Machine Safeguarding

Thanks to Jennifer Schneider for this presentation
ANSI/OSHA

Their Relationship to Each Other
and the World
ANSI
American National Standards Institute

- **Domestic**
  - Founded in 1918
  - Private non profit organization
  - Coordinates the U.S. voluntary consensus standards system and approves American National Standards
  - Only recognized system in the U.S. for establishing American National Standards
ANSI/OSHA Relationship

- Close cooperative relationship - each represented on each others committee
- OSHA often adopts ANSI standards
- Or under the General Duty Clause ANSI standards can be incorporated and enforced
(4) Nothing in this Act shall be construed to supersede or in any manner affect any workmen’s compensation law or to enlarge or diminish or affect in any other manner the common law or statutory rights, duties, or liabilities of employers or employees under any law with respect to injuries, diseases, or death of employees arising out of, or in the course of, employment.
Sec. 5 (a) Each employer

(1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;

(2) shall comply with occupational safety and health standards promulgated under this Act.

(b) Each employee shall comply with occupational safety and health standards rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.
American National Standards on Safety
Requirements for Construction, Care, and Use of Machine Tools

- ANSI B11.1-1988
- ANSI B11.2-1982 Mechanical Power Presses
- ANSI B11.3-1982 Hydraulic Power Presses
- ANSI B11.4-1983 Power Press Brakes
- ANSI B11.5-1988 Shears
- ANSI B11.6-1988 Iron Workers
- ANSI B11.7-1985 Lathes
- ANSI B11.7a-1987 Cold Headers and Cold Formers
- ANSI B11.7a-1987 (Supplement to ANSI B11.7-1985)
- ANSI B11.8-1983 Drilling, Milling, and Boring Machines
- ANSI B11.9-1975 Grinding Machines
- ANSI B11.10-1990 Metal Sawing Machines
- ANSI B11.11-1985 Gear Cutting Machines
American National Standards on Safety
Requirements for Construction, Care, and Use of Machine Tools

- ANSI B11.12-1983  Roll Forming and Roll Bending Machines
- ANSI B11.14-1983  Coil Slitting Machines/Systems
- ANSI B11.15-1984  Pipe, Tube, and Shape Bending Machines
- ANSI B11.16-1988  Metal Powder Compacting Presses
- ANSI B11.17-1982  Horizontal Hydraulic Extrusion Presses
- ANSI B11.18-1985  Machinery and Machine Systems for the Processing of Coiled Strip, Sheet, and Plate
- ANSI B11.19-      Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards

- Manufacturing Systems/Cells
General Requirements for All Machines

Machine Guarding

- (1) Types of Guarding. One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips and sparks. Example of guarding methods are - barrier guards, two-hand tripping devices, electronic safety devices, etc.
Machine Guarding

- (2) General requirements for machine guards. Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazard in itself.
Machine Guarding

- (3) Point-of-operation guarding.
  - (i) Point of operation is the area on a machine where work is actually performed upon the material being processed.
  - (ii) The point of operation of machines whose operation exposes an employee to injury shall be guarded. The guarding device shall be in conformity with any appropriate standards therefore; or, in the absence of applicable specific standard, shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle.
Machine Guarding

– (3) Point-of-operation guarding.

  (iii) Special hand tools for placing and removing material shall be such as to permit easy handling of material without the operator placing a hand in the danger zone. Such tools shall not be in lieu of other guarding required by this section, but can only be used to supplement protection provided.
This Section Covers

(a) Most, with some exceptions, all types of power-transmission belts.

(b) Prime-mover guards (Such As)

1. Flywheels
2. Cranks and connecting rods
3. Rods, Shafts and Shaft Ends
4. Power-transmission apparatus
   located in basements
5. Pulleys
6. Belt, rope and chain drives
7. Overhead Horizontal belts
This Section Covers:

(2) Wood Guards. (I) Wood guards may be used in the woodworking and chemical industries, in industries where the presence of fumes or where manufacturing conditions would cause the rapid deterioration of metal guards; also in construction work and in locations outdoors where extreme cold or extreme heat make metal guards an railing undesirable. In all other industries, wood guards shall not be used.
Basic Safety Requirements for Machinery (Among Other Things)

- Safeguarding
- Controls
- Disconnect
- Starter
- Cover
5 Concerns on Any Machine

- Safeguarding - guard, device, method
- Controls - control reliability
- Disconnect - lockable in off position
- Starter - magnetic (for drop-out protection)
- Covers - rotating components covered to 7 ft. from floor or from working platform
Types of Machines

- Metal fabricating - power presses, press brakes, shears, iron workers, etc.
- Metal turning - lathes, mills, drills, boring machines, grinders, saws, etc.
- Other Machines - robots, textile, assembly, packaging, special, etc.
PURPOSE: This directive describes policies and procedures for implementing a National Emphasis Program (NEP) to reduce and eliminate the workplace incidence of hazards associated with mechanical power presses.
National Emphasis Program on Mechanical Power Presses

- 10 Manufacturing industries by SIC code: plus other SIC’s as deemed necessary
  - #3469 stamping
  - #3444 sheet metal
  - #3442 metal doors
  - #3441 fabricated steel
  - #3429 hardware
    - #2542 manufactured furniture
    - #3714 motor vehicle parts
    - #3499 misc. metal products
    - #3443 boiler shops
    - #3496 wire products
National Emphasis Program on Mechanical Power Presses

- 1 Million workers in 22,000 companies with a total of 300,000 mechanical power presses
  - total of 650 amputations in 1994 (BLS 94) from all mechanical sources which was
    - 10% of all amputations in manufacturing
    - 2,650 violations in 3 years
    - 80% serious, willful, repeat
Safety Standards & Regulations

- 1910.217- Mechanical power presses (B11.1)
- 1910.212- General requirements for all machines
- 1910.219- Mechanical power transmission apparatus (B15.1)
FULL REVOLUTION

Press makes one full revolution after being tripped.

TO IDENTIFY:
Look for clutch operating rod usually on right side of press
FULL REVOLUTION CLUTCH INTRODUCTION

- Mechanical Mechanism
  Pin (Bolt) Most Common 1/4-60 Tons
  Jaw (Collar) 75-300 Tons (All Sizes On Niagara)
  Key (Rolling Key) 20-200 Tons (Later Bliss & Minster Presses)

- Above Engage Into Flywheel Or Gear That's Rotating
Single Stroke Capability

- Single Stroke Mechanism
  OR
- Single Stroke Trip Control System
- (only exception is guarded press dedicated to continuous)
  – Simple test--hold initiating means operated while in single stroke mode
PART REVOLUTION

Press can start and stop at any part of the revolution.

TO IDENTIFY:
Look for air line on air clutch presses or look for hand lever or treadle on older presses and press brakes with mechanical friction clutches.
FOOT SWITCHES

Minimum Protection of Top and Sides

Newer Models Have Added Protection of Front Flap
Safeguarding

- Employer’s responsibility
- guards
- devices
- auxiliary equipment
- not required if hazard is 1/4 inch or less
Safeguarding

- Guards - prevent (die enclosure, fixed, interlocked, adjustable)
- Devices - control (presence sensing, pull back, restraint, gates, 2 hand control or trip)
  - access to point of operation
Safeguarding mechanical power presses

- Guards--primary operations
- Devices--secondary operations-- by controlling operator or machine or both
Guard requirements

- Must be designed, constructed, applied, adjusted & maintained to meet the following:
  - openings of table O-10
  - no pinch point between guard and slide
  - utilize fasteners not readily removable
  - facilitate inspection
  - maximum visibility
A guard opening scale or tape can be used to measure opening.
Types of barrier guards

- Die enclosure - becomes part of die, need guard for each die
- fixed - may have openings but is not adjustable - ok for dedicated press/die applications
- adjustable - accommodates different size coil widths & thickness'
- interlocked - prevents or stops motion when interlock is open
Interlocking Guards

- Not mandatory for all hinged or movable guard sections to be interlocked
- Interlocked Guard sections must:
  - prevent the cycle (when open)
  - stop the cycle (when opened during cycle—must not allow injury)
Point of Operation Devices

- Presence sensing
- pull backs
- restraints
- gates or movable barriers
- two hand control
- two hand trip
Presence sensing

- prevent cycle initiation
- stop the downstroke

if sensing field is obstructed
Light Curtain

- Plane of light creates a sensing field
  - most use the infra red spectrum modulated to ignore other sources of light
  - units available from 7 inches to 70 inches in height
  - emitter and receiver from 2 to 65 feet apart
  - mirrors for multisided protection
Presence sensing devices

- Cannot be used:
  - on machines with full revolution clutches
  - as a tripping means to initiate a slide motion

  (PSDI- self tripping)
Presence sensing devices

- Can be muted out (turned off) on the upstroke for these purposes:
  - parts ejection
  - circuit checking
  - material feeding
Light curtain

- Must be mounted at a safe distance from the nearest point of operation hazard
- “safety distance”- based upon machine’s stopping ability
- “penetration distance”- based upon light curtain minimum object sensitivity
Presence sensing devices

- 217 (c) (3) (iii) (a) (f):
- ‘guards shall be used to protect all entry to the point of operation not protected by the presence sensing device’
- Precautions: radio frequency (operator must be detected), muting (non haz portion of stroke) and blanking (last resort)
Pullbacks

- Most often used for secondary operation where the concern is repeat stroke of press or inadvertent operation
  - pull operators hands out as die closes
  - wristlets for each hand
  - operated by slide or upper die
  - each operator must have a pullback
  - inspected every time a change
  - inspected on a regular basis (paragraph e).
Restraints

- Same requirements as pullbacks
- should always be adjusted so that the operator cannot reach the Point of operation hazard
- piece part must be long enough to hold onto at one end
- or must use a hand feeding tool to feed small parts
Gates (movable barriers)

- Type A - protects the operator during the entire press stroke (won’t open until the entire crankshaft rotation is completed)
- Type B - protects the operator during the downstroke only (opens before the crankshaft rotation is complete)
Two hand control as a safeguarding device

- Ring guards or fabricated shields
- require both hands or concurrent operation
- holding time
- anti-repeat
- interrupted stroke protection
- fixed in place at a minimum safety distance
- multiple operators multiple sets
- inspected according to paragraph e
Two hand trip as a safeguarding device

- Ring guards or fabricated shields
- require both hands
- concurrent operation
- anti-repeat
- multiple operators multiple sets
- fixed position at a safe distance from the point of operation
- inspected according to paragraph e
For quick easy reference, refer to the chart below. First determine the strokes per minute (SPM-RPM) when running in continuous mode and also the number of engagement points in clutch mechanism. Then determine the “SAFETY DISTANCE” from the formula or the following chart.

Example: If a press runs at 150 SPM and has 3 engagement points, the Safety Distance is 21 inches.
Handfeeding tools

- Are not considered a primary safeguard
- but are classified as secondary/auxiliary means of safeguarding
Safeguarding Devices

- That require side and back barriers to protect others in the machine area
  - 2 hand trip
  - 2 hand control
  - pullbacks and restraints
  - gates
  - presence sensing
Safeguarding Summary

- Min. OSHA requirement is for one primary safeguarding means
- for secondary operations, some use 2 safeguarding devices due to the strong points of each method (i.e., to make sure hands are in a safe position when machine is being actuated)
- for additional protection, secondary or auxiliary means may be needed to protect others in the area.
Repeat Strokes or Unintended Cycles

- Can occur on either full revolution or part revolution clutch presses because of 3 problems:
  - electrical (control reliability)
  - pneumatic (control reliability)
  - mechanical (maintenance)
Control Reliability

- ‘Critical Component Failure’ -- any single electrical or pneumatic component
  - controls made before 1971 unlikely to comply
  - 1971-1975 might comply
  - 1975+ probably comply
Control Reliability

- B(7)--detailed requirements for clutch control
- b(13)--control reliability
- b(8)(vi)--control circuit
Brake Monitoring

- Monitors each stroke to automatically prevent additional strokes if:
  - stopping time or braking distance has deteriorated to an unsafe point
  - distance: topstop overrun
  - time: motion detection
Electrical

- Disconnect
- Starter
- Transformer
- Ground
- Control Circuit
Safety Blocks (Die Blocks)

- Used whenever dies are being adjusted or repaired while in the press
- Safety blocks should be interlocked to the main motor of the press
Power Press Brakes

Safety Requirements for
Construction, Care, and Use
Power Press Brakes

- Light curtains (low to high production w/ small to large pieceparts)
- 2 hand control (low, with any size piece parts)
- pullbacks (high, with any size pieceparts)
- restraints (high, with medium to large pieceparts)
Considerations on Press Brakes

- Light Curtains:
  - Interface properly to:
    - mechanical friction
    - air clutch
    - hydraulic
    - hydra-mechanical

- warning signs
- color coding
- proper handling of piecepart
- hand tools
TWO-HAND DOWN

FOOT-THRU
Other considerations for Press Brakes

- Operator slipping clutch or inching ram to bottom of stroke for slow bending
- unused portion of die must be guarded or die cut to the length of the material
- protect rear of machine by:
  - cable with interlock & warning sign
  - pressure sensitive mat
  - single beam w/latch out
  - guard
DANGER

Do not operate this machine until you read and understand the following safety precautions.

Never operate this machine unless you feel you have been fully trained and have received and understand all operating instructions.

Never place any part of your body in the die area.

Never place any part of your body where it can be struck or crushed by part movement.

Never operate this machine without the use of a guard or safety device that will always protect you from bodily injury.

Always use hand tools for feeding and retrieving material from the point of operation or any other hazardous part of the machine.

Never work on this machine unless power is off, flywheel is at rest, safety blocks are used between dies and ram, and all energy (electrical, air, hydraulic, etc.) are in a zero state.

Closing Ram and Die
Will result in loss of limbs or bodily injury if placed in machine.

Never place your hands or any part of your body in this machine.

ROCKFORD SYSTEMS, INC.
ROCKFORD, ILLINOIS 61109

DO NOT REMOVE OR COVER THIS SIGN - SEE BACK FOR MOUNTING

KSC-080
NHID/HOOD B11.3-1998

- Employer to provide correct type dies and hand tools
- supervisor to ensure employees do not reach in dies
- constructor of safe material position gauges
- operator self responsibility
Shears

Safety Requirements for Construction, Care, and Use
Shear Safeguarding

- Barrier Guards
- A or B type gates
- Pullbacks/restraints
- 2 hand controls
- Awareness-- barriers, devices, signals
Safeguarding for Metal Turning Machines as Referenced in the ANSI B11 Series Standards
Metal Turning Machines

- Lathes
- drills
- mills
- bores
- saws
- grinders
- gear cutting
- SWARF: chips, coolant, lubes, sparks, debris
The Point of operation on manual machines does not require safeguarding.

Semiautomatic do require it, because a tool trapping space is created.

All cutting turning machines must have a chip shield; ro prevent swarf from being thrown at the operator or causing a hazard in the work area.

Also require operator protection from rotating chucks.
Shields

- Do not replace PPE
- can’t create hazard such as pinch points, sharp edges, or fire hazards
Spring Loaded Chuck Wrench

- To prevent chuck wrench from being left in the chuck
- even more important with machines with large chucks
Safeguarding Grinders

OSHA 1910.215 Abrasive Wheel Machinery
OSHA 1910.94 Ventilation
Safeguarding for Grinding Machines

as

Referenced in the ANSI B11.9 Series Standards
90° Maximum Opening

65° From Work Tool Rest to Tongue Guard
Ring Test

- Visual Inspection
- Dry & Free from Dust
- Tap with Nonmetallic Tool
- Clear Ring Tone
Saws covered by B11.10

- Horizontal cutoff band saws
- Vertical Cutoff
- Vertical Contour
- Circular Blade
- Hacksaws
Safeguarding Point of Operation

- **Guard**: covers that portion of the blade that is not involved in the cutting
- **Barrier**: restricts accidental entry into the area
- **Awareness Device**: warns operator that he has or is about to enter area
- **Device**: barrier other than a guard designed to minimize unintentional entry
Roll - Forming and Roll - Bending Machines

Safety Requirements for Construction, Care, and Use
Pipe, Tube, and Shape Bending Machines

Safety Requirements for Construction, Care, and Use
Safeguarding - ANSI B11.19

- When referenced by other B11 machine tool standards
Safety Mat Device

- Must detect and respond to the presence or absence of the operator or others
- should be large enough to prevent entry
Awareness

- Devices or Signals to warn operator or others of present or approaching hazard
  - instruction
  - training
  - signs
Safe opening

- Limits access to hazard by size of opening or by closing off access when piece is in place
Safe position of controls

- Operator must be at controls stations which is anchored at a sufficient distance so that he/she cannot reach the hazard area during the hazardous portion of the machine cycle or until hazardous motion has ceased
Safe holding

- Piece restricts operator and others from entering hazard area
- Size, shape, weight of piece requires operator to support it with both hands
- May require supplemental safeguarding for protection of operator or others in area
Safe Control Position

- Safe holding
- safe opening
- safe distance
- Need training and supervision to prevent tendency of operators to circumvent these measures
Hand Tools

- Must not shatter if caught in tooling as machine cycles
- Sufficient in length and shape to keep hands outside of hazard
- Of ergonomic design to minimize stress on body
Employers must:

- Ensure that employees know meanings of signs, tags and color codes
- Be aware of language differences and color blindness
- Use international symbols and pictograms where possible
Riveter and Spot welder safeguarding

- Mechanically senses obstructions, such as a finger
- probe must be shaped for each piecepart configuration
- sparks from welder
Safeguarding Precautions

- When selecting safeguarding means for any machine the following should be considered:
  - Complete a risk assessment
  - Completely review the appropriate OSHA regulation and ANSI standard as they apply
  - Consider all production requirements
  - If the hazard exists it must be abated