



Machine Guarding

Pre-Industrial revolution

- Waterwheel was source of injuries
- Injuries taken as matter of course since infrequent
- Regarded as victim's own fault



Industrial Revolution

- Steam engine and electric motors invented
- Increased use of power driven machinery
- Workers caught by projecting set screws on line shafting
- Crushed flat by belts and pulleys
- Chewed inch by inch in gears and screw conveyors

Public Reaction

- Workers felt unguarded machines partly employers fault
- Newspapers printed details of gory cases
- Labor unions fought for guarding of hazardous machinery



Massachusetts 1877

- First law requiring guarding of hazardous machinery
- Outrage over young girls getting fingers cut off or mangled in adjacent gears of textile machines
- By 1900 most industrialized states had laws requiring machine guarding

Massachusetts Study 1939

- Studied injuries from 1933-1938
- Woodworking machines highest source of all machine injuries with 18.5%
- Saws 53% of those injuries (circular saws #1)



1949 Illinois

- 4,908 injuries due to machines requiring worker compensation in manufacturing or 21.7 % of total
- Little attention placed on safe placing of machines, emergency stops, and safe arrangement of machine controls

Safety Codes

- Safety Code for Mechanical Power Transmission Apparatus published in the 1940's by American Standards Association
- Very similar to OSHA 1910.219 std.
- Required forethought guarding vs. afterthought guarding for machine manufacturers

Machine Hazards

- **Motions**

Rotating: in-running nip points, spindles, shaft ends, couplings

Reciprocating: back-and-forth, up-and-down

Transverse: movement in a straight, continuous line

- **Operations**

Cutting: bandsaws, drills, milling machines, lathes

Punching: punch presses, notchers

Shearing: mechanical, pneumatic, or hydraulic shears

Bending: press brakes, tube benders, plate rolls



Principles of Machine Guarding

- Safe Distance - 7' rule of belts, etc.
- Guards - employees can't get in hazardous area through the use of barriers.
- Table 0-10 for guard opening design
- Devices - Presence sensing mats, pullbacks, light curtains, restrains

Table O-10

Distance of opening from the point of operation hazard (in inches)	Maximum width of opening (in inches)
• 1/2 to 1 1/2	• 1/4
• 1 1/2 to 2 1/2	• 3/8
• 2 1/2 to 3 1/2	• 1/2
• 3 1/2 to 5 1/2	• 5/8
• 5 1/2 to 6 1/2	• 3/4
• 6 1/2 to 7 1/2	• 7/8
• 7 1/2 to 12 1/2	• 1 1/4
• 12 1/2 to 15 1/2	• 1 1/2
• 15 1/2 to 17 1/2	• 1 7/8
• 17 1/2 to 31 1/2	• 2 1/8

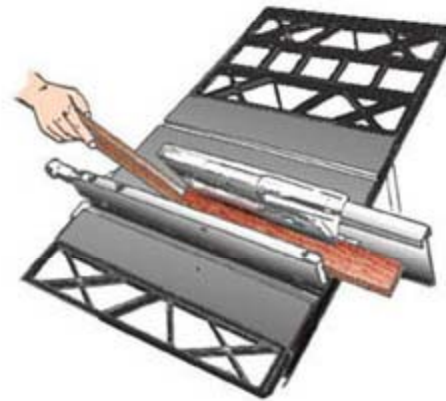
Types of Machine Safeguards

- Barriers and guards
- Mechanical or electronic devices that restrict contact, such as presence-sensing, restraining, or tripping devices, two-hand controls, or gates.
- Feeding and ejection methods that eliminate part handling in the hazard zone.



Definitions

- Point of Operation - work such as bending, punching, cutting on the material – P.O.O
- Nip point - location where machine pieces come together such as belts and a pulley, two in-running rollers, etc.



SIGCASE

- \$140,00
- Unguarded mandrel winder carriage
- Unguarded rotating shaft amputated worker arm when sleeve caught on a collar bolt



Wire or filament is wound around a rotating mandrel.

Guarding Most Cited

- Unguarded nip points, rotating parts
- No P.O.O. Guarding
- Tongue grinder 1/4"
- Work Rest 1/8"
- Unguarded pulleys
- Unguarded Vertical Belts
- Chain and sprocket not guarded
- Lower blade guard radial arm saw
- No punch press inspection records
- Unguarded horizontal belts

Shafts

- Hazard - caught in
- Unguarded rotating shafts can easily snagged clothing or hair
- Fixed Guards used



In-running Nip Points

- Belts and Pulleys
- Chains and Sprockets
- Gears
- In-running rollers
- Fixed Guards used the most



AMPUTATE LEP

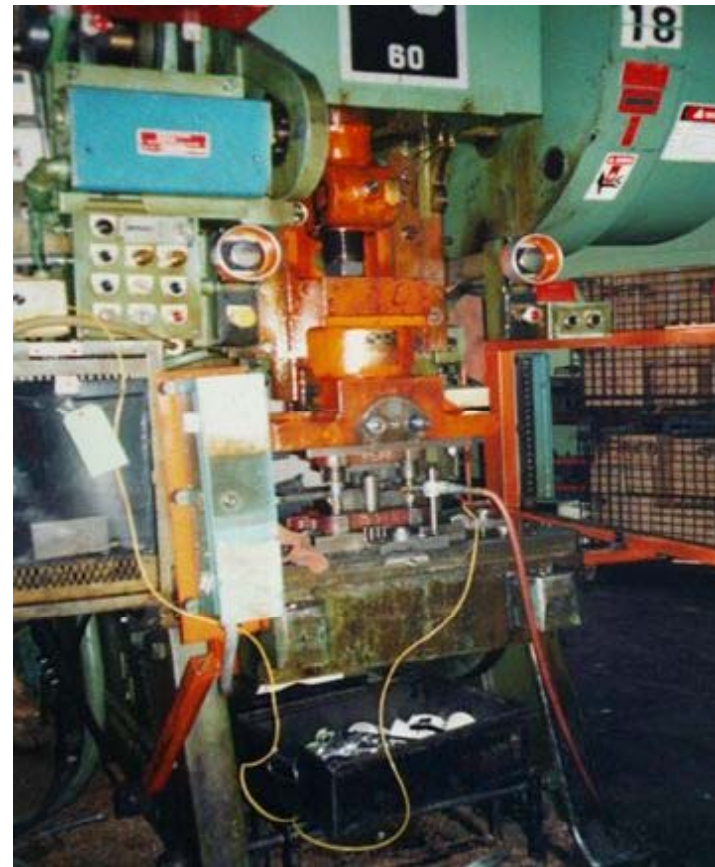
- CSHO will review OSHA 200 and 300 logs for all amputation injuries or hazards
- Limited to hazards associated with power presses, press brakes, saws, shears, slitters, and slicers, but may be expanded
- Inspections began March 26, 2002
- CPL 2-1.35

AMPUTATE LEP cont.

- CSHO will also evaluate employee exposures during the following:
 - Regular operation of machine
 - Setup/threading/preparation for operation of machine
 - Clearing jamups or upset conditions
 - Making adjustments while machine is operating
 - Cleaning of machine
 - Oiling/greasing of machine /machine parts
 - Scheduled/unscheduled maintenance
 - Lockout/tagout considerations

Punch Presses

- Point of Operation guarding required on front, back, sides
- Prevent Double trips - double trip took both hands of a worker in 1997
- Inspection, records, employee training



Horizontal Molding Presses

- Hazard is getting caught in horizontal ram
- Interlocked doors used
- Lockout for repairs



Press Brakes

- Employee reaches in to get stuck material
- Pullbacks, light curtains
- 12 inches safe distance per ANSI
- Opening too large
- 1984 - Eight fingers lost on hydraulic brake in IL



Shears

- Most come with guards
- Table O-10 distance must be used
- Guards bent back on this shear



Slicers

- Commonly used to slice meat and food
- Use rotary blade
- Guillotine cutters used in other industries
- Most injuries occur in restaurants and grocery stores



Circular Saws

- Lower blade guard required
- Clean saw and blade to prevent guard from sticking
- Aurora 1998 - 100+ stitches from saw



Vertical Bandsaw

- Adjustable guard to height of product
- Many injuries by guiding product into POO
- Handling cold slippery products will increase chances of slipping into POO



Horizontal Bandsaw

- Unused portion of blade need to be guarded
- No oversized blades used



Radial Arm Saw

- Lower blade awareness device
- Retracts to original position
- Does not extend past plane of table
- Anti-kick back device



Table Saws

- Top guard
- Magnetic restart
- Spreader
- Push sticks
- Anti-kick device



Chop Saw

- Lower blade awareness device
- Speed marked on saw
- Clean saw blades to prevent varnish/sap buildup



Food Mixers

- Requires cleaning of food
- Rotating blades
- Hand Amputation in 2002



Conveyors

- Emergency stops placed
- ANSI B20.1
- In-running nip points guarded by fixed guards
- This elevator section unguarded



Calendars and Rubber Mills

- Emergency trips placed so operator breaks emergency stop cable
- Less than a second to get pulled in



Take-up Coils/Reels

- Often slow moving
- Several amputations due getting caught in nip point
- Interlock guards or barriers used
- Unguarded fabric take-up roll nip point



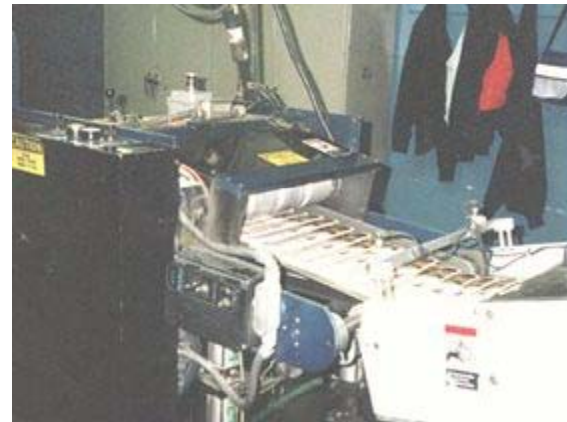
Fans

- Hazard - rotating blades
- Use wire mesh guard



Printing Press

- Fixed guard prevent entry to moving nip point when cleaning rolls
- Interlocked Guards for ink addition



Packaging Machines

- Multiple pinch points
- Employee reach in to clear jams
- Fixed guards or light curtains
- Lockout is needed
- 1999 - Aurora amputation



Drill Press

- Hair or clothing get caught in rotating shaft
- Automatic ones can guard against pinch point via 1/4 opening or presence sensing devices



Belt Sanders

- Hazard is nip point
- Use fixed guard



Bench Grinders

- Tongue Guard - 1/4”
- Work rest - 1/8”
- Blotters used
- Ring test
- Spindle speed
- Side nut guarded



Surface Grinder

- Half moon guard over wheel
- No feeding by hand
- Proper wheel speed



Lathes

- **Eye protection glasses with side-shields.**
- **Use Guard over chuck**
- **No loose sleeves, long hair, or jewelry**
- **Work is securely clamped in the chuck. Start the lathe at low speed and increase the speed gradually.**
- **Removing the chuck key immediately after use.**



Mixer/Blenders

- Fixed guard needed
- Worker reaches in to clean or clear jam and it restarts
- Must lockout
- 1995 - arm amputation was \$1M loss



Auctioned or Used Machines

- Often missing guards
- Employer must guard even if not designed with them
- Consult ANSI standard applicable



Training

- A description and identification of the hazards associated with the machine(s).
- A description of the safeguards and their functions and use.
- Instruction on how, and under what circumstances safeguards may be removed, and by whom.
- Instruction on what to do if a safeguard is missing, damaged, or inadequate



Summary

- If a four year could get hurt with a machine, an adult will eventually get hurt too.



Quiz

- Tongues on grinders must be adjusted to _____ inches from the wheel.
- List the guards required on a table saw.

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- If you were working 3 inches from the point operation, the guard opening would be _____ inches maximum.
 - Belts and pulleys under _____ feet would need guarding.

Resources

- Here is the OSHA eTool site.
- <http://www.osha.gov/SLTC/etools/machineguarding/index.html>
- http://www.orosha.org/subjects/machine_guarding.html has a video from Oregon OSHA on the topic.
- Every state has free consultation available to small employers.

Further

- This was prepared as a collaborative effort of several friends as a preliminary aid for anyone covering basic machine guarding.
- These are just some of the issues. A comprehensive job hazard analysis should be conducted for any task where someone can get hurt.
- This is not an official OSHA publication. Those will be on the OSHA.gov website.
- Newquist.john@dol.gov is my email if you see any errors.
- 312-353-5977 is my contact phone number.
- I want to thank Ron Stephens, Sharon H. Merri M. Misette K, Jim W. and Aaron P. for all their assistance in answering questions and providing insight to the many hazards in this sector.