Machine Safeguarding Overview

OSHA 1910.212 - General Requirements for all B11 Metalworking Machines

OSHA SubPart O - Machinery and Machine Safeguarding Regulations

ANSI B11.19 - Five Basic Safeguarding Methods used to protect personnel

Awareness Barriers; how they are used for lower level hazard exposures

Five Basic MSG Concerns; Safeguarding, Controls, Starter, Disconnect, Covers

Rotating Components must be covered to at least 7' from the floor/platform

Presence Sensing Safeguarding Devices - six common categories of PSSD's

Infra-red Light Curtains; POO and Perimeter-type; muting and blanking

Two-hand Actuators for cycle-actuation and possibly as a Safeguarding Means

OSHA Safety Distance for Two-hand Controls and Infra-red Light Curtains

Function-testing Light Curtains before every operating shift (test rods)

Safety Blocks; when they are required on mechanical power presses

Press Brake Safeguarding methods including Laser-based devices

Point of Operation Guards; Over, Under, Through, Around (O.U.T.A.)

Use of OSHA and ANSI Guard Opening Scales (for allowed guard openings)

Guard Interlocks and Function-testing them per applicable ANSI Standards

OSHA 1910.215 (and ANSI Standards) for Grinders and Abrasive Wheels

Laser Scanners vs. Pressure-sensitive Mats for Area Safeguarding

Drop-probe (ring-drop, halo) devices for riveters and spot welders

Robot Safeguarding, LOTO, and NFPA79 Electrical Standards for Machines

Shields (chuck shields and chip/coolant shields) for Lathes, Drills, Mills, etc.

Code of Federal Regulations OSHA Sub-Part O

Machinery and Machine Safeguarding

1910.211 Definitions  www.rockfordsystems.com

1910.212 General requirements for all machines

1910.213 Woodworking machinery (ANSI 01.1)

1910.214 Cooperage machinery (barrel making)

1910.215 Abrasive wheel machinery

1910.216 Mills and calendars (rubber and plastics)

1910.217 Mechanical Power Presses (ANSI B11.1)

1910.218 Forging machines (presses and hammers)

1910.219 Mechanical power transmission apparatus

Severity of Injury:

Minor 3 6 10
Serious 4 6
Major

Probability of Injury:

Unlikely 2 4 6
Possible Probable Certain

Frequency of Exposure:

Seldom 1 2
Occasional

High 4 6

Medium 4

Low

Severity + Probability + Frequency = Level of Exposure to Hazards

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ANSI B11.TR3-2000 Risk Assessment/Risk Reduction

OSHA 1910.212 General requirements (a) (1)

protect operator & other employees in the machine area from hazards

- point of operation
- ingoing nip points
- rotating parts
- flying chips & sparks

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eamples of safeguarding methods: barrier guards, two-hand actuators, electronic safety devices, etc.

5 Safeguarding Methods in ANSI B11.19  www.rockfordsystems.com

Guards: Prevent access to Point of Operation

Devices: Control access to Point of Operation

Distance: Large piecepart size/shape prevents Operator from reaching the P.O.O.

Location: (Safe Position of Controls) Operator not required to be in the Point of Operation hazard area

Safe Opening: ¼” or less opening at P.O.O.

Level of (Hazard) Exposure Determines Safeguarding

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Risk assessment and risk reduction - Equally in critical, evanescent and reflect

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Risk assessment and risk reduction - Equally in critical, evanescent and reflect
5 concerns on any machine

Safeguarding - guard, device, method
Controls - control reliability
Disconnect and other LOTO devices
Starter - magnetic (drop-out protection)
Covers - rotating components covered to (7 feet - OSHA) from floor/working platform (8 feet - ANSI) (10 feet – European Stds.)

Presence Sensing Safeguarding Devices

- Safety Light Curtains / Screens
- Single and Multiple Safety Beams
- Safety Mat Systems
- Area Scanning Systems
- Radio Frequency (capacitance)
- Drop Probe (Ring Drop) devices

Light Curtain – Presence Sensing Devices

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Light Curtain can only be used on machines that can stop consistently and immediately anywhere in their stroke or cycle without damaging: machine - tooling - work or creating another hazard

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Area Scanning Systems

Laser Scanners

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Light Curtain - Single or Continuous

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Two-hand control for Cycle Actuation / Safeguarding
Light Curtain Muting (c)(3)(iii)(d)
Bypasses output signal of P.S.D. on upstroke
Muting used for:
1) parts ejection
2) circuit checking
3) material feeding
Muting done in timing circuit of press control

Larger "dead-zone" is at TOP instead of the BOTTOM of this Light Curtain

3-sided Light Curtain includes the coil feed

3-sided Light Curtain includes the coil feed

Front-surface mirrors reduce range about 12%
Stainless-steel mirrors about 18% - shatterproof

Don’t Blank too many

2-sided Perimeter Light Curtain
2-hand Controls rules to be a SAFEGUARDING DEVICE:
- Protect from unintended operation,
- Anti-Repeat, Concurrent ½ sec max,
- Holding-time, Interrupted-stroke
- Anchored at Safety Distance, etc.

OSHA Safety Distance Formula
2-Hand Control or Light Curtain

Stopping Time in seconds at 90° crankshaft position
x 63 inches per second (hand speed constant)
= minimum safety distance in inches

\[ 0.200 \times 63 = 12.6” \text{ Safety Distance} \]

Light Curtains
FLYING OBJECTS
NO PROTECTION

“No-Force Actuators” mounted on swivels for ERGO
when Operators are using a 2 HC for high-repetition

Guard / Light Curtain Combination

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Function Testing Light Curtains before every operating shift

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Function Test Checklist steps on this plastic-laminated quick-reference guide are generic. Refer to specific procedures from the manufacturer of your light curtain.

MOS = Minimum Object Sensitivity differs for each make/model of Light Curtain.

Blankers increase Safety Distance

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Don’t leave the KEYS in Light Curtains or in Press Mode Selectors

Red: obstructed  
Amber: blanking  
Green: clear

Light Curtains should be only be installed, checked out, and maintained by a “Qualified Person” - a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.” ANSI B30.2-1983

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ANSI B11.1-2009 - lots of new information on Safety Blocks

Interlocked Safety Block

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ANSI B11.1-2001 8.3.1 Guards and devices must be checked...

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MINSTER Power Press SAFETY MANUAL

The Minster Machine Company  
(419) 628-2331 Manual #805D  
Minster, OH www.minster.com

National Safety Council  
(800) 621-3433 #129760000  
Roselle, IL www.nsc.org
ANSI B11.3-2012 Press Brake Safeguarding

Light Curtain - Press Brake bending operation

LazerSafe
Safeguarding System
ONLY FOR HYDRAULIC PRESS BRAKES

Light Curtain and Manual Gate protect Operator
Lexan Guarding keeps other people out of POO

Light Curtain and Two-hand Control protect Operator

Point of Operation Guard Requirements
OSHA 1910.217(c)(2) and ANSI B11.1-2009(8)(5)

- can’t reach through, over, under, around
- meets Table 0-10 for openings and distances
- no pinch points between guard & moving parts
- good visibility into the point of operation
- fasteners not readily removable (tool required)
- *materials strong enough to protect people
  *free from sharp edges that could injure people

Robotically-fed Press Brake with Perimeter Light Curtain
Interlocked Perimeter Guard

Blanking required
No Blanking required

Feed line height adjustable height table
Can’t reach over or under LC
Can reach over or under LC
OSHA Guard Opening Scale – 1948
Liberty Mutual and ANSI Standard writing committee

ANSI Guard Opening Scale – 1996
Liberty Mutual and ANSI Standard writing committee

Over, Under, Around, Through?

Guard Opening Scale Comparison

Newer Guard Interlock Switches
KEY geometry makes it difficult to defeat
KEY forces a make/break of electrical contacts

Risk Assessment for Interlock Reliability

§ Minor Risk – Cat. 1
§ Serious Risk – Cat. 2
§ Major Risk – Cat. 3
§ Fatal Risk – Cat. 3

Function Testing
Point of operation Guard
2 Reasons to “Function-test” Guard Interlocks before starting each new operating shift:
1) to make sure the interlock WORKS
2) to make sure it has NOT been CHEATED

OTHER FTC’s: Light Curtains, 2-Hand Controls, Perimeter Guards, etc.
ANSI B7.1-2000 Abrasive Wheels
ANSI B11.9-2010 Grinding Machines

1/4" maximum opening
Both ANSI Standards
Covered spindle end/nut
OSHA 1910.215 (a)(2)(i)
Direction Arrow
Both ANSI Standards

1/8" maximum opening for Work Rest
#1 OSHA Machine Safeguarding violation-every state in the U.S.A.
OSHA 1910.215 (a)(4)

Area Laser Scanners on AGV’s

Area Guarding:
2 Safety and 2 Warning Zones, horizontal mounting
Access Guarding:
2 Safety Zones, vertical mounting, using contour-as-reference

Area Laser Scanners

Area Guarding:
1 Safety and 1 Warning Zone, horizontal mounting
Access Guarding:
1 Safety Zone, vertical mounting, using contour-as-reference

Area Laser Scanners

L-shaped Mats on a Tube Bender

Two-hand Control on floor pedestal

YES

NO

Mats must be fastened to floor to prevent moving them too close to the hazard area

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"Drop-Probe" Devices
"Ring-drop" Devices
"Halo" Devices
ANSI B11.19 - 2010 8.7
Also see ANSI B154.1-1995
Rivet Setting Equipment

Mechanically verifies the absence of hand or fingers in Point of Operation

Riveters, Spot Welders, Staplers, Stakers, Eyeletters, Terminators, Dinkers, Clickers

Combination of Safeguarding Devices

Grab-wire E-stop cables

Material Handling for Laser-cutting system

Laser Scanner

Grab-wire E-stop cables

Laser-cutter System

3-sided Perimeter Light Curtain

Awareness Barrier Floor Markings

Radio Frequency and Lexan Guards

Riveter with a Drop-Probe

Solenoid

Locating Point of Operation

Interlock Light Curtain

Mechanically verifies the absence of hand or fingers in Point of Operation

Combination of Safeguarding Devices

Riveter with a Drop-Probe

Material Handling for Laser-cutting system

Point of Operation Light Curtain

Pressure sensitive mat operated Actuator interlock

Grab-wire E-stop cable

Point of Operation Light Curtain

Combination of Safeguarding Devices

Riveter with a Drop-Probe

Material Handling for Laser-cutting system

Point of Operation Light Curtain

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Grab-wire E-stop cable

Point of Operation Light Curtain

Combination of Safeguarding Devices
When R/A shows that A/B are not enough:

R/A Risk Assessment

A/B Awareness Barrier

Perimeter Guarding for Auxiliary Equipment

Danger and Warning Signs

Polycarbonate “Vision Panels”

ANSI B11.19-2010 Annex E “Considerations for Transparent Guards”
Rope Pull Cable type of E-Stop requires reset when tripped

Cable runs longer than 20' may need a switch on BOTH ends

Belt Conveyor

ANSI B20.1-2006 5.11.2 (1)
Conveyors that start up automatically require an Audible or Visual Warning Device that can be clearly seen or heard at all points that people may be present.

ANSI B20.1-2006 5.11.4
Manual reset or start at the location where the Emergency Stop was initiated required to resume operation.

Red E-Stop Cables

This meets NFPA 79
Electrical Standard for Industrial Machinery

EMERGENCY STOP
Red Button    Engaged
Yellow Background
Manual Latch
Disengaged

Article 119.7 Electrical Safety Program

(A) General.
The employer shall implement and document an overall electrical safety program that directs activity appropriate for the voltage, energy level, and circuit conditions.

Source: Littlefuse
#1 Hazard - starting lathe with key in chuck

Sprung Loaded Chuck-Wrench

to prevent wrench from being left in chuck

Chip/Coolant Shield with built-in Interlock

Hinged Chuck Shield with built-in Interlock

Releasing and Lifting

Telescopic stainless-steel sleeves cover horizontal rotating components

Universal Ball & Socket Shields