



# SMT Safety Series

## Lockout/Tagout and Machine Guarding

December 21, 2023

BENECON

# A premier self-funded worker's compensation program for Pennsylvania municipal entities and their employees.



Established in 1995 and administered in partnership with Benecon.

**78 members within a 36-county service area.**

# LOCKOUT/TAGOUT & MACHINE GUARDING

- ❖ Different types of hazardous energies to consider when working with machinery.
- ❖ Basic principles of machine guarding to ensure safety of workers around machinery.
- ❖ Fundamental concepts of lockout/tagout (LOTO) procedures to ensure isolation of hazardous energy sources before doing maintenance or repair work.

# Workplace Safety Resources Available on the “Members Only” Portal of SMT’s Website



[www.smtpa.org](http://www.smtpa.org)

Questions about SMT’s website? Contact Kelly Holmes: [kholmes@benecon.com](mailto:kholmes@benecon.com)

**SUSQUEHANNA MUNICIPAL TRUST**  
A regional workers compensation self-insured Trust  
Providing coverage for Pennsylvania municipalities and authorities

Home Advantages Board of Trustees Join SMT About SMT Contact s **Members Only**

**Providing workers compensation coverage in eastern and central Pennsylvania**

The Susquehanna Municipal Trust is a member owned, non-profit organization providing quality workers' compensation coverage for municipal entities and their employees.

[Learn More](#)

**Susquehanna Municipal Trust**  
A regional workers compensation self-insured Trust

The Susquehanna Municipal Trust (SMT) was established on July 1, 1995, as a non-profit self-insurance program for Pennsylvania municipal entities. SMT members include townships, boroughs and municipal authorities. As of January 2022, membership in the Trust is comprised of 78 municipal entities. Each municipal member strengthens the program and shares in the success of the Trust.

# Machine Guarding & Lockout Tagout



- The Types of Hazardous Energy
- The Basics of Machine Guarding
- The Basics of Lockout Tagout (LOTO)

Most effective



Least effective



**Elimination**

Physically remove the hazard

**Substitution**

Replace the hazard

**Engineering controls**

Isolate people from the hazard

**Administrative controls**

Change the way people work

**PPE**

Protect the worker with personal protective equipment

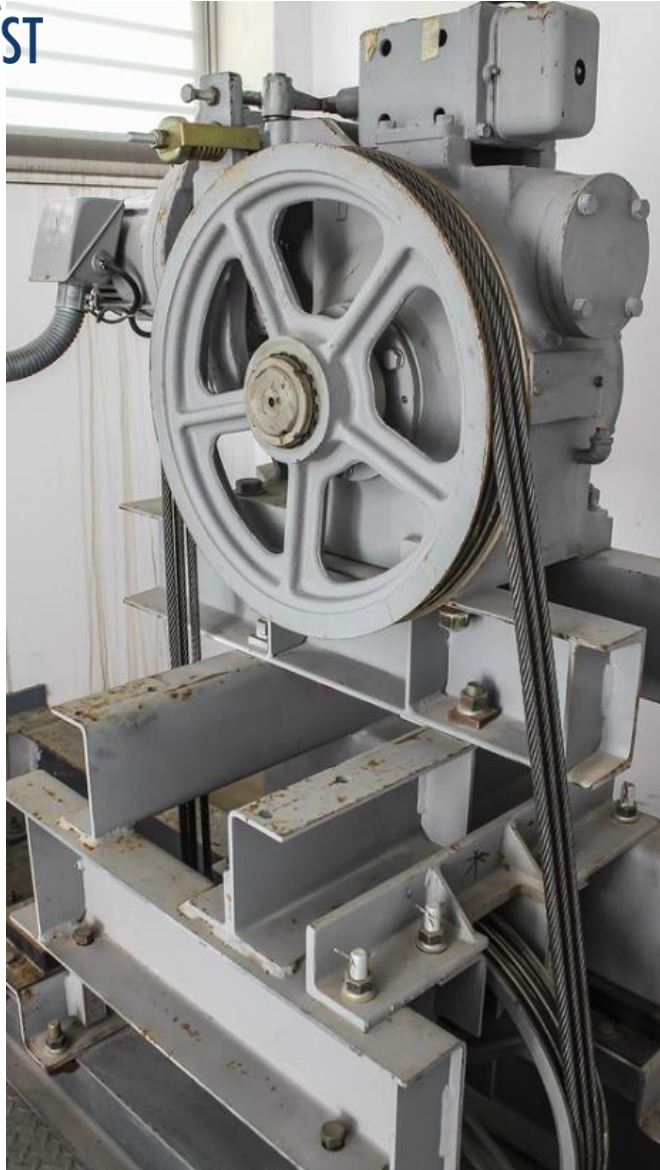


# Electrical Energy

---

- This is the most common energy type.
- Sources include the following:
  - Electrical power
  - Static electricity
  - Electrical storage devices
- Results may include the following:
  - Electric shocks
  - Burns
  - Electrocution
  - Explosions





# Mechanical Energy

---

- This energy is created by mechanical motion.
  - Rotation
  - Reciprocating Motion
  - Transverse Motion
  - In-running Nip Points
  - Cutting Action
  - Punching, Shearing, or Bending
- It may be found in the following:
  - Power transmission apparatuses
  - Fly wheels
  - Belts
  - Pulleys
- Contact with moving parts can crush, fracture, cut, or amputate a body part.

# Rotation

---

Mechanisms grab loose material.

Uneven surfaces increase the hazard.

This is a “caught-in hazard.”

Examples include the following:

- Drill bit
- Shafts
- Flywheels

**The rotation of this  
chuck and drill presents  
a hazard.**



# Reciprocating Motion

---

- It goes back and forth in a straight line.
- It also causes a caught-in hazard.
- Examples include shaker tables.



# Transverse Motion

---

- It moves in a straight line.
- It creates pinch points.
- Examples include the following:
  - Belt sanders
  - Belts moving in a single direction

# In-running Nip Points

---

These are points that rotate toward each other or a fixed component.

Examples:

Belts and pulleys

Mill rollers

Gears

Conveyor systems

**The rotation of these mill rollers presents an in-running nip point as the rollers rotate toward each other.**



# Cutting Action

---

- Cutting or removing materials
- Examples:
  - Table saw
  - Circular saw
  - Band saw

**This table saw blade lacks proper guards.**

## Punching, Shearing, or Bending



These involve two machine parts coming together.



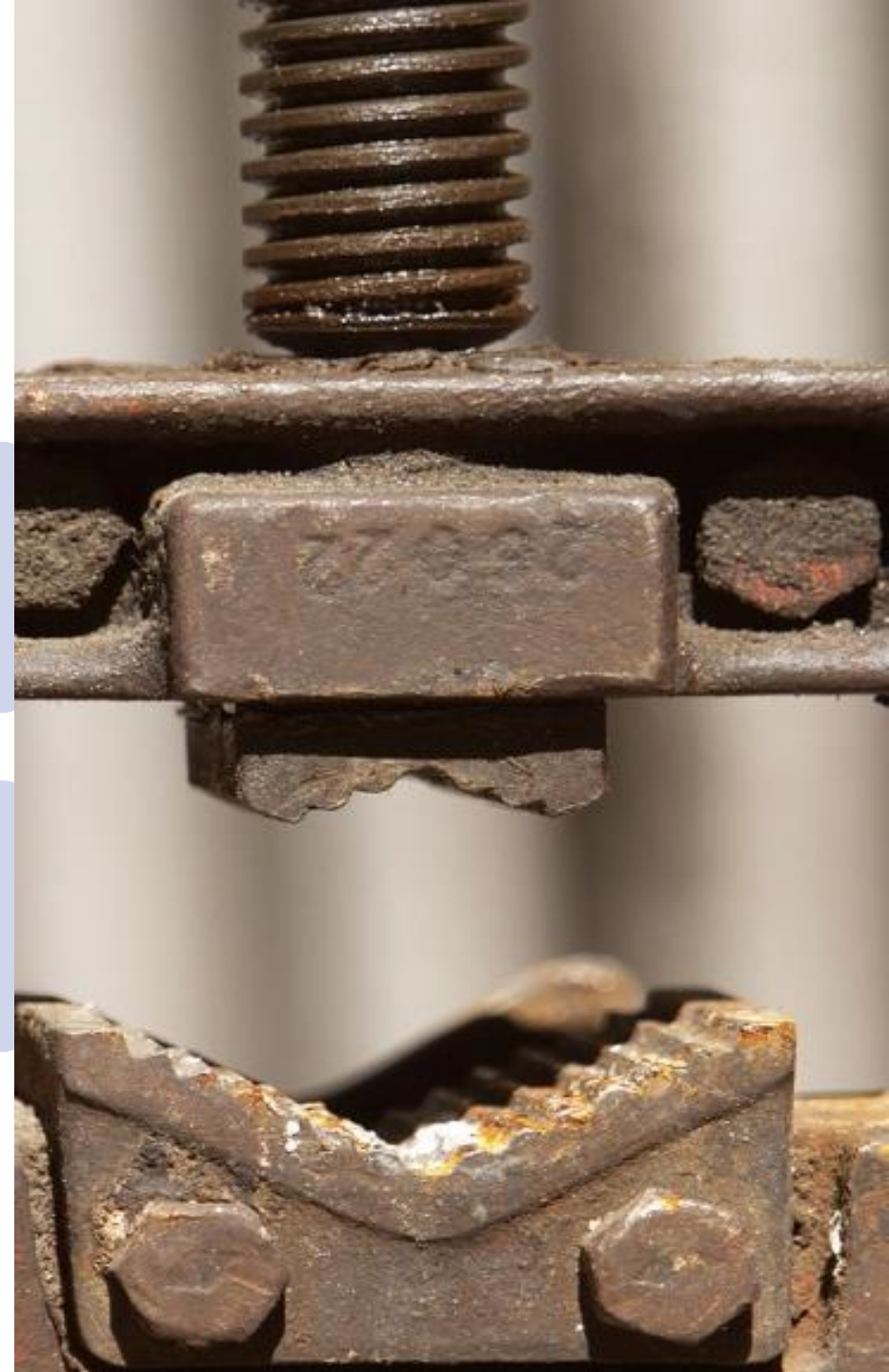
Examples include the following:

Power presses

Press brakes

Shears

Forges



# Chemical Energy

---

- It is the energy produced by chemical reactions.
- It may cause splashes or splatters.
- It often needs to be controlled in pipes and other portions of equipment.
- Other chemical-related dangers include:
  - Gas or heat from chemical reactions.
  - Hazardous chemicals.





# Pneumatic Energy

---

- It is the product of stored pressure from gas or air in pneumatic lines and vessels.
- Pressure must be relieved prior to servicing or maintenance.
- It may be encountered in the following:
  - Pressurized systems
  - Compressors
  - House air
  - Air powered tools
  - Gases



# Hydraulic Energy



- This energy is derived from the motion and pressure of liquids.
- It is commonly found in the following:
  - Pistons
  - Hydraulic brakes
  - Piston motors
  - Hydraulic presses



# Potential Energy

---

- It is stored energy that could be hazardous if released.
- Examples include the following:
  - Gravity
  - Springs
  - Thermal energy

Most effective



Least effective



**Elimination**

Physically remove the hazard

**Substitution**

Replace the hazard

**Engineering controls**

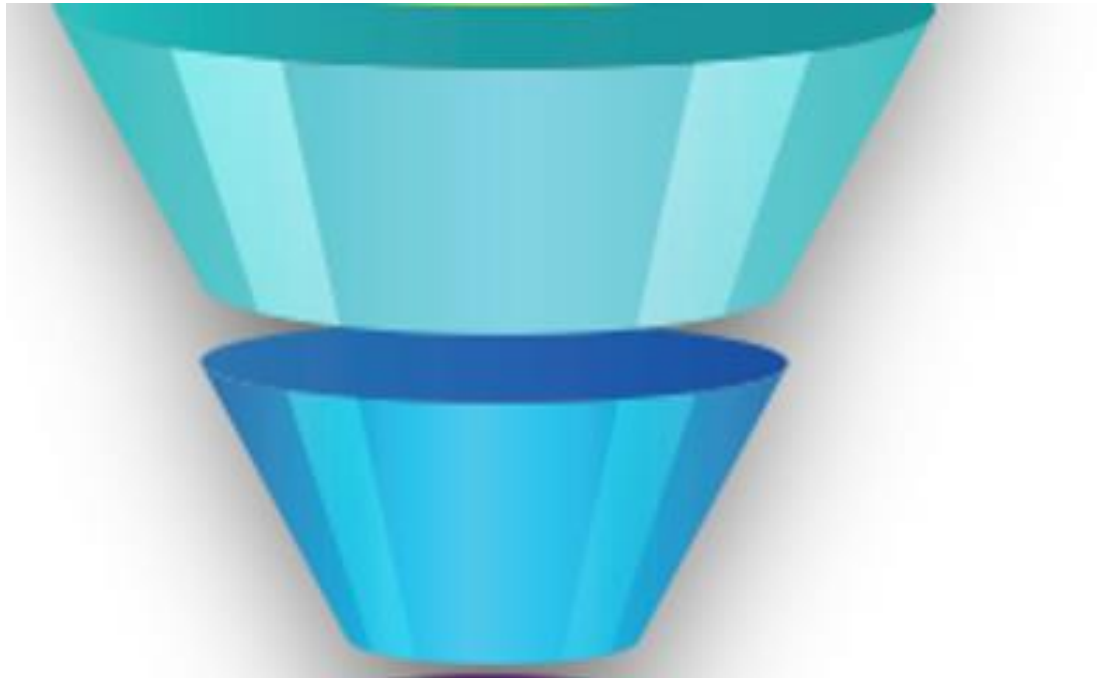
Isolate people from the hazard

**Administrative controls**

Change the way people work

**PPE**

Protect the worker with personal protective equipment



## Engineering controls

Isolate people from the hazard

## Administrative controls

Change the way people work



# Why is Machine Guarding Important?

Because guards protect the people and the equipment.

# Goals of Safeguarding

- Preventing access to the danger zone during operation
- Preventing objects falling into moving parts
- Allowing for safe lubrication and adjustment
- Being a permanent, securely-attached part of the machine that cannot be removed
- Not interfering with job or presenting an additional hazard





# Three Areas of Safeguarding

---

- Points of operation
- Power transmission apparatuses
- Other moving parts



# The Point of Operation

---

This is the point where the machine works on the material.

Examples include the following:

Cutting

Boring

Shaping

Forming

**The point of operation on this milling machine is the point where the drill action occurs.**



# Power Transmission Apparatus

---

## Power transmission apparatus:

- This powers the part of the machine that performs work.
- Examples include the following:
  - Chains
  - Belts
  - Flywheels





# Other Moving Parts

---

- All moving parts of the machine must be guarded.
- Examples:
  - Feed mechanisms
  - Auxiliary parts
  - Rotating transverse parts



# Types of Machine Guarding

---

- **Guards**
  - Interlocking
  - Self-adjusting
- **Safeguarding devices**
  - Two-hand controls
  - Light curtains
  - Pressure-sensitive mats
- **Other controls**
  - Emergency stops
  - Guardrails
  - Signs

# Definition

- Guards are barriers that prevent entry into the machine.
- Fixed guards are preferred.





# Design Requirements

---

- Take hazards and limitations into account.
- Minimize exposures.
- Maximize control.
- Fasten guards so that they require a tool for removal.
- Address potential issues that impact guard effectiveness.

**The shower of sparks on this cutting operation must be taken into consideration when selecting guard construction material.**

# Guard Openings

**Guards may have openings to allow the following actions:**

- Inserting the product into the point of operation
- Accessing the machine for inspection or lubrication
- Monitoring machine action

**The larger the guard opening, the further an employee can reach into it.**



# Interlocking Guards

---

Interlocking guards (interlocks) use a tripping mechanism that automatically shuts off the machine when a guard or cover is open or removed.

## Interlocks with:

- **Proximity switches** use a magnetic field.
- **Limit switches** use a switch to initiate the starting action.
- **A key-activated mechanism** is the preferred type.

A proximity switch on a trash compactor







# Self-adjusting Guards

---

- Maintain protection at the point of operation
- Adjust to allow varying sizes of stock to enter
- Prevent reach-in

**The guard on this circular saw adjusts as the blade goes through the stock.**

# (Ab)normal Production Operation

Machine safeguards must only be removed to specifically address a maintenance or safety concern.

## Never:

- Remove or modify safeguards during operation.
- Operate a machine that is unguarded.
- Place any part of your body in or near a machine's point of operation
- Place any part of your body in a danger zone associated with machine operations

## Always:

Follow formal lockout procedures when removal of guards necessary.

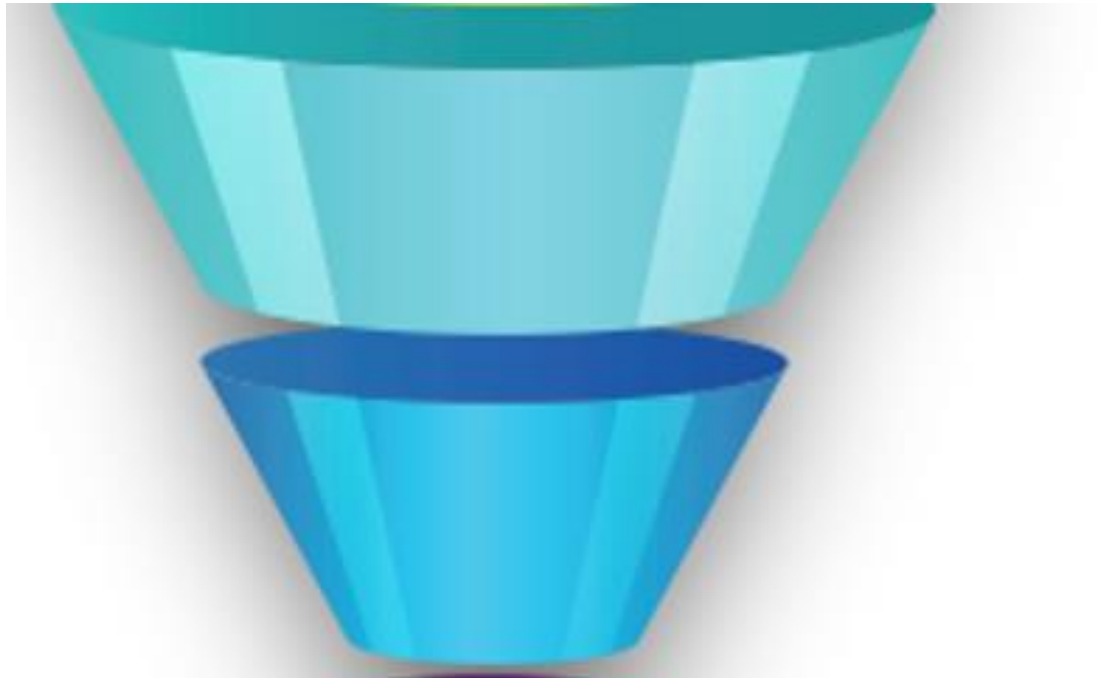


**NEVER SHORT CUT  
THE GUARDS THAT ARE  
THERE TO PROTECT YOU**





**Always fully isolate before working on any moving machinery. Never defeat or interfere with any safety device including guarding and electrical panels!**



## Engineering controls

Isolate people from the hazard

## Administrative controls

Change the way people work

# Importance of Lockout and Tagout Programs

Employees servicing equipment face  
severe injuries or even death.

---



# LOTO Basics



## What is Lockout?

Lockout involves isolating or securing prime movers, machinery, and equipment from hazardous energy sources using devices, methods, and procedures.



## Lockout devices

Lockout devices hold energy-isolation devices in a safe, "off" position. They prevent machines from becoming energized by acting as restraints that cannot be removed without a key or other unlocking mechanism.



## Tagout devices

Tagout devices warn employees not to reenergize a machine while it's being serviced. They're easier to remove than lockout devices and provide less protection by themselves.

# LOTO Basics

- When are you required to use LOTO
  - If your employees service or maintain machines where the unexpected startup, energization, or the release of stored energy could cause injury, you will likely be required to use LOTO.
    - Sources of Energy: mechanical, electrical, hydraulic, pneumatic, chemical, etc...



# Service or Maintenance Activities

Service or maintenance activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining or servicing machines or equipment.

These activities include lubricating, cleaning or unjamming machines, and making adjustments or tool changes, where the employees may be exposed to hazardous energy.



# Roles and Responsibilities

Affected employees



Authorized employees



Other employees



# Program Requirements

---

- A program is required if employees service or maintain machines or equipment that can start up unexpectedly or release stored energy.
- The program must:
  - Establish procedures for removing energy supplies and applying lockout/tagout devices.
  - Address stored or potentially accumulated energy, when appropriate.
  - Include training and program review requirements.
- Customize the program to each individual site.



# Hazardous Energy Control Procedures

## **The HECPS must clearly and specifically outline at least the following:**

The machines, equipment, operations, and processes where they apply (i.e., scope)

What the procedures are used for (i.e., purpose and intended use)

The name of the people who will carry out the procedures (i.e., authorization)

Rules for carrying out the procedures

The means to enforce compliance with the procedures

Techniques used for the control of hazardous energy

The steps (meaning the procedures and requirements) for:

- Shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy;
- The placement, removal, and transfer of lockout / tagout devices and who is responsible (i.e., responsibilities) and,
- Testing to determine and verify the effectiveness of lockout and tagout devices and other hazardous energy control devices.

## EQUIPMENT-SPECIFIC LOCKOUT/TAGOUT PROCEDURE

General Information					
Building or Location		Intended Use			
Manufacturer and Equipment Name		Asset Number(s)/ Equipment ID(s)			
Required Device(s)					
Permit(s) Required					
<input type="checkbox"/> Hot Work <input type="checkbox"/> Confined Space <input type="checkbox"/> Other (specify)					
Hazardous Energy Identification					
<input type="checkbox"/> Chemical <input type="checkbox"/> Electrical <input type="checkbox"/> Gravitational potential <input type="checkbox"/> Hydraulic potential <input type="checkbox"/> Kinetic <input type="checkbox"/> Mechanical <input type="checkbox"/> Pneumatic potential <input type="checkbox"/> Radiation <input type="checkbox"/> Thermal					
Personal Protective Equipment Required					
<b>ONLY TRAINED AND AUTHORIZED PERSONNEL SHALL CONDUCT LOCKOUT/TAGOUT.</b>					
Shutdown Overview					
Shutdown Procedure					
1	Notify all affected employees that servicing or maintenance is required on the machine or equipment and all energy sources will be shut down and locked out to perform the servicing and maintenance.				
	Energy Source(s)	Control Method and Location(s)	Required Devices	Verification Method and Location(s)	Picture(s) (optional)
2					
3					
4					
5					
6					

Final step	Perform servicing and maintenance on equipment.
<b>IF THE SYSTEM CANNOT BE LOCKED OUT OR IF SYSTEM FAILS VERIFICATION, CONTACT YOUR SUPERVISOR.</b>	

Startup Procedure	
1	
2	
3	
4	
5	
6	
Final step	Notify affected employees that the servicing or maintenance is complete and the equipment is ready for use.

Version History and Approvals		
Date:	Name and Position:	Status: (Created/Approved/Annual Review*)

*\*Procedure must be annually reviewed*



# Hazard Assessment

---

- Identify all the hazardous sources.
- Hazardous energy may include the following:
  - Electrical
  - Mechanical
  - Chemical
  - Hydraulic
  - Pneumatic
- Also consider the following:
  - Stored or potential energy
  - Thermal sources
  - Human factors

# Energy Control Procedures: Overview of Steps

---

- Prepare for shutdown
- Shutdown
- Isolate energy sources
- Apply locks & tags
- Control residual energy
- Verify energy control methods





# Energy Control Procedures: Step 1—Prepare for Shutdown

- Notify affected employees of activities.
- Identify shutdown procedures.
- Identify energy sources.
- Identify energy isolation devices.
- Determine quantity and type of lockout/tagout devices required.

# Energy Control Procedures: Step 2—Shutdown

---

- Shut equipment down by its normal start/stop method.





# Energy Control Procedures:

## Step 3—Isolate Energy Sources

- Use energy-isolating devices appropriate for the energy source, such as:
  - Manually-operated circuit breakers or electrical disconnects for electrical energy.
  - Valves for pneumatic energy.
  - Blocking or bars for mechanical energy.
- All devices must be equipped with a place to attach a hasp or a lock or have a built-in locking mechanism.



## Energy Control Procedures: Step 4—Apply Locks and Tags

---

- Locks are attached so that the device cannot be operated until locks are removed.
- Devices must be in the off position.
- Tags indicate that the device and equipment may not be operated.
- Locks, tags, signs, and seals must be securely attached.
- The name of the authorized employee must be included.



# Energy Control Procedures: Tagout-only Programs

---

- Some energy-isolating devices may not allow locks.
- Tags are attached where a lockout device would be placed.
- Disadvantages include:
  - No physical protection.
  - A possible false sense of security.



# Energy Control Procedures: Requirements

---



- **Requirements for all devices:**
  - Durable
  - Standard in color, shape, and appearance
  - Substantial enough to prevent accidental removal
    - Tags must have a minimum unlocking strength of 50 lbs.
  - Labeled with the authorized employee's name

# Energy Control Procedures: Additional Tag Requirements

- Readable and understandable by all employees
- Contains instructions not to operate or energize equipment
- Single-use
- Self-locking
- Non-releasable
- Applied by hand



*Best practice is to use **both** locks and tags.*



A piece of equipment already has a lock and tag. Do I have to place my own locks & tags?

- **YES!!!!!!!!!!!!!!**
- **Each person working on the equipment must place their own locks and tags to ensure their safety.**

# Energy Control Procedures: Group Lockout

---

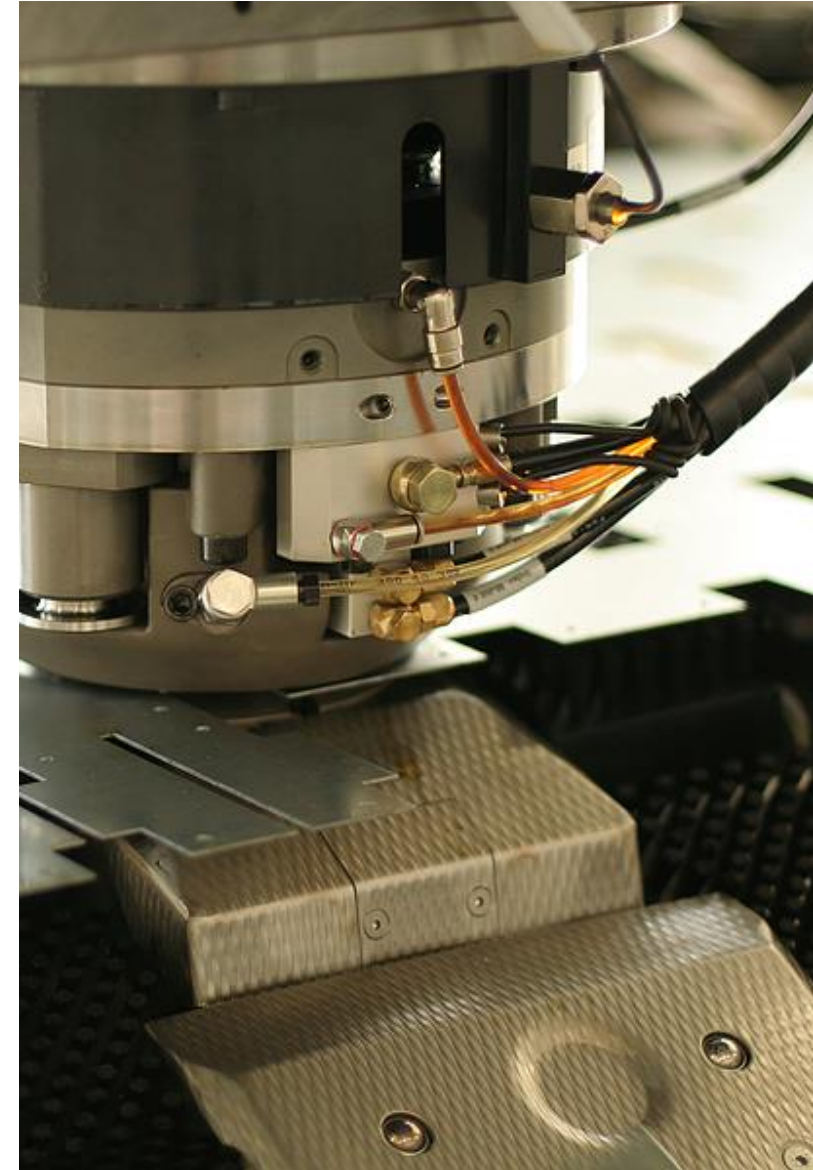
- One employee has overall responsibility.
- Each person verifies the lockout.
- They attach personal devices to the group lockout box.
- It must provide the same level of protection.



## Energy Control Procedures: Step 5—Control Residual Energy

---

- Release, restrain, or dissipate energy.
- Prevent the reaccumulation of energy.
- Isolate the space:
  - Blind the lines.
  - Disconnect and misalign the lines.
  - Double block the valves and bleed the residual materials.







## Energy Control Procedures: Step 6—Verify Energy Control Methods

---

- Assure that switches, valves and other mechanisms cannot be turned on.
- Activate equipment control switches and levers, and depress start buttons to assure the power is isolated.
- Return switches, levers, and buttons to the off position.
- Use a meter to assure that electrical energy is not present.



# Energy Control Procedures: Start-up Procedures

---

- Inspect area and remove all tools, rags, and other materials.
- Assure that equipment is operationally intact.
- All guards and other safety devices are replaced, if applicable.
- Notify affected employees that equipment will be restarting.
- Check work area to assure all employees are safely positioned.
- Verify all controls are in the neutral or off position.
- Remove lockout/tagout devices.
- Notify affected employees that lockout/tagout devices have been removed and the equipment or machinery is ready for use.

# Who can remove Locks & Tags?



# Who can remove Locks & Tags?

- Only the employee who placed the tag
- or
- A supervisor, after obtaining permission from the worker who placed the tag, or after verifying that the employee has left the building.



### Man Cooked With Tuna

10/11/12 - Jose Melena was performing maintenance in a 35-foot-long oven at the company's Santa Fe Springs plant before dawn Oct. 11, 2012, when a co-worker, who mistakenly believed Melena was in the bathroom, filled the pressure cooker with 12,000 pounds of canned tuna and it was turned on.

# Lockout-Tagout Protects YOU!

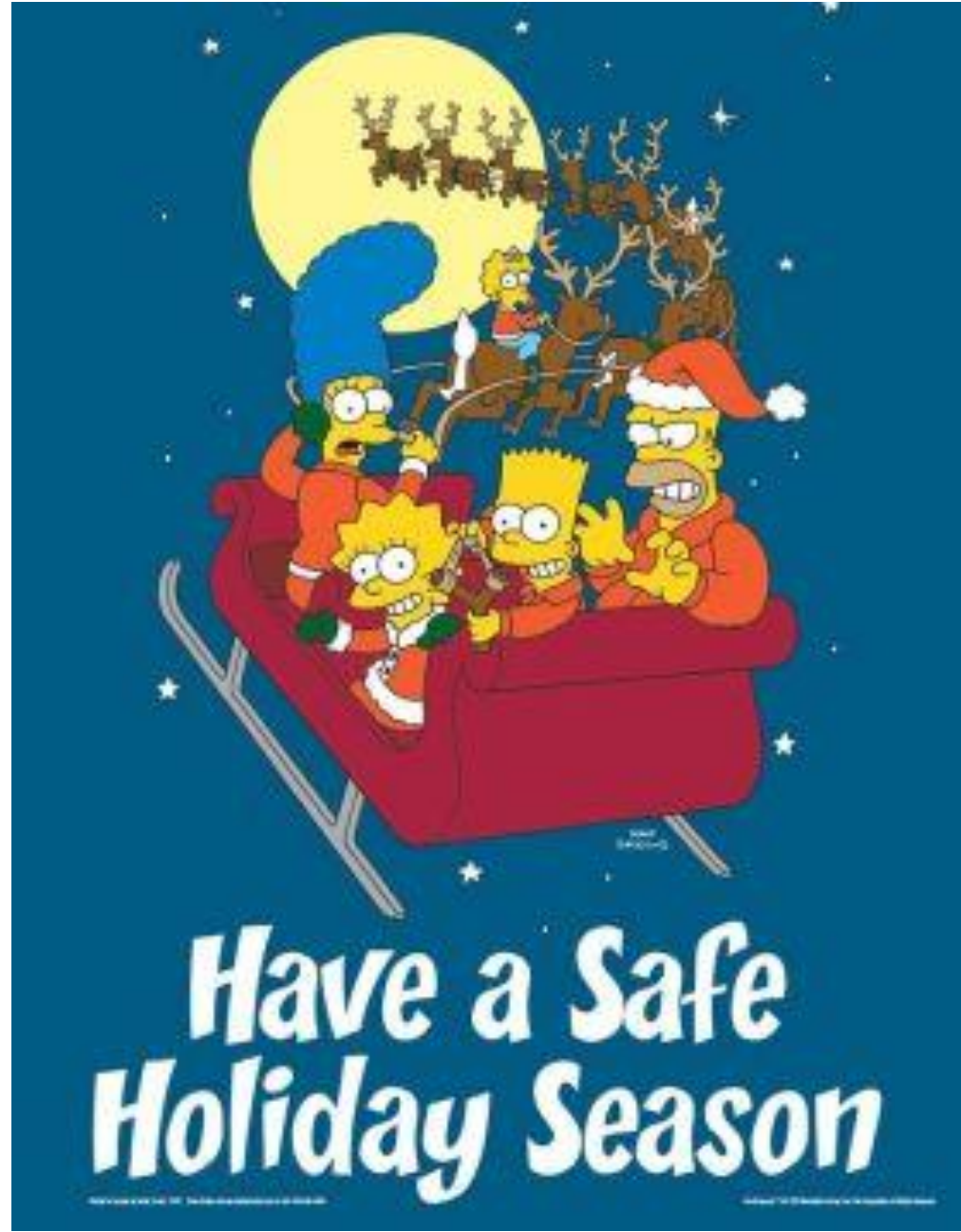
---

- **USE Proper Lockout - Tagout Procedures**
- **Please be careful when working on equipment**



# Any Questions?









# Thank you!

- SMT website: [www.smtpa.org](http://www.smtpa.org)



# SMT Safety Series

**NEXT MONTH...**

**SMT AIPP MANUAL TEMPLATE**

January 25, 2024

**BENECON**