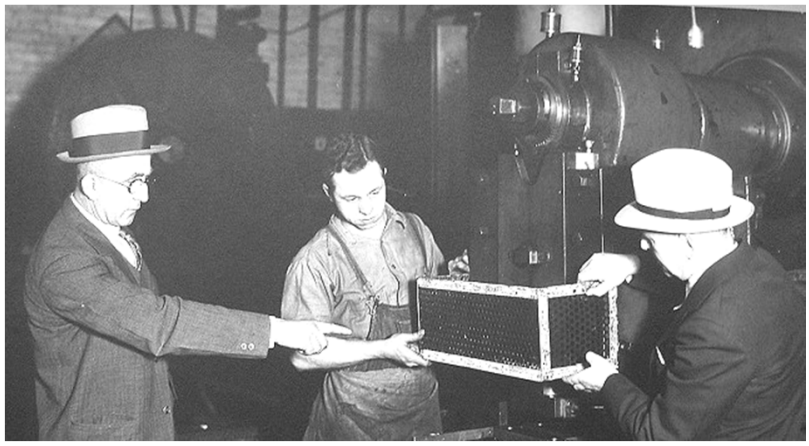
LOCKOUT/TAGOUT

Hazardous Energy Control

Instructor Guide

MACHINE SAFEGUARDING



DEPARTMENT OF CONSUMER & BUSINESS SERVICES

Presented by the Public Education Section
Oregon OSHA
Department of Consumer and Business Services

Oregon OSHA
PUBLIC EDUCATION

Oregon OSHA Public Education Mission:

We provide knowledge and tools to advance
self-sufficiency in workplace safety and health

Consultative Services:

- Offers no-cost on-site assistance to help Oregon employers recognize and correct safety and health problems

Enforcement:

- Inspects places of employment for occupational safety and health rule violations and investigates complaints and accidents

Public Education and Conferences:

- Presents educational opportunities to employers and employees on a variety of safety and health topics throughout the state

Standards and Technical Resources:

- Develops, interprets, and provides technical advice on safety and health standards
- Publishes booklets, pamphlets, and other materials to assist in the implementation of safety and health rules

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Salem Central Office:
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Introduction

Many serious injuries and fatalities have occurred when someone thought a machine was safely turned off and/or assumed all energy sources were correctly disconnected. This problem has resulted in many preventable injuries and deaths.

This is where OSHA's Hazardous Energy Control standard comes in. Routinely referred to as "Lockout/Tagout", this regulation covers servicing and maintenance of machines and equipment in which the unexpected energization or start-up of the machines or equipment, or release of stored energy could cause injury to employees. This standard is found in OR-OSHA's Division 2/Subdivision J 29 CFR 1910.147 and it sets minimum performance criteria for the control of hazardous energy.

In general, the standard requires that all energy sources for equipment be turned off, isolated (disconnected), and physically locked out. Bleeding, relieving, or blocking other stored and residual energy must also be done to achieve ***zero energy state***. Finally, the last important function before service begins is to verify all energy has been deenergized and/or isolated.

The key is that the equipment or machines are returned to a ZERO energy state before work begins.

Objectives

- ☒ Gain a greater awareness of all requirements in OR-OSHA Div 2/Sub J 29 CFR 1910.147 The Control of Hazardous Energy
- ☒ Discuss the importance of a hazardous energy control plan
- ☒ Discuss energy control procedures, training, and periodic inspection criteria

This standard applies to all Oregon employers including construction and maritime. Refer to OR-OSHA Div 4/Sub J for hazardous energy control in agriculture.

OSHA requirements for installations under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution are covered in OR-OSHA Div 2/Sub R 29 CFR 1910.269. Furthermore, exposures to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations are regulated in OR-OSHA Div 2/Sub S 29 CFR 1910.331-335.

Please Note: This material, or any other material used to inform employers of compliance requirements of Oregon OSHA standards through simplification of the regulations should not be considered a substitute for any provisions of the Oregon Safe Employment Act or for any standards issued by Oregon OSHA. The information in this workbook is intended for classroom use only.

Part 1: Scope and Application

OR-OSHA Div 2/Sub J 29 CFR 1910.147
The Control of Hazardous Energy (Lockout/Tagout)

(c)(1) Energy Control Program. The employer shall establish a program consisting of energy control procedures, employee training, and periodic inspections to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the **unexpected** energizing, start up or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source, and rendered inoperative.

What are the three key elements of an energy control program?

1.
2.
3.

See paragraph above:
1. Energy Control Procedures
2. Employee Training
3. Periodic Inspections

Scope: The lockout/tagout rule covers the following employees:

Authorized Employee **Affected Employee** **Other Employee**

The person who operates or uses a machine or piece of equipment which is being serviced is an:

Authorized Employee **Affected Employee** **Other Employee**

The person who works in an area where lockout procedures are being used is an:

Authorized Employee **Affected Employee** **Other Employee**

The person who services or performs maintenance on machines and equipment is an:

Authorized Employee **Affected Employee** **Other Employee**

Procedures must be followed when...

...servicing and/or maintenance is being done when Unexpected energization, start-up or release of stored energy could cause injury.

What is servicing or maintenance?

Some workplace activities considered to be **"servicing and/or maintenance"** include:

Adjusting...inspecting...modifying...constructing...re-tooling...

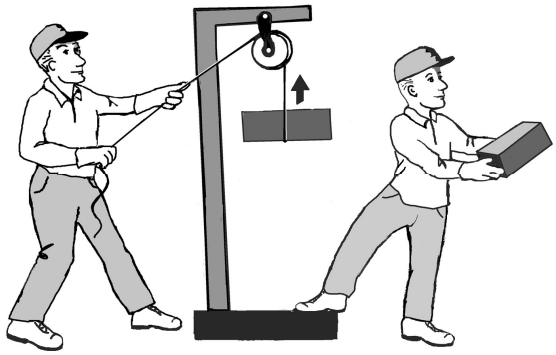
lubricating...installing…setting up...removing jams...cleaning...

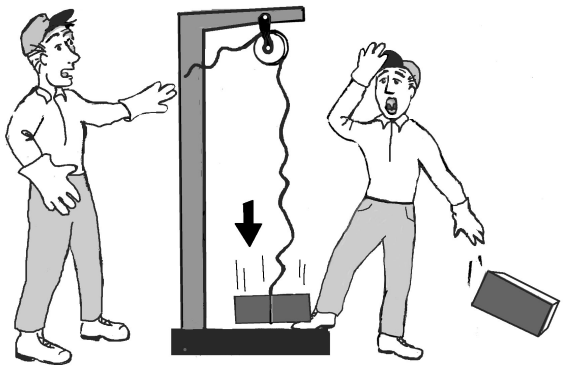
Sources of Energy

Sources of energy capable of causing serious injury include:

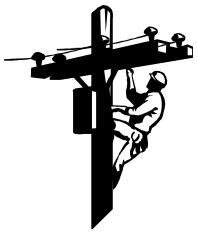
Brainstorm with the class about the type of energy they may find in their workplaces. Some examples may be:

- Electrical
- Pneumatic
- Gravity
- Hydraulic
- Radiation
- Kinetic





This standard {OR-OSHA Div 2/Sub J 29 CFR 1910.147} does not apply to:



- **Installations under the control of electric utilities for the purpose of power generation, transmission, and distribution**
  {OAR Div 2/Sub R 29 CFR 1910.269}

- **Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations**
  {OAR Div 2/Sub S 29 CFR 1910.331-335}

- **Oil and gas well drilling and servicing**

- **Servicing/maintenance during normal production operations* <u>unless</u>:**

– guards, or other devices are removed/bypassed
– employees place themselves in the point of operation (the area of the machine where work is actually performed)
– employees place themselves in any area considered dangerous during a machine operating cycle

** Servicing and/or maintenance during normal production operations can include minor tool changes and adjustments that are routine, repetitive, and integral to the use of the equipment for production.*

- **Work on** Plug and Cord **connected equipment**

– only when under the exclusive control of the authorized person

- **Hot tap operations involving transmission and distribution systems for gas, steam, petroleum, etc., when performed on pressurized lines and when the employer demonstrates that:**

– continuity of service is essential
– shutdown of the system is impractical
– documented procedures are followed
– special equipment is used which will provide proven effective protection for employees

Part 2: The Energy Control Plan

Your hazardous energy control plan must specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy. **The plan must also include your methods to enforce compliance.**

At a minimum, the following steps must be taken:

1. A specific statement of the intended use of your procedures
2. Specific procedures to shut down, isolate, block and secure machines or equipment
3. Specific procedures to place, remove and transfer lockout/tagout devices
4. Assigning responsibility for lockout/tagout devices
5. Requirements and procedures to test machines and machinery to determine and verify effective lockout/tagout devices, and other energy control measures

Why is a comprehensive written plan critical to a successful lockout/tagout program?

Talk with the class about why they feel it is important to have a LOTO program and why the beginning of it should be the comprehensive written program.

What are some reasons a lockout/tagout program may not work effectively?

Brainstorm these failings with the class. There may be many reasons why. Focus on training and supervision for a start.

Who is responsible….who is accountable….and for what?

Talk about the people responsible. Why is it important to do that?

Steps to developing a successful program

1. List all equipment or machines that need servicing or maintenance;
2. Identify those machines which could unexpectedly start up or release stored energy while being serviced or maintained;
3. Determine the steps in the maintenance or servicing task; and
4. Review each step for the potential of a hazard from all energy sources.

Good Idea

Post user-friendly procedures on each piece of equipment. Identify energy sources, hazards, and energy isolating devices.

These steps listed above will help as an outline for creating the LOTO program.

Equipment Lockout/Tagout Procedure

File Name: Lock-Tag Procedure.doc
Rev. 5-1-00

HIS TAG

DANGER

Equipment Name:
GALLON STACKER
#1
Equipment Location:
FILLER ROOM

Energy Sources: Electrical, Hydraulic
1. 120 VAC
2. Hydraulic
3. Control power through transformer 120 VAC.
4. Motor Voltage 120 VAC

HAZARDS:
1. Mechanical Pinch Point
2. Electrical Shock
3. Stored energy

Energy Isolation Devices:
1. Filer panel disconnect on machine
2. Panel L1B Circuit #13
3. (2) ¾" Hydraulic ball valves.

De-Energizing Equipment

1. **Notify** all affected employees that the equipment is being shut down
2. **Turn off the equipment** by normal stopping procedures. Isolate the equipment from its source of energy by turning the main 120V electrical disconnect to off position on the operator control box. Turn off the main 120V disconnect on the main control panel.
3. **Turn off Hydraulic's**
4. **Make sure** that energy has been disconnected by pushing the start button to verify that the equipment is off

Re-Energizing Equipment

1. **Clear all** personnel, tools, etc. from machine. Replace all guards and notify all affected employees
2. **Make sure all** operator controls are in neutral position
3. **Turn on** main electrical power at machine disconnect after removing padlock and a tag
4. **Turn on Hydraulic**
5. **Push machine start button to assure proper machine operation.**

Portland area example!

Part 3: Lockout/Tagout Procedures

Step 1 - Prepare for Lockout

The first step in the lockout/tagout procedure is preparing to shut down the equipment or machinery.

Before shutting down, the authorized employee(s) must know the :

- Types and magnitudes of energy
- Hazards posed by that energy
- Methods to effectively control the energy

Pay close attention to energies (such as gravity, electrical, high pressure) that can be stored or re-accumulated after shut-down.

Notify all affected employees prior to shutdown so they can clear their work area and/or any other area that might be hazardous.

What can you do to ensure the above review and notification is conducted prior to lockout?

Create a checklist

Step 2 - Shutdown

Machinery and equipment must be turned off or shut down using the procedures you've established for the machine or equipment.

An orderly shutdown must be utilized to avoid any additional or increased hazards due to equipment stoppage.

If more than one authorized employee is involved in shutdown, a team leader should make sure everyone has accomplished their tasks and are aware that shutdown will occur.

Step 3 - Energy Isolation

All energy isolating devices must be located and operated to completely de-energize and isolate the equipment.

The authorized employee(s) will verify operation of each energy isolating device. If more than one authorized employee is involved, a team leader should make sure everyone has accomplished their task.

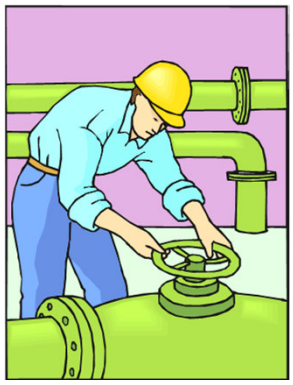
An ***"energy isolating device"*** physically prevents…

...the t___ Transfer or Release **of energy.**

Some examples of energy isolating devices include:

Have the class list as many items as they can think of to block energy flow. What have they seen in their workplace or other workplaces.

You may also want to get a catalog from a supplier to show what is available.



Pushbuttons, selector switches and other control circuit type devices <u>are</u> energy isolating devices.

TRUE **FALSE**

Why?

Step 4 - Lockout or Tagout Application

Take note of the bolded words

Lockout v. Tagout: There is a difference!

"Lockout" is the placement of a *lockout device* on an energy isolating device, in accordance with an established procedure, **ensuring** that the energy isolating device and the equipment being controlled **cannot** be operated until the lockout device is removed.

"Tagout" is the placement of a *tagout device* on an energy isolating device, in accordance with an established procedure, **to indicate** that the energy isolating device and the equipment being controlled **may not** be operated until the tagout device is removed.

Lockout Devices

- A "lockout device" is a device that uses a positive means such as a lock to hold an energy isolating device in a safe position to prevent the energizing of a machine or piece of equipment
- Only authorized employees can affix lockout devices
- Lockout devices must be able to hold energy isolation devices in a "safe" or "off" position

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Tagout Devices

- A "tagout device" is a prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed
- Only authorized employees can affix tagout devices
- Tagout devices must be affixed in such a manner as will clearly indicate that the moving of energy isolating devices from the "safe" or "off" position is strictly prohibited

  *Must warn against hazardous conditions if the machine or equipment is energized and must include a message such as **Do Not Start**, **Do Not Close, Do Not Energize, Do Not Operate.***

- If a tag cannot be affixed directly to the energy isolating device, it must be located as close as safely possible to the device so that the tag is obvious to anyone attempting to operate the device

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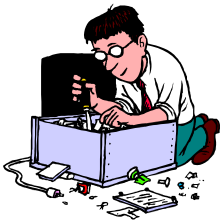
Which is the preferred method: Lockout or Tagout?

An energy isolating device is "capable of being locked out" if…

…it has a hasp or other means to attach a lock

…it has a built in locking mechanism



…it does not have to be dismantled or rebuilt to achieve lockout

After 1/2/90, whenever replacement or major repair, renovation, or modification of a machine or piece of equipment is performed; and whenever new machines or equipment are installed, energy isolating devices for such machines or equipment must be designed to accept a lockout device.

When can an employer use a tagout system?

1. When an energy isolating device is not capable of being Locked Out or
2. When the employer can demonstrate (prove) that using a tagout system will provide full employee protection.

How?

Tags must be affixed on the energy isolating device at the same location the lock would have been attached, and

The employer demonstrates that equivalent protection can be obtained…

How?

Must demonstrate full compliance with all tagout-related provisions (e.g. p. 9), and

Implement additional safety measures such as removing an isolating circuit element, blocking of a controlling switch, opening an extra disconnect, removing a valve handle, blocking a ram, etc.

More on the *protective hardware!*

Use the following terms to fill in the blanks:

standardized
substantial
employer
identify
substantial
only

Protective materials and hardware must be provided by the e_Employer_

Each lockout and tagout device must be singularly identified as being used_Only_ for lockout or tagout.

Lockout and tagout devices must be s_Standardized_ within the facility (i.e. color, size, print and format of tags, etc.).

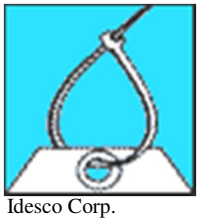
Lockout and tagout devices must _Identify_ the user.

Lockout and tagout devices must be capable of withstanding the environment to which they are exposed for the maximum period of time the exposure is expected:

- Tagout devices must be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible
- Tags must not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored

Lockout devices must be s_Substantial_ enough to prevent removal except with the use of excessive force or unusual techniques (i.e. bolt cutters).

Tagout devices must be s_Substantial_ enough to prevent inadvertent or accidental removal.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- Attachment means must be non-reusable, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of 50 lbs., and designed equivalent to a one-piece, all environment-tolerant nylon cable tie

What are some examples of lockout devices?


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Step 5 - Controlling Stored Energy

Immediately after applying lockout or tagout devices, the authorized employee must ensure all potentially hazardous stored or residual energy is:

- relieved
- disconnected
- restrained

If there is a possibility of stored energy reaccumulating to a hazardous level...

- continue to verify isolation until the servicing or maintenance is completed or until the possibility of such accumulation no longer exists.

What are some examples of stored or residual energy?

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Step 6 - VERIFY

Before starting work on a machine or piece of equipment that has been locked or tagged out, the authorized employee must Verify that the machine or piece of equipment has been isolated and deenergized.

VERIFY ZERO ENERGY STATE!

How do you verify that a machine or piece of equipment is actually isolated and deenergized?

Release from Lockout or Tagout

The authorized employee must follow the procedures below prior to removing lockout/tagout de

Take some time to walk through this page with the class. Spend time on the exception and make sure the class understands it.

Equipment

- Make sure machinery or equipment is properly reassembled
- Inspect machinery or equipment to make sure nonessential items have been removed

Employees

- Make sure all employees are safely positioned outside dangerous areas
- Notify affected employees that lockout or tagout devices have been removed and that energy is going to be reapplied

Removing lockout/tagout devices

- Only the authorized employee who applied the lockout or tagout device may remove that device
- *Exception - When the authorized employee is not available to remove it, the device can be removed under the direction of the employer*
  - *Specific procedures and training must be developed, documented, and placed in your energy control plan*
  - *At a minimum, the procedures must include:*

    *Verification that the authorized employee who applied the device is **not** at the facility*

    Making all reasonable efforts to contact him/her to inform them that their lockout or tagout device has been removed

    Ensuring that they are aware of this upon returning to work

If the authorized employee is not available, who is authorized to remove the lockout or tagout device?

Testing/Positioning Machines or Equipment

Whenever lockout or tagout devices must be temporarily removed to test or position the machine or equipment, the following sequence must be conducted:

1. Clear the machine or equipment of tools and materials
2. Remove employees from the machine or equipment area
3. Remove the lockout or tagout devices
4. Energize and proceed with testing or positioning
5. Deenergize all systems and reapply energy control measures

How can employees be injured while testing the machinery or equipment during maintenance?

If a step is missed or not done adequately employees are exposed to the same hazards as running the machine without guards.

Outside Personnel

Outside servicing personnel, contracted to perform maintenance or other services requiring lockout or tagout procedures, must not begin work until the host employer and the contractor inform each other of their respective hazardous energy control procedures.

The host employer must also ensure company employees understand and comply with the contractor's lockout or tagout procedures.

What does this basically involve? S Share Information **_____.**

Who is responsible if an employee is injured because an outside contractor did not follow proper lockout/tagout procedures?

Shift/Personnel Changes

Continuity

Specific procedures must be utilized during shift or personnel changes to ensure the _____ of lockout or tagout protection, including provision for the orderly transfer of lockout or tagout device protection between both off-going and oncoming workers

What is the intent of these shift change procedures?

Share Information

Group Lockout or Tagout

When servicing and/or maintenance is performed by a group (crew, craft, department, etc.), they must utilize a procedure which affords the employees a level of protection equivalent to that provided by a personal lockout or tagout device.

Group lockout or tagout devices must be used in accordance with specific procedures and must include the following requirements, at a minimum:

- Primary responsibility is vested in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (e.g. an *operations lock*)
- Provision for the authorized employee to monitor the exposure status of individual workers with regard to the lockout or tagout of the machine or equipment
- When more than one group is involved, assignment of overall job-associated lockout or tagout control responsibility to an authorized employee designated to coordinate all affected groups and ensure continuity of protection
- Each authorized employee must affix a personal lockout or tagout device to the group lockout device (group lockbox or comparable mechanism) when he/she begins work, and must remove the device when he/she stops working on the machine or equipment being serviced or maintained

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Part 4: Lockout/Tagout Training

General requirements

Training must ensure that the purpose and function of your energy control plan are understood and that employees gain the needed knowledge and skills to safely apply, use, and remove hazardous energy controls.

Minimum training must include:

Authorized employees must be able to recognize:

- hazardous energy sources
- types and magnitudes of energy in the workplace
- methods and means necessary to isolate and control the energy

Affected employees must be instructed on the:

- purpose and use of your energy control procedures

Other employees must be instructed about:

- the energy control procedure in general
- prohibitions relating to attempts to restart/reenergize equipment

What are effective training strategies for each level of training?

Authorized employee	Classroom, on the job, and verification
Affected employee	Classroom, on the job
Other employee	Classroom

What are some other training considerations?

Education level, reading and writing skills, prior knowledge, generational differences, learning style preferences, language barriers, trust

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Training on Tagout Devices

If tagout devices are used, further training on tagout systems need to emphasize that:

- Tags are warning devices only and do not provide a physical restraint that lockout devices provide
- Tags must not be removed without the authorized employee's approval and should never be bypassed, ignored, or otherwise defeated
- Tags must be legible and understandable by all employees
- Tags must be able to withstand environmental conditions in the workplace
- Tags may give employees a false sense of security
- Tags must be securely attached to prevent inadvertent or accidental detachment

Retraining

When should employees be retrained?

Whenever there is a change in their job a Activities

Whenever there is a change in Machine , equipment, or process that present a new hazard

Whenever there is a change in your energy c Control Procedures

Whenever there are deviations from or inadequacies in the e Employee's knowledge or use of the energy control procedures

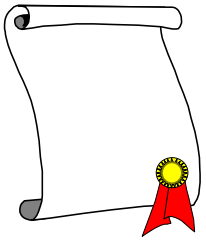
The retraining must reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

Documentation

A training certification must contain each employee's name and date(s) of training.

What's missing?

Did the employee understand (pass/fail), What they were trained on (topics), and Who trained them.



Part 5: Lockout/Tagout Periodic Inspections

An inspection of each energy control procedure must be conducted at least annually. These inspections must at least include a demonstration of the procedures (steps) and may be implemented through random audits and/or planned visual observations.

- ✉ Inspections must be performed by an authorized employee **other than the one**(s) using the energy control procedure being inspected

- ✉ The purpose of the inspection is to correct deviations or inadequacies relating to your procedures and/or training…*but should also point out the good!*

  Where lockout is used, the inspector and authorized employee(s) involved in the procedure being inspected must review applicable controls and responsibilities.

  Where tagout is used, the inspector and each authorized and affected employee involved in the procedure being inspected must review applicable controls and responsibilities, and the limitations a tagout system provides.

Documentation

The employer must certify that the periodic inspections are being performed. This certification must identify:

- The equipment or machine being serviced
- The date(s) of inspection
- The employees included in the inspection
- The authorized employee performing the inspection

What's missing?

Did the control work? Did the employee follow the procedures? Any changes needed?

What questions would you consider when conducting your inspection?

How often must lockout/tagout inspections occur?

At least annually by an authorized employee

Who must conduct the inspection?

Reference

SAMPLE Training Certification

The Lockout/Tagout *"Two-Pager"*

SAMPLE

Hazardous Energy Control Training Certification Date _____

Trainee certification. I have received training on _____(Company Name)_____ policy and procedure for controlling hazardous energies (lockout/tagout).

This training has provided me adequate opportunity to ask questions and practice procedures to determine and correct skill deficiencies. I understand that performing these procedures/practices safely is a condition of employment. I fully intend to comply with all safety and operational requirements discussed. I understand that failure to comply with these requirements may result in progressive discipline (or corrective actions) up to and including termination.

_____ _____

Employee Name *Signature*

This training primarily covered the following:

Roles and responsibilities of authorized and affected employees.

Specific machinery and equipment subjected to energy control procedures (including energy sources).

Hazardous energy control procedures (prep, shutdown, isolating energies, applying devices, relieving stored energy, verification of isolation; releasing lockout; adjusting/troubleshooting).

Periodic inspection procedures.

Procedures for contractors, shift changes, and/or group lockout (if applicable).

*Other specific aspects (e.g. tagout, manufacturer specs,):*_____

This training was conducted in the following form(s):

This training included the following demonstrations:

This training qualified the trainee's understanding by (test, observation, etc.):

Trainer certification. I have conducted orientation/on-the-job training to the employees(s) listed above. I have explained related procedures, practices and policies. Employees were each given opportunity to ask questions and practice procedures taught under my supervision. Based on each student's performance, I have determined that each employee trained has adequate knowledge and skills to safely perform these procedures/practices.

_____ _____ _____

Trainer *Signature* *Date*

Supervisor validation. I have observed the above employee(s) on _____ and certify that he/she/they correctly completed all steps and employed safe practices as trained.

_____ _____ _____

Supervisor *Signature* *Date*

The Importance of Controlling Hazardous Energy

8/28/02

An Oregon worker was pulled into a machine by a moving belt and was crushed. He was 61 years old.

8/12/02

An Oregon worker was crushed by a machine that moves blanks for cans. He was 25 years old.

12/21/99

An Oregon worker was caught between an in-feed frame and accumulator arm of a veneer dryer. He was 62 years old and two weeks from retirement.

5/9/99

An Oregon worker was caught in a wood/bark shredder. He was 52 years old.

5/3/99

An Oregon worker was pinned under the fuel tank of a dump truck when the lowering control valve was opened. He was 34 years old.

9/24/98

An Oregon worker's head was crushed between a truck's lift gate and frame.

9/3/98

An Oregon worker was crushed between glass and the machine. He was 39 years old.

7/28/98

An Oregon worker was performing end of the day cleanup and was struck by a hydraulic powered log kicker. He was 28 years old.

** as of 9/1/02*

The Control Of Hazardous Energy {Lockout/Tagout}

The standard for the control of hazardous energy sources (Lockout/Tagout) covers servicing and maintenance of machines and equipment in which the unexpected energization or start-up of the machines or equipment, or release of stored energy could cause injury to employees.

In general, the rule requires that all energy sources for equipment be turned off, isolated (disconnected), and physically locked out. Bleeding, relieving, or blocking other stored and residual energy must also be done to achieve ***zero energy state.*** Finally, the last important function before maintenance begins is to verify all energy has been deenergized and/or isolated.

This two-page document only serves as a supplement to the safety standard. In addition to OR-OSHA's hazardous energy control (lockout/tagout) standard, OR-OSHA *Div 2/Sub J 29 CFR 1910.147*, the following resources can provide assistance in developing and/or improving your hazardous energy control plan:

- OR-OSHA's Guide to Controlling Hazardous Energy (publication #3326)
- OSHA's Control of Hazardous Energy (OSHA #3120)
- Preventing Worker Deaths from Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy {DHHS (NIOSH) Publication No. 99-110}

NOTE: OSHA requirements for installations under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution are covered in OR-OSHA Div 2/Sub R (29 CFR 1910.269). Exposures to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations are regulated in OR-OSHA Div 2/Sub S (29 CFR 1910.331-335).

The Big Three

Specific Written Procedures

- For Shut Down
- For Isolating/Blocking
- For Applying Individual Locks or Tags
- For Relieving Stored/Residual Energy
- For Verifying **Zero Energy State**
- For Removing & Transferring Locks

Training

- Authorized Employees
- Affected Employees
- Other Employees
- Certify *(Document/Authorize)*

Periodic Inspections

- Conducted By Authorized Employee(s)
- Evaluate Each Authorized Employee During Procedure
- Are The Steps In The Energy Control Procedure Being Followed?
- Do The Employees Involved Know Their Responsibilities?
- Is The Procedure Adequate And What Changes, If Any, Are Needed?
- Certify *(Document)*

Develop a hazardous energy control program consisting of **written procedures**, effective training, and periodic inspections.

Develop and implement specific written procedures for the control of hazardous energy including preparation for shutdown, actual shutdown, equipment isolation, lockout application, release of stored energy, verification of isolation, and removal of device(s).

The procedures must clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for controlling hazardous energy. The procedures must also clearly and specifically outline the means to enforce compliance. The procedures must address release of lockout/tagout including machine inspection, notification and safe positioning of employees, lockout transfer (shift changes), equipment testing/adjusting, group lockout (if done), and communications with outside contractors.

Furthermore, use locks when equipment can be locked out (new /overhauled equipment must accommodate locks). Employ additional means to ensure equivalent protection when tags are used by developing an effective tagout program consisting of additional training and additional means of protection (i.e. removing a circuit element, valve handle, battery, etc.). Provide standardized locks and tags which identify the authorized employee using them and are of sufficient quality and durability to ensure effectiveness.

Develop a hazardous energy control program consisting of written procedures, **effective training**, and periodic inspections.

Train authorized employees in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control. Instruct affected and other employees on the purpose of energy control procedures and the prohibition relating to attempts to restart and reenergize equipment.

Retrain employees whenever there is a job change; a change in machinery, equipment, and/or processes; a change in the energy control procedures; or whenever the periodic inspection identifies deficiencies.

Document this training by listing the trainees, trainer(s), and date(s). It is recommended to also document specific equipment procedures, energy sources and methods of isolation and relief, lockout devices, lockout release/transfer, periodic inspection criteria, etc.).

Develop a hazardous energy control program consisting of written procedures, effective training, and **periodic inspections**.

Designate authorized employees to conduct inspections of energy control procedures at least annually. Evaluate each authorized employee during procedure to ensure all steps are being followed, employees involved know their responsibilities, and to ensure if the procedure is adequate. This is your means of enforcement! Document the good and bad found during your inspections! Document the machine/equipment involved, your ‘inspector’, authorized employee(s) involved, and the date(s), at a minimum. It is recommended to document everything found for training purposes, program evaluation, and accountability.

Principles of Machine Safeguarding

Instructor Guide

Welcome

Crushed hands and arms, severed fingers, blindness -- the list of possible machinery-related injuries is as long as it is horrifying. There seem to be as many hazards created by moving machine parts as there are types of machines. Safeguards are essential for protecting workers from needless and preventable injuries.

A good rule to remember is:

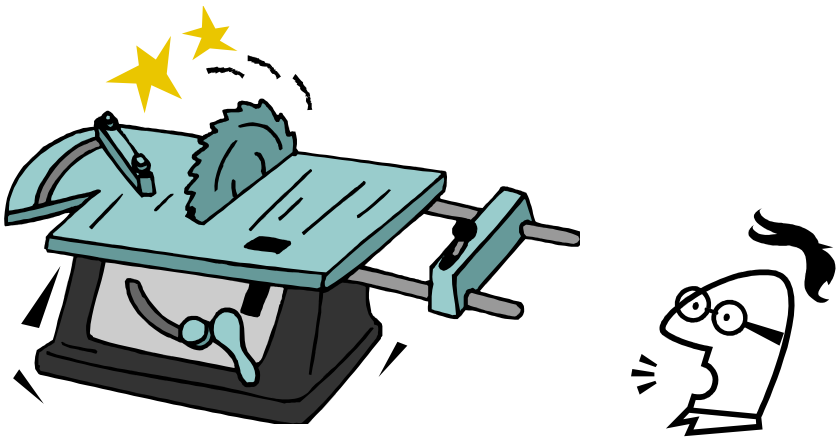
Any machine part, function, or process which may cause injury must be safeguarded. Where the operation of a machine or contact with it can injure the operator or others in the vicinity, the hazards must be either eliminated or controlled.

This workbook overviews the various hazards of mechanical motion and actions and presents some techniques for protecting workers from these hazards. General information covered in this workbook includes where mechanical hazards occur, the hazards created by different kinds of motions and the requirements for effective safeguards, as well as a brief discussion of training guidelines.

Speak about the goals of the class

Goals

- Describe the basic hazards involving machinery including point of operation and power transmission devices
- Introduce control measures through effective machine guarding principles and methods



Please Note: This material or any other material used to inform employers of compliance requirements of Oregon OSHA standards through simplification of the regulation should not be considered a substitute for any provisions of the Oregon Safe Employment Act or for any standards issued by Oregon OSHA. This workbook contains many photos which, in some cases, represent non-compliance with machine guarding rules. If you reproduce these photo for training, make certain the related non-compliance issue is properly addressed when referring to the photo.

Machine Guarding Principles

A good rule to remember is:

Any machine part, function, or process which may cause injury must be safeguarded. Where the operation of a machine or contact with it can injure the operator or others in the vicinity, the hazards must be either eliminated or controlled.

If it moves, it merits your attention!

The purpose of machine guarding is to protect against and prevent injury from point of operation, in-running nip points, rotating parts, flying chips, and sparks.

Although some OR-OSHA standards provide certain machine guarding requirements, OR-OSHA's Div 2/Sub O Machine Guarding standard provides general guarding requirements in addition to specific requirements for woodworking machinery, abrasive wheel machinery, mechanical power presses, and power transmission devices.

Dangerous moving parts in t

Spend time talking about these three categories. Brainstorm with the class about where they find these items in their workplace.

1. The point of operation

That point where work is performed

Cutting	*Shaping*	*Boring*	*Forming*	*Grinding*
Turning	*Shearing*	*Punching*	*Bending*	*Drilling*

2. Power transmission apparatus

All components of the mechanical system which transmit energy to the part of the machine performing the work

Flywheels	*Couplings*	*Pulleys*
Cams	*Spindles*	*Belts*
Chains	*Cranks*	*Sprockets*
Gears	*Shafts*	*Rods*

3. Other moving parts

All parts of the machine which move while the machine is working

Reciprocating	*Rotating*
Transverse	*Feed mechanisms*

Hazardous Mechanical Motions & Actions

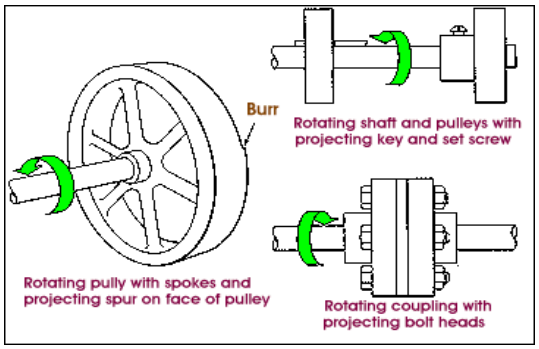
A wide variety of mechanical motions and actions may present hazards to the worker. These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any parts that impact or shear.

These different types of hazardous mechanical motions and actions are basic in varying combinations to nearly all machines, and recognizing them is the first step toward protecting workers from the danger they present.

Motions: 1. Rotating 2. Reciprocating 3. Transverse

1. Rotating motion

- *Sprockets*
- *Flywheels*
- *Couplings*
- *Shafts*
- *Fans*
- *Pulleys*
- *Clutches*
- *Gears*

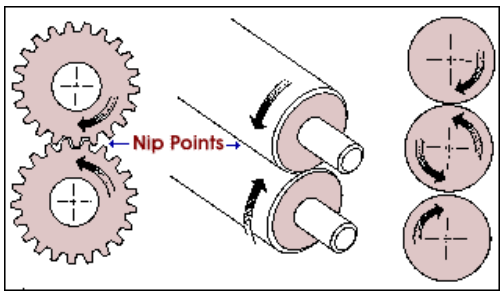


In-running nip point hazards

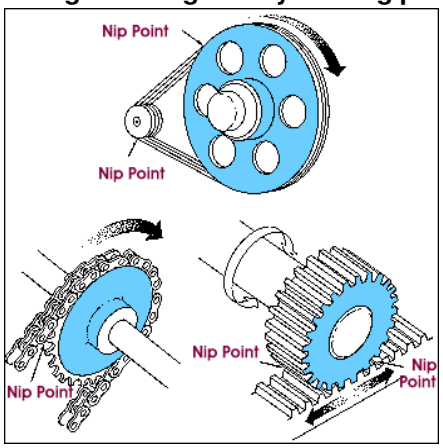
There are three main types of in-running nips:

- ✉ Parts rotating in opposite direction
- ✉ Rotating and tangentially moving parts
- ✉ Rotating and fixed parts

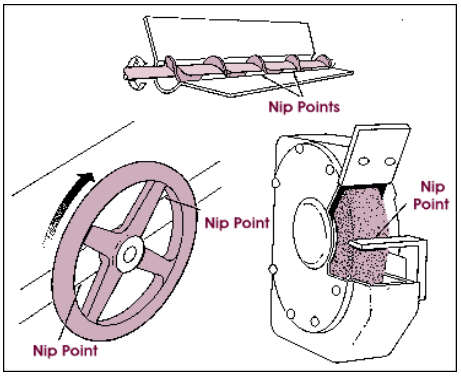
Parts rotating in opposite direction



Rotating and tangentially moving parts



Rotating and fixed parts

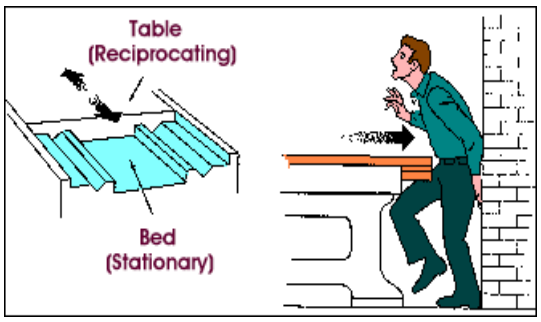


2. Reciprocating motion

Back & forth; Up & down

May be struck by or caught between a moving and stationary part

Scissor lifts, shaker screens, feed tables, knife sharpeners, slicers, feeding/ejecting parts, etc.

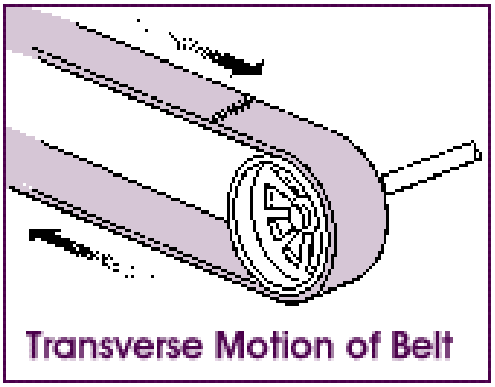


3. Transverse motion

Straight & continuous line

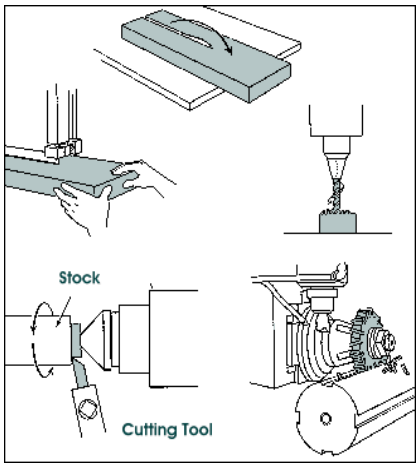
- *Conveyor lines*
- *Lengthy belts*

May be struck or caught in a pinch or shear point by the moving part

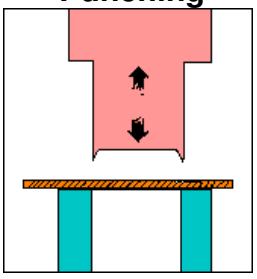


Actions: 1. Cutting 2. Shearing 3. Bending 4. Punching

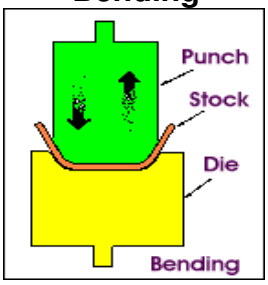
Cutting



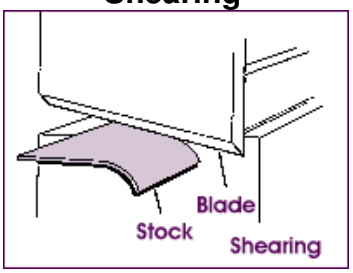
Punching



Bending



Shearing



Machine Safeguarding

There are many ways to safeguard machines. The type of operation, the size or shape of stock, the method of handling, the physical layout of the work area, the type of material, and production requirements or limitations will help determine the appropriate safeguarding method for the individual machine.

As a general rule, power transmission apparatus is best protected by fixed guards that enclose the danger areas. For hazards at the point of operation, where moving parts actually perform work on stock, several kinds of safeguarding may be possible. One must always choose the most effective and practical means available.

Safeguarding strategies include:

- Guards *Fixed; Interlocked; Adjustable; Self-adjusting*
- Devices *Presence-sensing; Pullback; Restraints; Controls/Trips; Gates*

Guards

Devices

Other safeguarding strategies may include:

- Location and/or Distance
- Feeding/Ejection Methods *Auto/semi-auto feeding/ejection; Robotics*

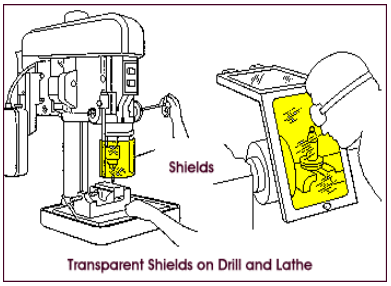
Miscellaneous aids can help reduce exposure

Awareness barriers

Protective shields

Hand-feeding/holding tools

Anti-restart devices



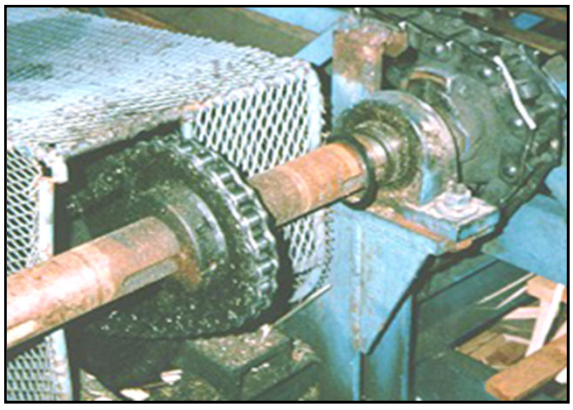
Transparent Shields on Drill and Lathe

What makes a guard effective?

- ➔ Must prevent any contact to the machine hazard and installed to prevent contact from around, over, through, or under the guard

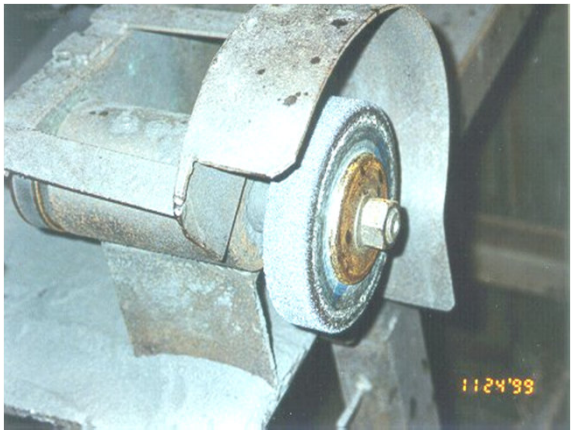
  "…so designed and constructed as to prevent the operator from having any part of his/her body in the danger zone during the operating cycle".
  OR-OSHA Div 2/Sub O 29 CFR 1910.212(a)(3)(ii)

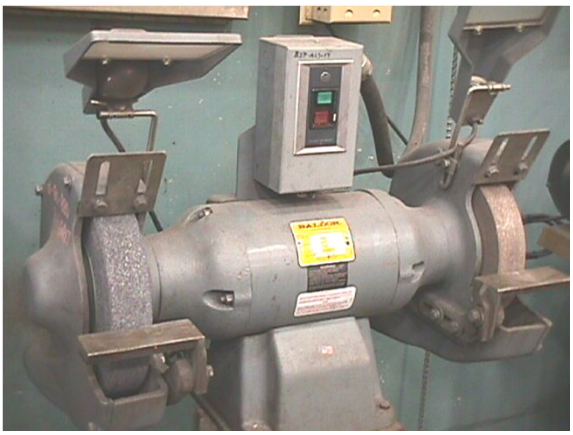
- ➔ Must not present a hazard in itself or create interference
- ➔ Must not allow objects to fall into moving parts
- ➔ Allows safe maintenance and lubrication
- ➔ Affixed to the machine where possible and remains secure
- ➔ Conforms with other appropriate standards
  - ANSI, manufacturer specifications, etc.



▲ **Not Effective** ▼

▲ **Effective** ▼





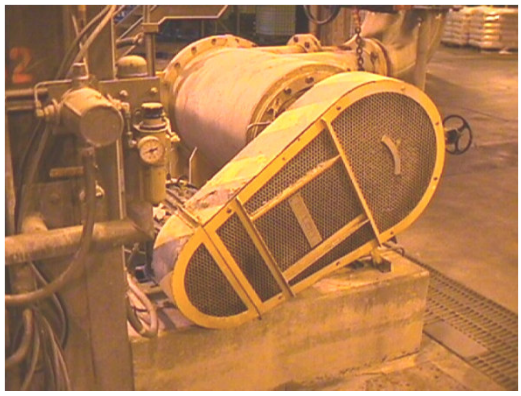
First Safeguarding Strategy: Guards

Guards are physical barriers which prevent access to danger areas.

Guards:	Fixed	Interlocked	Adjustable	Self-adjusting

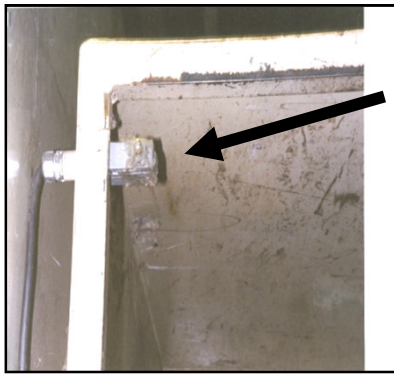
Fixed Guards

- Permanent part of the machine
- Not dependent upon moving parts to perform its intended function
- Constructed of sheet metal, screen, wire cloth, bars, plastic, or other substantial material
- Usually preferable to all other types because of its relative simplicity and permanence



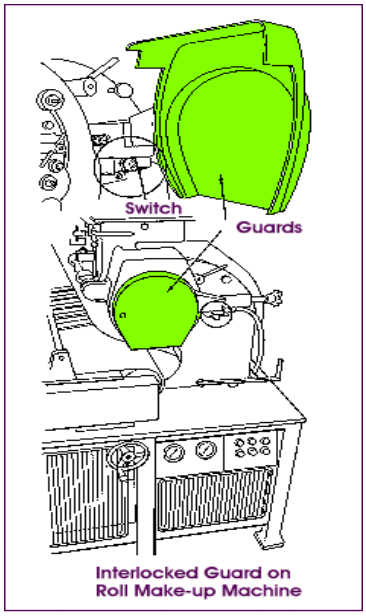
Interlocked Guards

- When opened or removed, the tripping mechanism and/or power automatically shuts off or disengages
- Machine cannot cycle or be started until the guard is back in place
- Electrical, mechanical, hydraulic, or pneumatic power
- Replacing the guard should not automatically restart the machine



Careful!

Interlocked guards can be bypassed - this electric interlock on a trash compactor was taped down

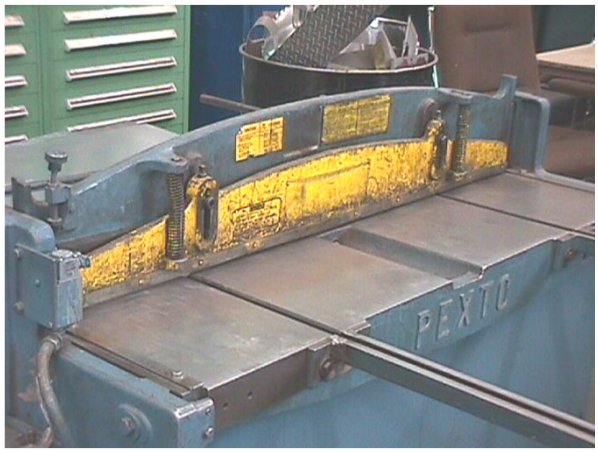


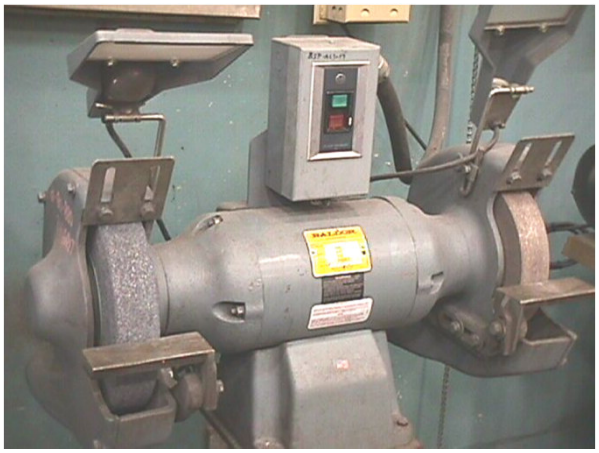
Interlocked Guard on Roll Make-up Machine

This is NEVER energy isolation for lockout/tagout purposes!!! Never rely on interlocks for energy control protection! Machine is still energized even when disengaged by interlock.

Adjustable Guards

- Allow flexibility in accommodating various sizes of stock





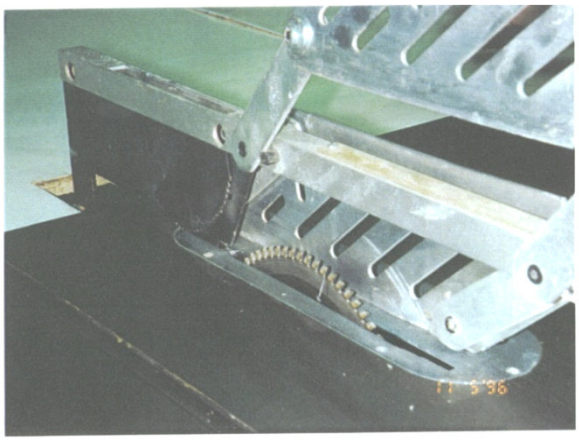
Self-adjusting Guards

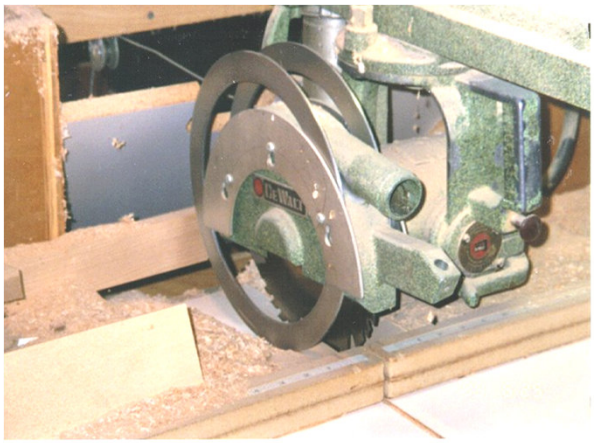
- Openings are determined by the movement of stock

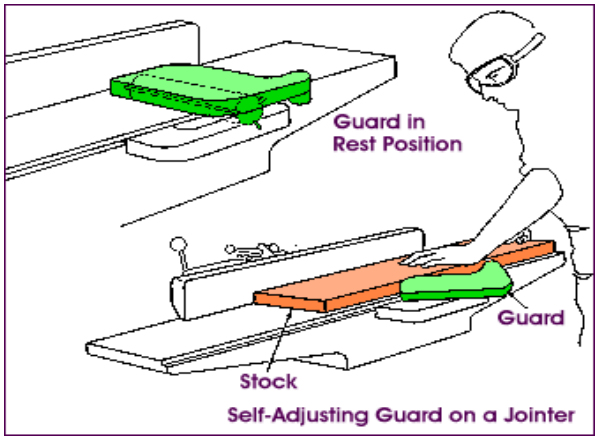
  Guard is pushed away as stock is introduced

  Opening is only large enough to admit the stock

  Guard returns to rest position after stock passes through







Second Safeguarding Strategy: Devices

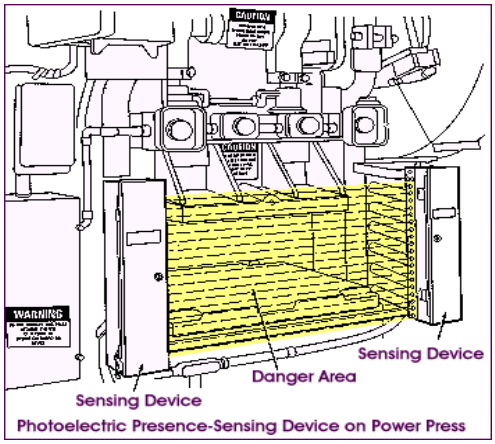
A safety device <u>controls</u> access to danger areas and may perform one of several functions:

- It may stop the machine if a hand or any part of the body is inadvertently placed in the danger area
- Restrain or withdraw the operator's hands from the danger area during operation
- Require the operator to use both hands on machine controls
- Provide a barrier which is synchronized with the operating cycle of the machine in order to prevent entry to the danger area during the hazardous part of the cycle

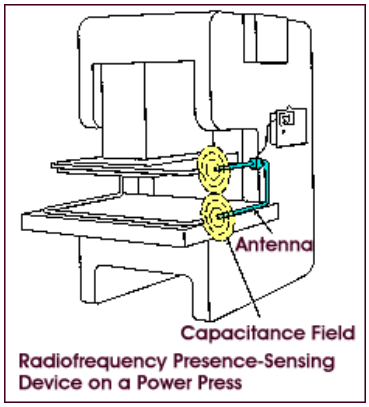
Presence-Sensing Devices

Photoelectric (optical)

Uses a system of light sources and controls which can interrupt the machine's operating cycle.



Photoelectric Presence-Sensing Device on Power Press



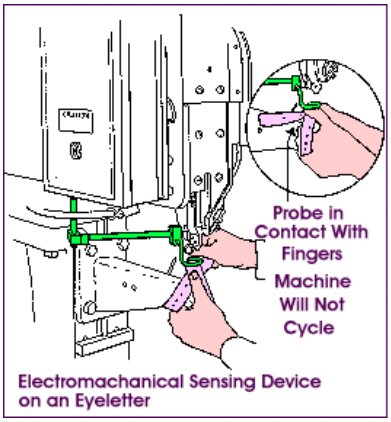
Radiofrequency Presence-Sensing Device on a Power Press

Radiofrequency (capacitance)

Uses a radio beam that is part of the machine control circuit. When the capacitance field is broken, the machine will stop or will not activate.

Electromechanical

Has a probe or contact bar which descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full predetermined distance, the control circuit does not activate the machine cycle.



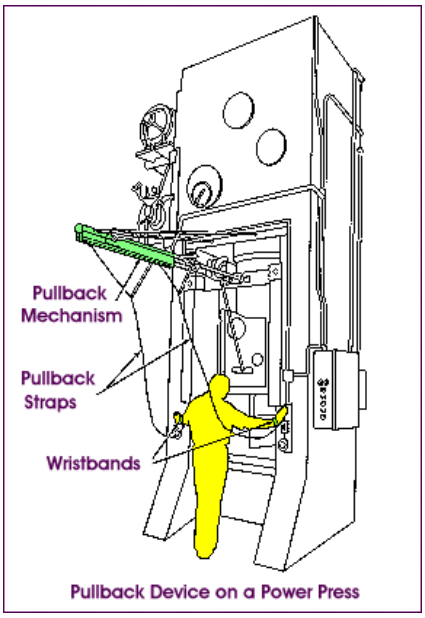
Electromachanical Sensing Device on an Eyeletter

Pullback

Pullback devices utilize a series of cables attached to the operator's hands, wrists, and/or arms.

This type of device is primarily used on machines with stroking action. Slack is taken up during the downstroke cycle 'pulling' the operator's hands from the point of operation, if still there.

When the slide/ram is up between cycles, the operator is allowed access to the point of operation.



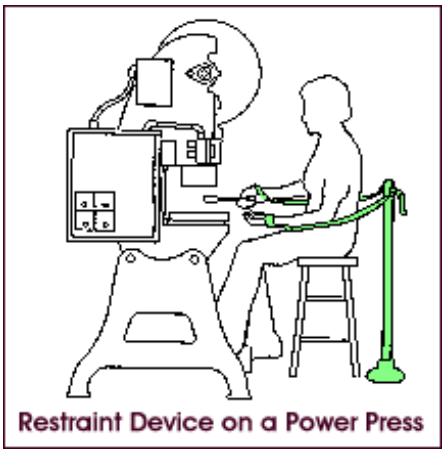
Pullback Device on a Power Press

Restraint

The restraint (holdout) device utilizes cables or straps that are attached to the operator's hands at a fixed point.

The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area. There is no extending or retracting action involved.

Consequently, hand-feeding tools are often necessary if the operation involves placing material into the danger area.

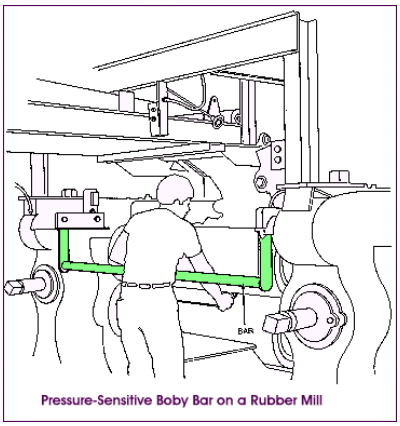

Restraint Device on a Power Press

Safety Trip Controls

Provides a quick means for deactivating the machine in an emergency situation.

A **pressure-sensitive bar**, strategically placed, will deactivate the machine when depressed.

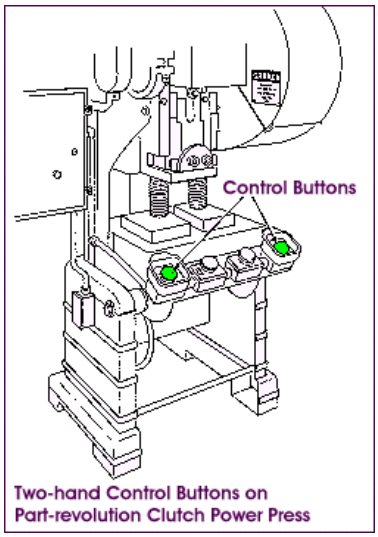
Safety **tripwire cables** may also be located around the perimeter or near the danger area.


Pressure-Sensitive Boby Bar on a Rubber Mill

Two-Hand Controls

Requires constant, concurrent pressure by the operator to activate the machine.

With this type of device, the operator's hands are required to be at a safe location (on the control buttons) and at a safe distance from the danger area.



Two-hand Control Buttons on Part-revolution Clutch Power Press

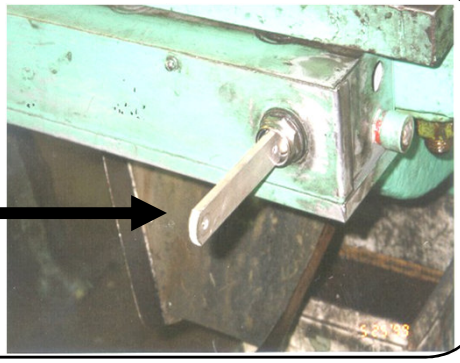
Two-Hand Trip

This device requires concurrent application of both the operator's control buttons to activate the machine cycle, after which the hands are free.

Two-hand controls and two-hand trips must incorporate both anti-tiedown and anti-repeat features:

Anti-tiedown prevents "tying" one button down and still being able to cycle the machine by depressing the other

Anti-repeat prevents continuous cycling

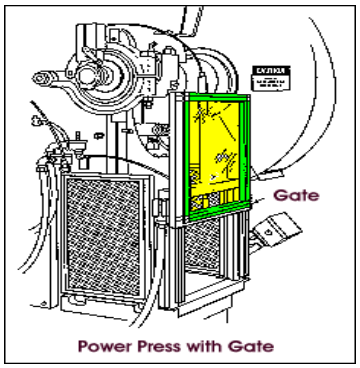


Gate

A gate is a movable barrier which protects the operator at the point of operation before the machine cycle can be started. They are usually designed to operate with each machine cycle.

Two types:

Type A - remains closed during entire cycle
Type B - remains closed during downstroke only

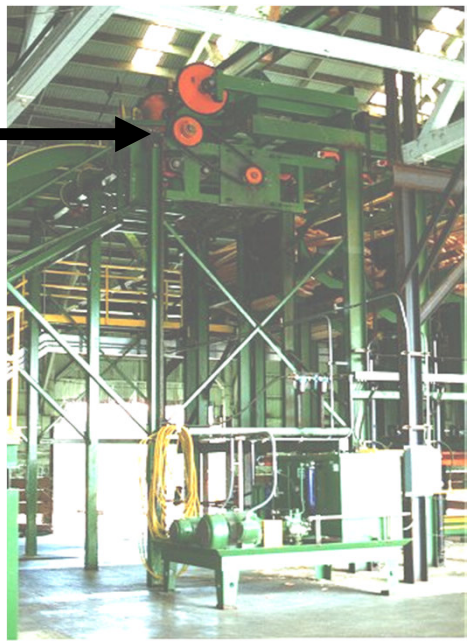


Power Press with Gate

Third Safeguarding Strategy: Location & Distance

The machine or its dangerous moving parts are positioned so that the hazardous areas are not accessible or do not present a hazard during normal operation.

- Walls
- Barriers/Fences
- Height above worker
- Size of stock (single end feed, punching)
- Controls (positioned at a safe distance)



Factors to consider when guarding by location/distance:

Can it still be accessed, even with great effort?

Can pieces/parts break and fall onto someone/something?

Are sparks or other flying debris being produced from the equipment?

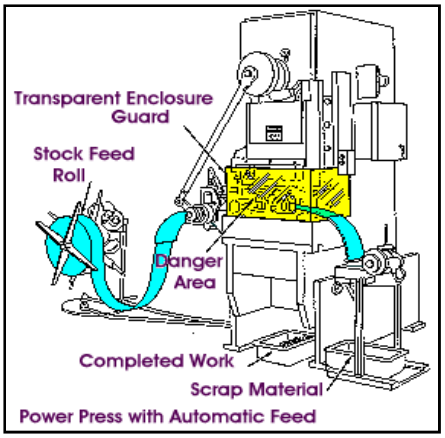
OSHA still has the "7 foot rule" for fan blades and power transmission devices but think twice about it - seven feet isn't much and can still be easily reached!

Fourth Safeguarding Strategy: Feeding & Ejection

Designing exposure out!

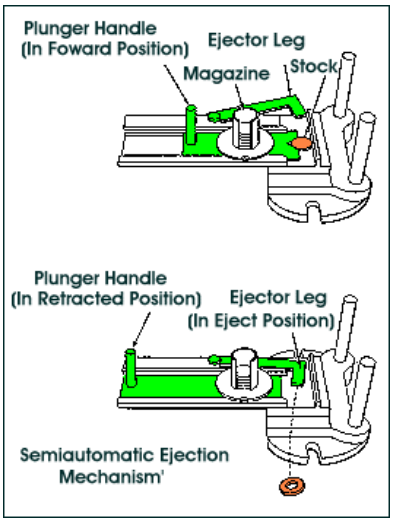
Automatic Feeding/Ejection

Operator involvement is not necessary after the machine is set up



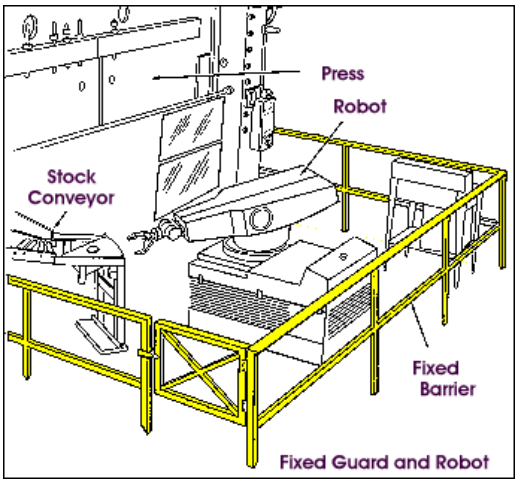
Semi-Automatic Feeding/Ejection

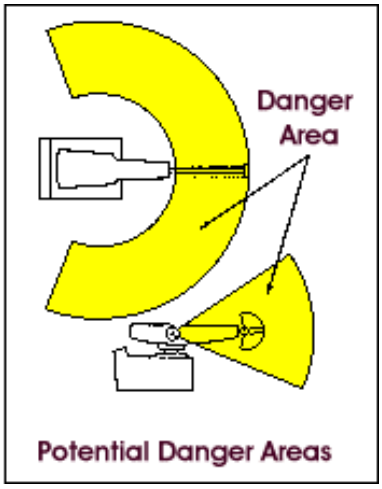
Manually feed without reaching into the point of operation or other danger zones



Robots

Machines that load and unload stock, assemble parts, transfer objects, and perform other tasks - otherwise done by the operator.



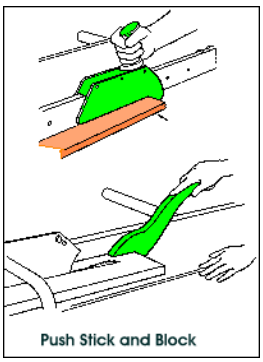


Robot concerns include being struck by robotic arms and other mechanisms within or near it's working envelope. Most common injuries are being struck by the end effector (claw on the end) and being pinned between end effector and a stationary object.

Also, possible malfunctions and/or missed steps can surprise nearby workers!

Recommended safety standard - ANSI/RIA 15.06-1999

Miscellaneous Aids



Does not give complete protection from machine hazards, but can assist in moving stock, deflecting minor chips, or providing awareness. Examples include awareness barriers, ropes, shields, holding tools, and push sticks or blocks. *Ensure hand feeding tools are made of soft materials to prevent shattering.*

Does not replace the need for personal protective equipment or guarding! For example, plexiglass shields on abrasive wheel grinders do not substitute the requirement for eye/face protection or a tongue guard if distance from safety guard and top periphery of stone exceeds 1/4 in. Plus, they can get in the way and are often broken or dirty - creating a hazard in themselves!

Metal turning machines (lathes, grinders, drills/mills, gear cutters, etc.) require chip/coolant shields and chuck shields. A spring loaded chuck wrench should always be used on metal lathes! Automated cutting/turning machines require point of operation guarding.

Anti-restart devices are required if machinery can automatically start when power is restored (i.e. after a power failure).

Idesco Corp.

Reference

Machine Safeguarding Training Guidelines

Guard Opening Scale

ANSI references for machine safeguarding

Machine Safeguarding Training Guidelines

An extremely important step in machine safeguarding - a step which oftentimes is overlooked - is providing safety instruction and training on the various types of equipment the worker is expected to operate and the safeguarding the worker is expected to use. At a minimum, this education should include:

- ✉ Discussion of hazardous exposures and control measures
  - • Hazardous motions
  - • Hazardous actions
  - • Potential of flying/ejected material
  - • Effective guarding methods and/or other control measures
  - • Ergonomics
  - • Fire/combustion potential
  - • Appropriate personal protective equipment and clothing
  - • Health hazards
    - - Air quality
    - - Noise & vibration
    - - Metal-working fluids
- ✉ Equipment-specific training (hands-on)
  - • Proper operation of safeguards
    - - Limitations
    - - Maintenance & care
    - - Inspection
    - - Adjustment/placement
  - • Clarification of manufacturer requirements
  - • Instruction on when safeguard is discovered damaged, missing, etc.

Don't forget safeguarding strategies also include management controls such as enforcing, training, inspecting, maintenance and repair! For example, clean and roomy work areas, lubricated self-adjusting guards, ring testing abrasive stones, ensuring stable fixed guarding, smooth edges, etc.

Also, don't forget personal disabilities (i.e. color blindness, hearing impaired) if relying on visual warnings (colors) and/or audible warnings (machine startup).

Retraining?

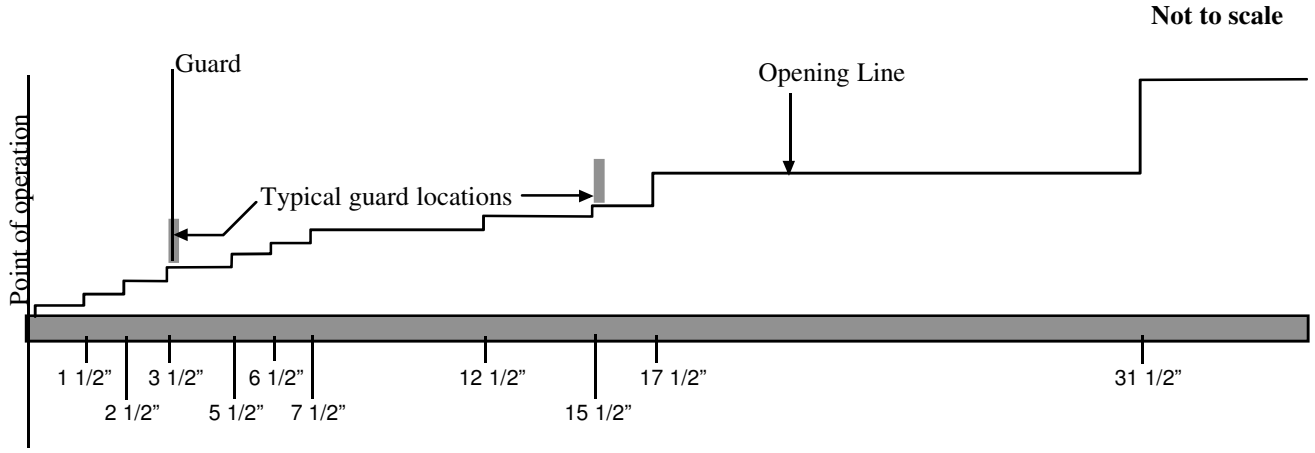
Training, and relevant retraining, must be provided for new operators and maintenance/setup employees. Also, retrain affected employees when new or altered safeguards are used, when the employee(s) is assigned to a new machine or operation, and whenever worker deficiencies are discovered.

Placing guards at a safe distance from point of operation

This diagram shows the accepted safe openings between the bottom edge of a guard and feed table at various distances from the point of operation hazard.

The various openings are such that for average size hands, an operator's fingers won't reach the point of operation.

After installation of point of operation guards and before a job is released for operation, a check should be made to verify that the guard will prevent the operator's hands or fingers from reaching the point of operation.



Distance of opening from point of operation hazard (inches)	Maximum width of opening (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
Over 31 1/2	6

Listing of Specific ANSI Safety Standards

ANSI B11.1 Mechanical Power Presses
ANSI B11.2 Hydraulic Power Presses
ANSI B11.3 Power Press Brakes
ANSI B11.4 Shears
ANSI B11.5 Iron Workers
ANSI B11.6 Lathes
ANSI B11.7 Cold Headers and Cold Formers
ANSI B11.8 Drilling, Milling, and Boring Machines
ANSI B11.9 Grinding Machines
ANSI B11.10 Metal Sawing Machines
ANSI B11.11 Gear Cutting Machines
ANSI B11.12 Roll Forming and Roll Bending Machines
ANSI B11.13 Single- and Multiple-Spindle Automatic Screw/Bar and Chucking Machines
ANSI B11.14 Coil Slitting Machines/Equipment
ANSI B11.15 Pipe, Tube, and Shape Bending Machines
ANSI B11.17 Horizontal Hydraulic Extrusion Presses
ANSI B11.18 Machinery and Machine Systems for the Processing of Coiled Strip, Sheet, & Plate
ANSI B11.19 Machine Tools, Safeguarding
ANSI B11.20 Manufacturing Systems/Cells
ANSI B15.1 Power Transmission Apparatus
ANSI B19.1 Air Compressor Systems
ANSI B19.3 Compressors for Process Industries
ANSI B20.1 Conveyors and Related Equipment
ANSI B24.1 Forging Machinery
ANSI B28.6 Rubber Machinery, Hose
ANSI B28.7 Rubber Machinery, Hose
ANSI B28.8 Rubber Machinery, Hose
ANSI B28.9 Rubber Machinery, Hose
ANSI B28.10 Rubber Machinery, Endless Belt
ANSI B30.16 Overhead Hoists
ANSI B151.1 Plastics Injection Molding Machinery, Horizontal
ANSI B151.2 Plastics Machinery, Film Casting
ANSI B151.3 Plastics Machinery, Screen Changers
ANSI B151.4 Plastics Machinery, Blown Film Takeoff & Auxiliary Equipment
ANSI B151.5 Plastics Machinery, Film & Sheet Winding
ANSI B151.6 Plastics Machinery, Slit Tape & Monofilament Postextrusion Equipment
ANSI B151.7 Plastics & Rubber Extrusion Machinery
ANSI B151.11 Plastics Machinery, Granulators, Pelletizers, & Dicers
ANSI B151.15 Plastics Machinery, Extrusion Blow Molding
ANSI B151.21 Plastics Machinery, Injection Blow Molding
ANSI B151.25 Plastics Machinery, Injection Molding
ANSI B152.2 Permanent-Mold Casting Machines (Other than Gray Iron)
ANSI B153.1 Automotive Lifts
ANSI B155.1 Packaging Machinery
ANSI B169.1 Envelope Manufacturing Machinery
ANSI B177.2 Printing Ink Vertical Post Mixers
ANSI/NEMA ICS2:225.95 Interlocking Control Circuits for Personnel Protection
ANSI/NFPA 79 Electrical Standard for Industrial Machinery
ANSI/RIA R15.06 Industrial Robots and Robot Systems
ANSI Z8.1 Commercial Laundry & Dry-Cleaning Equipment
ANSI Z241.1 Foundry, Sand Prep., Molding, & Core-Making
ANSI Z241.2 Foundry, Melting & Pouring of Metals
ANSI Z241.3 Foundry, Cleaning & Finishing of Castings
ANSI Z245.1 Refuse Collecting & Compacting Equipment
ANSI Z245.3 Stability of Refuse Bins
ANSI Z245.5 Bailing Equipment
ANSI Z268.1 Metal Scrap Processing Equipment

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