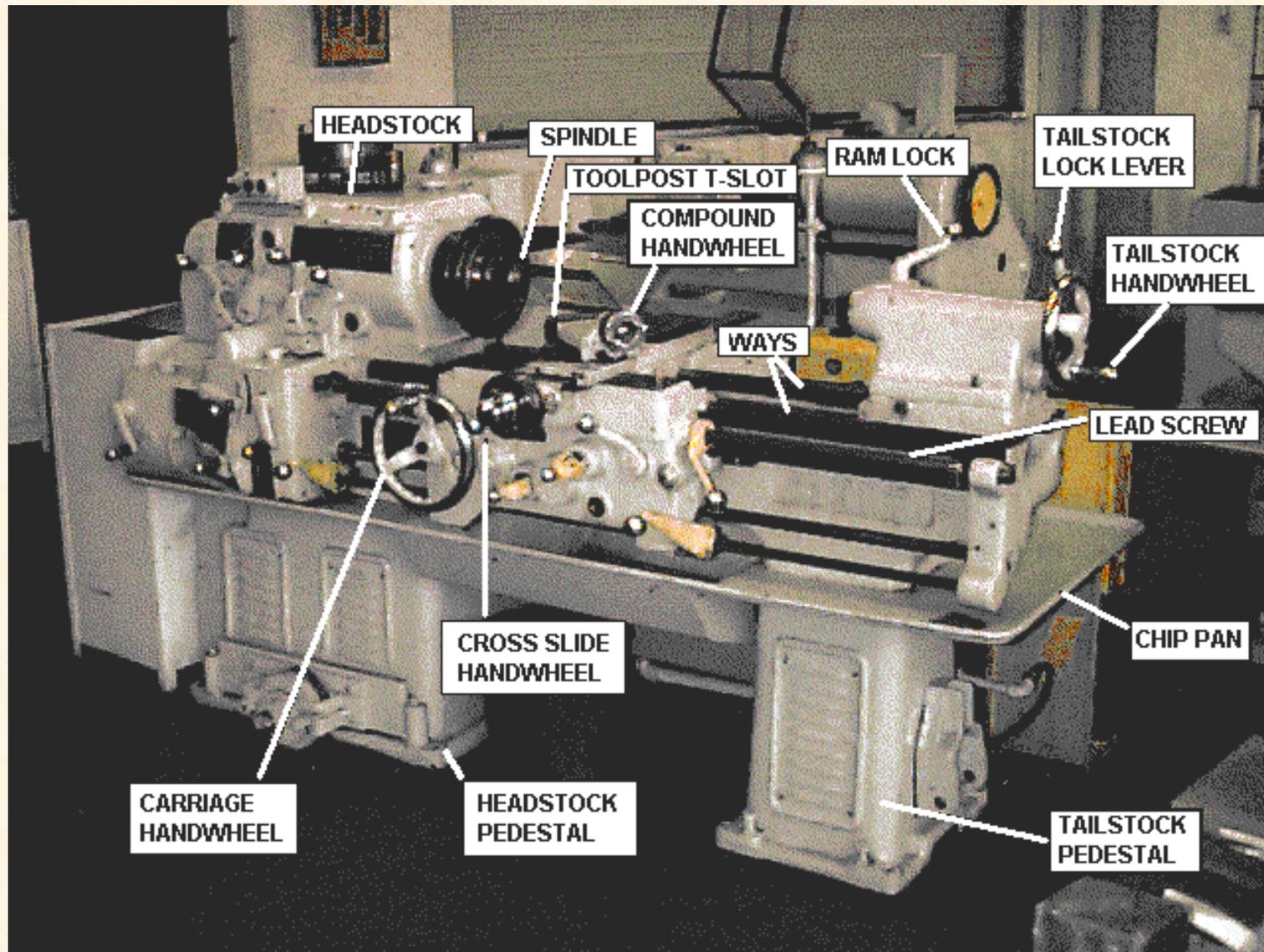
Adjust work rest  
No gloves



No gloves  
Adjust speed

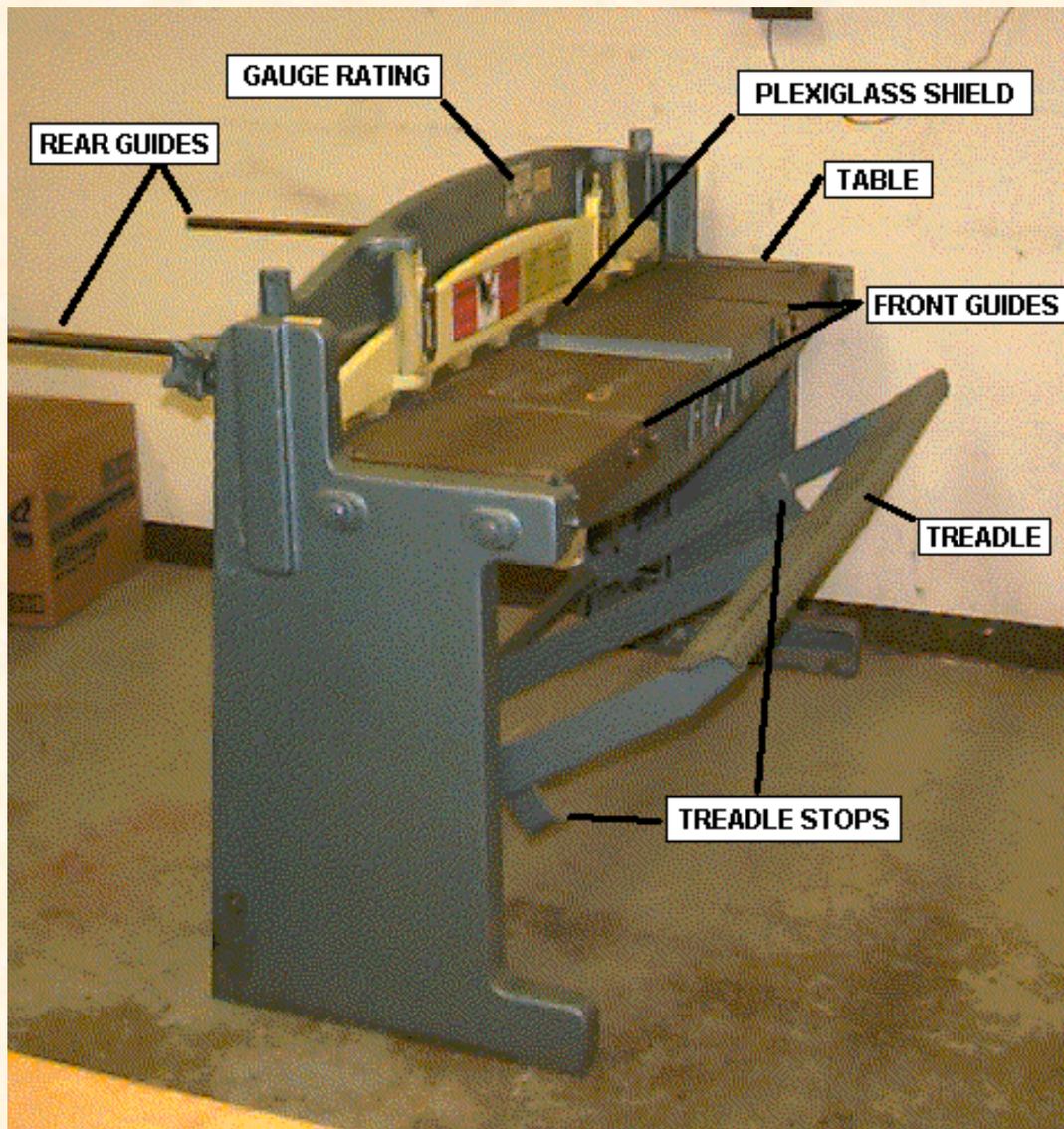


No gloves  
Adjust tool rest 1/8"  
Not for soft metals



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# 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*