This course focuses on the requirements of the OSHA Standard 1910.147, The control of hazardous energy (lockout/tagout). When lockout/tagout is not performed correctly, it usually results in a serious injury or fatality.
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OSHAcademy Course 621 Study Guide

Controlling Hazardous Energy (Lockout-Tagout)

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Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 621.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Modules and Learning Objectives

Module 1 – Introduction to Rule Requirements

Learning objectives in this module include:

- Discuss the purpose and scope of the Energy Control Program.
- Describe the two states and at least five types of hazardous energy.
- Give an example of how energy is transformed from one type to another.
- Discuss the differences among lockout (LO), tagout (TO), and lockout/tagout (LOTO).
- List the eight exceptions to the requirement to perform lockout/tagout.
- Describe the various types and criteria for lockout/tagout devices.

Module 2 – Training and Inspections

Learning objectives in this module include:

- Describe Energy Control Program training and retraining requirements.
- Contrast training requirements for authorized, affected, and other employees.
- Describe the additional training requirements when tagout procedures are used.
- Discuss training documentation and certification requirements for authorized employees.
- Describe periodic Energy Control Program inspection requirements.
- Describe the various types of corrective actions that might be required after inspections.

Module 3 – Lockout/Tagout Procedures

Learning objectives in this module include:

- List the seven basic steps in performing lockout tagout.
• Discuss the process of identifying energy sources and energy-isolating devices.

• Describe how to properly de-energize equipment and machinery for lockout/tagout.

• Identify how to properly secure energy-isolating devices.

• Discuss the importance of dissipating or restraining potential energy.

• Contrast traditional lockout/tagout with group lockout/tagout procedures.

• Discuss how to verify equipment isolation.

• Discuss the procedures for release from lockout/tagout.

• Describe the proper sequence for lockout/tagout for testing purposes.

• Discuss the relationship and procedures when working with contractors.
Course Introduction

This course presents OSHA's general requirements for controlling hazardous energy during service or maintenance of machines or equipment as detailed in 29 CFR 1910.147, Control of Hazardous Energy. It is not intended to replace or to supplement OSHA standards regarding the control of hazardous energy.

After completing this course, you should also review the OSHA standards on the control of hazardous energy to gain a complete understanding of the requirements regarding the control of hazardous energy. These standards, as well as other relevant resources, are identified throughout this course. For a more complete treatment of this subject take OSHAcademy course 710 Energy Control Program.

Craft workers, electricians, machine operators, and laborers are among the 3 million workers who service equipment routinely and face the greatest risk of injury. Workers injured on the job from exposure to hazardous energy lose an average of 24 workdays for recuperation.

Lockout/Tagout will most likely be required where you work because, after all, just about every workplace includes hazardous energy sources that could injure or kill workers.
Module 1: Introduction to Rule Requirements

Energy Control Program (ECP) Purpose

Information about the Energy Control Program (ECP) can be found in 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout).

The purpose of the ECP is to provide written policies and rules within your safety management system that help prevent injury to workers due to the unexpected startup of machines and equipment, or release of stored energy.

Scope of Lockout/Tagout Rule

Employers must establish an Energy Control Program (ECP), comprised of three core components: energy control procedures; employee training, and periodic inspections to ensure machines and equipment that could unexpectedly startup, become energized, or release stored energy, are isolated from their energy source(s) and rendered safe before service and maintenance are performed.

1. Energy control procedures detail and document the specific information that an authorized employee must know to accomplish lockout/tagout, i.e., the scope, purpose, authorization rules and techniques to be used for the control of hazardous energy.

2. Periodic inspections of the energy control procedures ensure the procedures are effective and the requirements of the standard are being followed.

3. Employee training and retraining, along with additional training under a tagout system, ensure that authorized, affected, and other employees understand the purpose and function of the energy control programs.

Quiz Instructions

After each section, there is a quiz question. Make sure to read the material in each section to discover the correct answer to these questions. Circle the correct answer. When you are finished go online to take the final exam. This exam is open book, so you can use this study guide.
1. Each of the following is one of the three core components of a Energy Control Program, EXCEPT _____.
   a. energy control procedures
   b. periodic inspections
   c. Job Hazard Analysis
   d. training and retraining

Lockout/Tagout Definition

"Lockout/tagout" (LOTO) refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

The standard requires, in part, that a designated individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance. It also requires that an authorized employee(s) either locks or tags the energy-isolating device(s) to prevent the release of hazardous energy and take steps to verify that the energy has been isolated effectively.

If the potential exists for the release of hazardous stored energy or for the re-accumulation of stored energy to a hazardous level, the employer must ensure that the employee(s) take steps to prevent injury that may result from the release of the stored energy.

Two States of Energy

Energy is the power for doing work. Energy exists in different types, but they are all associated with motion. Regardless of the type, energy exists in two basic states: potential energy and kinetic energy. Tensioned objects such as suspended loads have potential energy – energy that has the opportunity for motion. Releasing the load converts potential energy to kinetic energy, causing the load to drop.

1. **Potential Energy** is stored energy that may be drawn upon to do work. Potential energy can be viewed as motion waiting to happen based on an object’s position, such as the energy found in elevated, suspended, compressed, or coiled materials. Potential energy can be converted to kinetic energy to do work.

2.
2. **Kinetic Energy** is energy resulting from moving objects, such as released loads, uncoiling springs, and moving machinery. When these objects are released, their potential energy converts to kinetic energy.

2. When a forklift is raised by a hoist, it has _____ energy. If it falls on a worker, the _____ energy can injure or kill.
   a. lifted, quantum
   b. potential, kinetic
   c. kinetic, gravitational
   d. moving, weight

**Types of Energy**

It's important to understand that electricity is not the only form of hazardous energy employees may encounter during lockout/tagout. Main energy sources that supply power to the entire machine or equipment may be electrical, but secondary energy sources such as pneumatic or mechanical energy may still be stored with the potential to cause injury. One or more of the following types of energy may require de-energization to completely isolate the equipment.

- **Chemical**: Liquids, such as gasoline, diesel, benzene, acids, and caustics. Gases, such as propane, natural gas, and methane. Solids, such as fertilizer, wet and dry cell batteries, and combustible dust.

- **Electrical**: Alternating (AC) and direct (DC) currents. Includes equipment and conductors at both household and industrial-voltages, photovoltaic systems, circuit breakers, transformers, capacitors, inverters, motors, and hybrid vehicles.

- **Gravitational**: Objects such as a hoisted vehicle, raised dumpster lids, objects supported by a crane, and elevated dump truck beds. Gravitational energy is one form of potential energy.

- **Hydraulic**: Pressurized hydraulic systems, including hoses, pumps, valves, actuators, and reservoirs such as those on a forklift, in an automotive vehicle hoist, power press equipment, or an injection molding machine.
• **Mechanical**: Sources such as a breeze rotating a wind turbine, water moving a paddle wheel, vehicle/mobile equipment movement, and a spring under compression. Extreme sound is also a hazardous mechanical energy.

• **Pneumatic**: Pressurized air or gas systems, including pipes, pumps, valves, actuators, and pressure vessels such as those found in coating or pesticide sprayers, air compressors, and tank and pipe purging systems.

• **Radiant**: Energy that travels by waves or particles, particularly electromagnetic radiation such as heat or x-rays. Ionizing radiation includes alpha and beta particles, computed tomography (CT) and X-rays. Non-ionizing radiation includes lasers, radio frequency (RF), and microwave (MW).

• **Thermal**: Hot water, heated oil, steam, and equipment need time to cool, while liquefied gases, such as nitrogen, need time to warm to safe thermal levels.

• **Explosive**: The rapid increase in the volume of energy with the generation of high temperatures and the release of gases. Supersonic explosions are called detonations. Subsonic explosions are called deflagration. A boiling liquid expanding vapor explosion is called BLEVE.

3. Which of the following is an example of potential energy?
   a. X-rays
   b. Boiling water
   c. Rotating wind turbine
   d. Capacitors

**Energy Transformation**

Energy is often converted from one type to another to make it more useful. For instance:

**Power Plant**

• Chemical energy stored within a fuel such as coal is released as thermal energy when it is burned at a power plant.

• This thermal energy is used to heat water within a boiler to create steam, which expands to rotate a turbine, generating electricity.
• The electrical energy is then distributed along power lines to businesses where the electricity can be used to power commercial and residential users.

**Air Compressor**

• An air compressor’s electric motor forces ambient air into a pressure vessel, confining large amounts of air into a small space for future use.

• This stored air is pneumatic potential energy that can be used at a later time. During an electrical power failure, you can still use an air-powered tool, as long as sufficient potential pneumatic energy (compressed air) remains within the air compressor’s pressure vessel to operate the tool.

**When Energy Becomes Hazardous**

Energy becomes hazardous when it builds to a dangerous level or is released in a quantity that could injure a worker. Hazardous energy is never far from those who need to service or maintain equipment. Simply turning the power off does not make the equipment safe! It is critical that those who service or repair equipment know how hazardous energy could harm them and how to control it.

4. **When energy is changed from one form to another, it is called energy _____**.
   
   a. transformation
   b. intensification
   c. entropy
   d. actualization

**Lockout Vs. Tagout**

**Equipment capable of being locked out.** If an energy isolating device can be locked out, the employer must use a lockout system unless the employer can prove that the tagout system will provide "full employee protection." Remember, if you can lock it out, do not tag it out.

**Equipment not capable of being locked out.** If the employer can prove that an energy isolating device cannot be locked out, the employer must use a tagout system. To use a tagout system, the employer must meet the requirements for additional training and periodic inspections.
Lockout (LO), Tagout (TO), or Lockout/Tagout (LOTO)

You actually have three options when performing lockout/tagout:

Option 1: Lockout (LO): Lockout follows an established procedure for placing a lockout device such as a padlock on an energy-isolating device to create a physical barrier of protection. If an energy-isolating device can accept a lockout device, you must use lockout – no exceptions!

Option 2: Tagout (TO): Tagout is a procedure for placing a warning tag or sign – a tagout device – on an energy-isolating device that cannot accept a lockout device. Tagout devices must control hazardous energy, at least as effectively as lockout devices. Since tagout devices do not provide the same physical barrier to hazardous energy as lockout devices, it is harder to ensure that they are equally effective. An additional measure of protection must be taken to provide equivalent protection. For this reason, some employers call this system "Tagout Plus."

Examples of additional tagout measures include removing a battery from a vehicle or removing the handle from a valve. A tagout device must be securely fastened to the energy-isolating device and must state that the equipment being serviced cannot be operated until it is removed.

Option 3: Lockout/Tagout (LOTO). As a best practice, many employers use a combination of lockout devices and tags commonly referred to as lockout/tagout or LOTO. The lockout device, when secured on an energy-isolating device, provides the mandatory physical employee protection while the use of tags serves as both a visual and written notification to others. Remember, the use of lockout is the minimum requirement if an energy-isolating device can accept a lockout device.

Best Practice: Require authorized employees to attach a tag when securing the lockout device to the energy-isolating device. Provide custom tags that include the authorized employee’s picture.

5. When can an employer use a tagout system on equipment that is capable of being locked out?
   a. When the employer can prove lockout is not possible
   b. When the employer can prove full employee protection
   c. When the employer can prove the scope of work is minimal
   d. When the employer can prove lockout is inconvenient
LOTO Procedure Elements

Procedures for equipment with one or more sources of energy must detail the scope, purpose, authorization, rules and techniques that the employer will use to control hazardous energy.

- **Scope:** The scope might be limited to a single or group of similar pieces of equipment or machinery.

- **Purpose:** The purpose of the procedures is to ensure the unexpected energization/startup or shutdown does not occur during servicing or maintenance activities.

- **Authority:** The responsible manager authorizes the procedures and ensures specific rules/techniques are listed within the procedures.

The procedures must state the means to be used to enforce compliance. This requirement is typically met by stating the procedure is mandatory and may result in disciplinary action.

At a minimum, the procedures must include the following:

- a statement of the intended use of the procedure;

- steps for shutting down, isolating, blocking, and securing equipment;

- steps for the placement, removal, and transfer of lockout devices; and

- test methods to verify equipment has reached a safe, zero energy state.

**Best Practice:** Place "machine-specific" lockout/tagout procedures at the location of the equipment. Include photographs of the energy-isolating devices specific to the equipment.

6. Where should written machine-specific lockout/tagout procedures be placed?

   a. Within the facility of building
   b. In a centralized workplace location
   c. Where the equipment is located
   d. Within the department in which the equipment is operating
The Eight Exceptions

The employer must develop, document, and use a written LOTO procedure for servicing or maintenance of a machine or equipment unless **ALL** the following eight exceptions exist:

1. The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after it is shut down which could endanger employees.

2. The machine or equipment has a single energy source which can be readily identified and isolated.

3. The isolation and locking out of the energy source will completely de-energize and deactivate the machine or equipment.

4. The machine or equipment is isolated from the energy source and locked out during servicing or maintenance.

5. A single lockout device will achieve a lock-out condition.

6. The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance.

7. The servicing or maintenance does not create hazards for other employees.

8. The employer, in utilizing this exception, has had no accidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance.

Again, if the employer cannot meet the above exception criteria, they must develop and use written LOTO procedures.

**New or Modified Equipment**

All new machines and equipment, or all machines and equipment that undergo major repair, renovations or modification, must be equipped with energy-isolating devices capable of accepting a lockout device.

Whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machine(s) or equipment must be designed to accept a lockout device.
7. If the employer has had previous accidents involving the unexpected startup of equipment, the employer _____.

   a. must have written lockout/tagout procedures for the equipment
   b. must have written procedures if the previous accidents were serious
   c. may elect to have written procedures for the equipment
   d. must conduct a Job Hazard Analysis on all equipment

Lockout Devices

Lockout devices, which are typically locks, hold energy isolation devices in a safe or “off” position.

They provide protection by physically preventing machines or equipment from becoming energized because they are substantial positive restraints that no one can remove without a key or other unlocking mechanism, or through extraordinary means, such as bolt cutters. The various types of lockout devices include:

- **Circuit Breaker Lockout** – Designed to help lock out most major brands of breakers. The goal of this product is to isolate a given breaker in a circuit breaker panel so that the entire breaker box does not need to be locked out.

- **Valve Lockouts** – Designed to prevent fluid or gas valves from being opened while repair or maintenance is occurring. This could involve ball valves (handle you turn 90° to shut off) or gate valves (round knob). Ball valve lockouts are measured by the length of the handle. Gate valve lockouts are measured by the diameter of the knob.

- **Plug Lockout** – Helps lock out any electrical plug up to certain diameters.

- **Electrical/Pneumatic Plug** – This multipurpose device can lock out electrical cords and male air hose connectors.

- **Wall Switch Lockout** – Prevents workers from tampering with switches or accidental startup of equipment. Switch can be locked in the on or off position.

- **Adjustable Cable Lockout** – Comes with a cable that allows for locking out a wide variety of electrical or valve lockouts and accommodates multiple padlocks.
• **Hasp** – Allows more than one worker to put their padlock on an energy control device when more than one worker is performing maintenance on a given piece of equipment.

• **Group Lock Box or Gang Box** – Commonly used to lock out very large pieces of equipment that have multiple work functions affecting the maintenance of the equipment. This box allows for each lockout point to be secured with just one designated lock. The accompanying keys are then placed in the box. Each employee locks just one personal safety lock onto the box. The captured keys cannot be removed, or the equipment re-energized until all have removed their locks from the box.

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**8. How do lockout devices physically prevent equipment and machines from being energized?**

a. They must have a key to work  
b. They require a substantial force  
c. They provide a substantial positive restraint  
d. They are controlled by authorized employees

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**Tagout Devices**

Tagout devices are prominent warning devices that an authorized employee fastens to energy-isolating devices to warn employees not to re-energize the machine while he or she services or maintains it.

Tagout devices are easier to remove and, by themselves, provide employees with less protection than do lockout devices.

Tags are attached with plastic ties and must be hard to remove. There are specific requirements for the use of tagout devices:

1. The tags must be attached where the lockout devices would be located.

2. The employer must prove the tagout system will provide protection at least as effective as locks and will provide full employee protection.

The employer must demonstrate the protection achieved using tags is equivalent to the level of safety obtained by using locks. So, how do they do it? They must comply with all tagout-related provisions and use additional safety measures that provide a level of safety equivalent to that obtained by using lockout.
Examples of additional safety measures include:

- removing and isolating a circuit element;
- blocking a controlling switch;
- opening an extra disconnecting device; and
- removing a valve handle to reduce the potential for any inadvertent energization while the tags are attached.

9. Where would you place tags during lockout/tagout of equipment and machinery?
   a. Where each lockout device would have been placed
   b. On the face of the equipment or machinery
   c. In a prominent location so employees can best see them
   d. On the warning tape surrounding the equipment or machinery

Facts About Lockout/Tagout Devices

Lockout and tagout devices must meet the following criteria to ensure that they are effective and not removed inadvertently:

- **Durable**: Lockout devices must work properly under the environmental conditions in which they are used. Warnings on tagout devices must be legible even in wet, damp, or corrosive conditions.

- **Standardized**: Lockout and tagout devices must be designated by color, shape, or size. Tagout devices must have a standardized print and warning format.

- **Substantial**: Lockout devices and tagout devices must be strong enough that they cannot be removed inadvertently. Tagout devices must be attached with a single-use, self-locking material such as a nylon cable tie with a minimum unlocking strength of 50 pounds.

- **Identifiable**: Any employee who sees a lockout or tagout device must recognize who attached it and understand its purpose. The device must not be used for purposes other than the control of hazardous energy.
• **Unique:** Each lock must have a unique key; this means that only the employee who uses the lock has the key to that lock.

• **Payment:** If you are an employer, you must provide lockout and tagout devices to employees who need to shut down equipment to service or maintain it.

10. Which of the following is NOT criteria for tagout device ties?
   
   a. They must be single-use
   b. They must be color coded with red stripes
   c. They must have a minimum unlocking strength of 50 pounds
   d. They must be made of self-locking material
Module 2: Training and Inspections

Employee Training and Communication

Employers are required to provide effective training for all employees covered by the lockout/tagout standard and ensure that all employees understand the basic program concepts, including the purpose, function, and restrictions of the energy control program, and how to control those hazards.

Authorized employees must possess the knowledge and skills necessary for the safe application, use, and removal of energy controls. This training also must make employees aware that disregarding or violating the energy control program could endanger their own lives or the lives of co-workers.

Why Training is Important

It is important to train employees so they understand the purpose and function of the energy control program and get the knowledge and skills necessary to safely apply, use, and remove the energy controls. The LOTO standard requires different levels of training for the three categories of workers: authorized, affected, and other employees.

Real Life Event

A recent news report shows the importance of lockout/tagout training within a company.

Expect the unexpected.

An employee at a wood chip company went through a wood chipper and survived. Something got stuck inside the machine and he went into the wood chipper to get the object. He thought everything was turned off. However, a fellow employee turned on the machine while he was inside.

The victim spent some time in the hospital with multiple injuries.

1. Who must possess the knowledge and skills necessary for the safe application, use, and removal of energy controls during lockout/tagout of equipment or machinery?
   a. Other employees
   b. Affected employees
   c. Authorized employees
   d. Qualified employees
Training Differences

"When do employees need to receive training for lockout/tagout?" Tom Campbell, Brady's Global Product Manager for LOTO, provides helpful input on this matter.

There are three types of employees which must receive training: authorized, affected, and other.

The amount and type of training that each employee receives is based upon the relationship of that employee's job to the machine or equipment being locked or tagged out and upon the degree of knowledge relevant to hazardous energy that the employee must possess.

In addition, employers are required to certify that effective training and retraining has been provided to all employees covered by the standard. The certification must contain each employee's name and dates of training.

**Authorized Employees**

Authorized employees lockout or tagout equipment and service or maintain the equipment. Required training for authorized employees includes:

- how to find and recognize hazardous energy sources;
- how to identify the types and magnitudes of energy used in the workplace; and
- how to isolate energy sources.

**Affected Employees**

Affected employees operate equipment serviced under lockout or tagout procedures or work in an area affected by the procedures. An affected employee becomes an authorized employee when the employee performs service or maintenance work on the equipment. Required training for affected employees includes:

- the purpose of energy-control procedures;
- how energy-control procedures are applied; and
- how energy-control procedures will protect them.
Other Employees

Other employees may work around or be near equipment that is under lockout/tagout. They need to receive awareness-level training regarding the Energy Control Program. They need to understand that if they see LOTO devices, they are not to touch them.

2. Which category of employees operates equipment serviced under lockout or tagout procedures or work in an area affected by the procedures?
   a. Other employees
   b. Affected employees
   c. Authorized employees
   d. Area employees

Retraining

The employer should retrain employees when the employer has reason to believe employees do not have adequate understanding, skills, or abilities (KSAs). Employers should conduct annual retraining if employees do not perform lockout/tagout procedures regularly. Situations requiring retraining include the following:

- When changes in job assignments affect lockout/tagout procedures;
- When changes in the workplace render previous training obsolete or inadequate;
- When changes in processes, equipment or machinery render previous training obsolete or inadequate; or
- When inadequacies in an authorized employee's knowledge of lockout/tagout procedures or equipment indicate that the employee no longer has the requisite understanding or skill necessary to correctly perform those procedures.

The purpose of retraining is to re-establish employee proficiency and introduce new or revised control methods and procedures, as necessary. Employers do not need to retrain their employees annually. However, if employees do not actually use LOTO procedures often, it is a good idea to practice the procedures at least annually.

**Additional Training**

Employers must train workers in the following limitations of tags listed below:
• Tags are essentially **warning devices** attached to energy isolating devices and **do not provide the physical restraint** on those devices that is provided by a lock.

• When a tag is attached to an energy isolating means, it is not to be **removed without authorization** and it is **never to be bypassed**, ignored, or otherwise defeated.

• Tags must be **legible and understandable** by all workers.

• Tags and their means of attachment must be made of materials which will **withstand the environmental conditions** encountered in the workplace.

• Tags may **evoke a false sense of security** and their meaning needs to be understood as part of the overall energy control program.

• Tags **must be securely attached to energy isolating devices** so that they cannot be inadvertently or accidentally detached during use.

3. What is the purpose of retraining in lockout/tagout procedures?

   a. Conform to ANSI standards
   b. Re-establish employee proficiency
   c. Comply with OSHA requirements
   d. Satisfy due diligence

**Training Certification**

Employers must certify that training or retraining took place and that the employee is kept up to date. However, if the training program aspires to conform to **ANSI Z490.1**, Criteria for Accepted Practices in Safety, Health, and Environmental Training, the employer will need to certify that each employee has demonstrated proficiency in the learning environment immediately after training. After training, the employer is required to certify that the employee has successfully applied what they have learned in the workplace.

**Certificate Information**

To meet basic Federal OSHA requirements in the USA, certification need only contain the information listed below:

• Each employee's name.
• The dates of training and/or retraining.

We believe the documentation should also include certifications by the trainer and authorized employees' supervisors.

• The trainer certifies that, based on testing and practice in the learning environment, authorized employees are initially competent and qualified to perform lockout/tagout procedures.

• The supervisor will evaluate authorized employees as they perform lockout tagout on the job. If an evaluation shows that employees have demonstrated adequate knowledge, skills, and abilities (KSAs), the supervisor may then certify authorized employees as fully competent and qualified.

For more information on certifying safety training, see OSHAcademy course Developing OSH Training, Module 5.

4. Although OSHA standards require only the employee's name and date of training/retraining, it is also important to include _____.

   a. the location and duration of the training
   b. start and end times of training
   c. testing methods used and scores obtained
   d. trainer and supervisor written certification

Lockout/Tagout Inspections

Periodic inspections help employers discover and correct program deficiencies. Each energy control procedure must be inspected at least annually by an authorized employee. The authorized employee who inspects an energy control procedure cannot be an employee who is following that specific procedure at the time of the inspection.

Inspections of energy control procedures can be scheduled or random audits. The authorized employee who does the inspection must understand the energy control procedure and must not be among those following the procedure at the time of the inspection. A successful inspection confirms that:

• The energy control procedure is correct.
• The energy control procedure is being followed.

• The energy control procedure addresses all energy sources.

• Employees understand the energy control procedure.

• Employees understand their energy control responsibilities.

The employer must certify that the periodic inspections have been performed. The certification must identify:

• the machine or equipment on which the energy control procedure was being utilized,

• the date of the inspection,

• the employees included in the inspection, and

• the person performing the inspection.

5. As part of the Energy Control Program, annual inspections must include _____.
   a. inspection of training curriculum
   b. inspection of each energy control procedure
   c. a list of all lockout/tagout procedures
   d. a job hazard analysis of hazardous tasks

Correcting Program Weaknesses

An authorized employee must inspect each energy control procedure for its accuracy, completeness, and effectiveness in energy control. A single procedure can cover a group of similar equipment if they all have the same or similar types and magnitudes of energy, and the same or similar energy control methods. Also, inspections must include a review of the energy control procedure between the inspector and the employees using the procedure.

When an inspection reveals employees not following the energy control procedure or discovers that the procedure is not fully protecting them, the employer must take corrective action. Corrective actions could include:

• revising the procedure to correct deficiencies
• acquiring additional or more-specific lockout or tagout devices to provide employees with appropriate equipment to complete the energy control procedure

• providing additional employee training

• increasing oversight of those that use energy control procedures

**Best Practice:** If you have several authorized employees, rotate them in the inspector role so everyone can be the inspector.

6. A single procedure can cover a group of similar equipment if the equipment meets all of the following criteria, EXCEPT _____.
   
   a. the equipment has similar energy control methods
   b. the equipment has the same magnitudes of energy
   c. the equipment has the same types of energy sources
   d. the equipment is in a similar location

**Reviewing a Lockout Procedure**

If the inspection covers a procedure for equipment with an energy-isolating device that can be locked out, the inspector must review the procedure with the authorized employees who use it to service the equipment. The inspector can review the procedure with the authorized employees individually or in a group.

**Reviewing a Tagout Procedure**

If the inspection covers a procedure for equipment with an energy-isolating device that can only be tagged out, the inspector must review the procedure with the authorized employees who use it to service the equipment and with affected employees who may work in the area when the equipment is serviced. The inspector can review the procedure with the authorized and affected employees individually or in a group.

**Documenting Inspections**

The employer must certify that the energy control procedure has been inspected. The certification must contain the following information:

• the equipment on which the procedure is used
• the date of the inspection
• the employees included in the inspection
• the person who did the inspection

**Best Practice:** Record findings of successes and deficiencies and incorporate them into your inspection records to improve training, procedures, and accountability.

You can use this [lockout/tagout inspection checklist](#) developed by Oregon OSHA as part of your inspection process.

7. With whom must the Energy Control Program inspector review lockout/tagout procedures during annual inspections?
   
   a. Authorized employees  
   b. Affected employees  
   c. Authorized and affected employees  
   d. Affected and other employees

**Real-Life Scenario**

**Hazardous Energy in the Workplace Can Kill**

*The son of the owner of a commercial drywall construction company in Oregon, who was also an employee of the company, was preparing an aerial lift for a job and had replaced two battery terminals. He raised the aerial boom and was reaching toward the battery compartment across the metal enclosure that houses the lift’s toggle controls when the boom dropped and pinned him to the control panel. His father discovered him and summoned emergency responders, but he died at the site.*

**Oregon OSHA Investigation Findings**

1. The employee did not use lockout procedures while he was working on the lift and did not block the boom to prevent it from dropping.

2. The lift’s emergency valve, hydraulic hoses and fittings, and electrical wiring were inspected after the accident and were not defective; however, the on/off key switch had been bypassed so that the operator could use the toggle switches without using the key.
3. The battery charging system was missing a fuse that would stop the system from charging, and the spring-loaded toggle switches that controlled the boom did not have guards to prevent accidental contact.

4. The owner had not reviewed the lift’s instruction manual with the victim or other company employees.

The accident resulted in the following violations:

1. **OSHA Standard 1910.147(c)(4)** – The employer did not develop, document, and require employees to use lockout procedures to control hazardous energy during maintenance work.

2. **Oregon Standard 437-001-0760** – The employer failed to ensure that employees did not remove or tamper with required safety devices.
Module 3: Lockout/Tagout Procedures

To control hazardous energy, you must prevent it from being transmitted from its source to the equipment that it powers. You can accomplish that by doing the following:

1. identify energy sources and energy-isolating devices
2. de-energize equipment by isolating or blocking the energy sources
3. secure energy-isolating devices in a safe position
4. dissipate or restrain potential energy that can't be isolated
5. verify equipment isolation

We'll cover each one of these steps throughout the rest of the module.

1. **To control hazardous energy, you must _____**.
   
   a. stop the energy from being transformed prior to maintenance
   b. block unwanted currents from being grounded at the source
   c. prevent it from being transmitted from its source to the equipment that it powers
   d. make sure it is controlled or eliminated to acceptable levels prior to servicing

Step 1. Identifying Energy Sources and Energy-Isolating Devices

The first step in controlling energy is to identify equipment in your workplace that needs service or maintenance. To identify equipment that needs servicing or maintenance:

1. determine the form of energy that powers the equipment, including potential energy that may remain when the energy source is disconnected; and

2. label the energy sources so that workers will know which energy source powers what equipment.

Before an authorized employee turns off a machine or equipment, he or she must have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.
Identify equipment that needs service or maintenance. Determine the types of energy (there may be more than one) that powers the equipment, including potential energy that may remain when the energy sources are disconnected.

**Example 1:** Industrial coffee bean roasters must be serviced to maintain optimum bean flavor and reduce fire risk. Depending on equipment options, some have rotating, heated drums; natural gas burners; cyclone chaff collectors; rotating cooling agitators; motorized trays; powered paddles; cooling blowers; and integrated carbon monoxide and heat exhaust systems. Once turned off, the electrical, mechanical (moving parts), chemical (natural gas), and thermal (heated parts) energies must be identified and controlled.

After identifying the energy sources, identify the devices that will effectively separate or block the energy from the equipment, preventing its activation or movement. Each energy source must be disconnected with an energy-isolating device (EID). Energy-isolating devices are mechanical devices that physically prevent the transmission or release of energy.

**Energy-isolating devices can be:**

- disconnect switches (main)
- line valves
- manually operated electrical circuit breakers
- bolted blank flanges
- bolted slip blinds
- safety blocks
- any similar device used to block or isolate energy

**Example 2:** Replacing a saw blade on a table saw. These tools have a rotating blade powered by an electric motor. Once turned off, the mechanical energy from the rotating blade must be allowed to come to a complete stop and the electrical energy must be controlled.

2. Before an authorized employee turns off equipment, he or she must have knowledge of all the following, EXCEPT _____.
a. the method or means to control the energy
b. the hazards of the energy to be controlled
c. type and magnitude of the energy
d. the name and address of the manufacturer

Step 2. De-Energize Equipment

Turn off or shut down equipment following established procedures. Stop buttons and on/off switches are used to shut down equipment. However, it's important to know that turning off the equipment does not separate the equipment from its energy sources.

The method you use to de-energize equipment depends on the types of energy and the means to control it. After the equipment has been shut down, engage the equipment’s energy-isolating devices, physically separating the equipment from the energy. For compressed air, this could mean closing a specific manually operated valve. For an electric motor, this could mean opening a manually operated circuit breaker.

Buttons and Switches

Push-buttons, selector switches, safety interlocks, control circuit type devices, and programmable logic controllers (PLCs) used in many modern machine applications are NOT energy-isolating devices. Control circuitry meeting appropriate performance levels can provide alternative safeguarding during minor servicing activities.

Safe practices for de-energizing equipment:

- Disconnect equipment from energy sources.
- Disconnect motors from the equipment.
- Disconnect electrical circuits (including batteries).
- Block the fluid flow in hydraulic, pneumatic, or steam systems with control valve, blinds, or both.
- Block equipment parts or materials that could be moved by gravity.

Check out this great reference from DE energize that covers how to de-energize various types of energy.
3. Which of the following statements is TRUE when you press the stop button on a piece of equipment?

- a. The electrical energy is physically grounded to earth
- b. It does not separate the equipment from its energy source
- c. It is safe to perform maintenance or servicing on the equipment
- d. The stop button acts as the energy-isolating device

Step 3. Secure Energy-Isolating Devices in a Safe Position

When equipment has been shut down, and then de-energized using an energy-isolating device, nothing will prevent the energy-isolating device from accidentally (or intentionally) being turned on, reopened, or reactivated until it is secured.

Locking out, also known as lockout (LO), is a procedure for physically securing energy-isolating devices in an off, closed, or neutral position. A lockout device – typically a lock with a unique key – secures the energy-isolating device in a safe position. When an energy-isolating device is secured by a lockout device, it physically prevents the energy-isolating device from being manipulated.

Tagging out, also known as tagout (TO), when performed correctly, is a procedure for securing a warning sign to an energy-isolating device when a lockout device cannot be used.

Key Criteria When Applying Lockout/Tagout Devices

- Authorized workers must attach lockout or tagout devices to each energy isolating device.
- Lockout devices, where used, must be attached in a manner that will hold the energy isolating devices in a "safe" or "off" position.
- Where tagout devices are used, it must be attached in a manner that will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.
- If the tag cannot be attached directly to the energy isolating device, the tag must be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.
A tagout device must be securely fastened to the energy-isolating device and must state that the equipment being serviced can't be operated until it is removed.

4. When an energy-isolating device _____, it physically prevents the energy-isolating device from being manipulated.
   a. is placed as close to the lockout device as possible
   b. is secured by a lockout device
   c. is placed in the safe or off position
   d. is secured by a tagout device

Step 4. Dissipate or Restrain Potential Energy That Can't Be Isolated

Stored energy must be released or restrained after equipment has been de-energized.

If the energy could return to a hazardous level, make sure that it remains isolated from the equipment until all service work is finished. Sources of stored energy include:

- capacitors;
- coiled springs;
- elevated machine parts;
- rotating flywheels; and
- air, gas, steam, chemical, and hydraulic systems.

Safe practices for dissipating potential energy:

- Drain pressurized fluids or gases until internal pressure levels reach atmospheric levels.
- Discharge capacitors by grounding them.
- Double block and bleed process piping.
- Release or block tensioned springs.
• Ensure that all moving parts, such as flywheels and saw blades, have come to a complete stop.

• Allow equipment components to cool (or warm) to safe thermal levels.

Just shutting off the air supply to an automatically operated air valve or turning off a hydraulic power unit without bleeding off the pressure does not make up energy isolation. Energy isolation is achieved when there is no energy left to be released. For this reason, many companies refer to their energy control program as zero energy state (ZES).

5. **When has energy isolation effectively been achieved?**

   a. When there is no energy left to be released
   b. When energy-isolation devices have been applied
   c. When stop buttons and on-off switches have been cycled
   d. When stored energy is reduced to acceptable levels

**Traditional Lockout vs. Group Lockout**

**Traditional Lockout**

Under traditional lockout, each authorized employee places their personal lock on each energy-isolating device before beginning service work, and then removes that lock after the work has been done. Service work involving many employees and many energy-isolating devices can make traditional lockout complicated.

**Group Lockout**

In many workplaces, however, a group of authorized employees may need to service equipment that has several energy sources and several energy-isolating devices. To be most effective and ensure lockout/tagout, authorized employees may perform a group lockout/tagout.

Under the standard's group lockout/tagout requirements, a single authorized employee must assume the overall responsibility for the control of hazardous energy for all members of the group while the servicing or maintenance work is in progress. The authorized employee with the overall responsibility must implement the energy control procedures, communicate the purpose of the operation to the servicing and maintenance employees, coordinate the operation, and ensure that all procedural steps have been properly completed.
Example of the group lockout steps for a common process using a group lockbox.

1. A designated, authorized employee in the group secures each energy-isolating device with a personal lock.

2. The same designated, authorized employee places the key that fits each lock in a group lockbox with a multi-lock hasp.

3. The other authorized employees in the group secure the lockbox – they attach their personal locks to the box – before beginning their service work.

4. After each employee finishes service work on the equipment, that employee removes their personal lock from the lockbox.

5. After all the employees have finished their service work and removed their personal locks from the lockbox, the designated, authorized employee who placed the key in the box removes it.

6. The designated, authorized employee uses the key to remove the lock from each energy-isolating device.

6. When equipment servicing or maintenance must be performed by a group of authorized employees, what process may be used to most effectively perform lockout/tagout?

   a. Groups are formed to do lockout/tagout on different parts of the equipment
   b. Each authorized employee affixes locks/tags on all energy-isolating devices
   c. The lead person attaches locks or tags so the others don't have to
   d. Authorized employees use "group lockout" procedures using a lockbox

Step 5. Verify Equipment Isolation

It's your last chance! Verification means confirming that equipment is separated from its energy source; therefore, it is "isolated." The authorized employee must verify that:

- Equipment has been properly turned off/shut down.
- Energy-isolating devices were identified and used to effectively isolate energy.
- Individual lockout or tagout devices have been attached to the energy-isolating devices.
- Stored energy has been removed or controlled.
Attempting to restart the equipment is one way to confirm isolation; however, testing equipment ensures that capacitors have been properly discharged, hazardous heat has dissipated, and excessive pressures have been relieved.

Best Practice: Some companies refer to their energy control program as "Lock, Tag, Try" or "Lock, Tag, Test" to emphasize this important verification step.

7. What is one common way to verify equipment has been successfully isolated?
   a. Use your common-sense knowledge
   b. Listen for noise due to equipment operation
   c. Try to restart the equipment
   d. Verify lockout devices are installed

Release from Lockout/Tagout

OSHA’s Lockout/Tagout standard includes requirements for releasing machines or equipment that have been locked out or tagged out prior to restoring energy to the equipment and using it.

Before removing lockout or tagout devices and restoring energy, the authorized employee must follow these procedures:

1. The work area must first be inspected to ensure that nonessential items (e.g., tools, spare parts) have been removed and that all of the machine or equipment components are operationally intact.

2. The work area must then be checked to ensure all workers have been safety positioned or have cleared the area. In addition, all affected workers must be notified that the lockout or tagout devices have been removed before the equipment is started.

3. Each lockout or tagout device must be removed from the energy-isolating device by the employee who applied the device.

4. To make sure all lockout/tagout devices have been removed, inventory them when you return them to the lockout station.

Alternative Steps for Release from Lockout/Tagout

There are some things an employer must do if a worker who did not apply the lockout/tagout device removes the device. The person in charge must accomplish three actions listed below:
1. Verify that the authorized employee who applied the device is not at the facility.

2. Make all reasonable efforts to contact the authorized employee to inform him/her that his/her lockout or tagout device has been removed.

3. Ensure that the authorized employee knows that the lockout device has been removed before they resume work at the facility.

8. Before energy is restored during release from lockout/tagout, the authorized employee must do all of the following, EXCEPT _____.
   a. inspect for non-essential items
   b. check to ensure all workers are safely located
   c. ensure each lockout/tagout device is properly removed
   d. make efforts to contact safety staff to report the release

Testing Machinery or Equipment

In some circumstances, workers need to temporarily restore energy to a machine or piece of equipment during servicing or maintenance to test and/or reposition the machine or piece of equipment. Workers may temporarily remove lockout or tagout devices in order to perform these tasks. However, it is important to know that you may not use an abbreviated procedure during the release-test-restore sequence. You must use full lockout/tagout procedures anytime you release from lockout/tagout or restore equipment after testing and positioning.

Temporary Removal Procedures

Below is the sequence of action that must occur in the temporary removal of the lockout/tagout devices:

1. The machine or equipment must be cleared of tools and materials.

2. Workers must be removed from the machine or equipment area.

3. All lockout or tagout devices may then be removed.

4. Authorized workers may then proceed to energize and test or position the equipment or machinery.

5. Following testing or positioning, all systems must be de-energized and energy control measures reapplied to continue the servicing and/or maintenance.
**Release after Long-Term Shutdown**

You should have an additional energy-control procedure to protect workers if they must restart equipment after long-term shutdowns. Determine who will be responsible for monitoring any lockout and tagout devices that control energy to the equipment. Include steps in the procedure for protecting workers if they need to remove or change parts while the equipment is shut down. Do not restart equipment until you are absolutely certain that it is working properly.

**9. What lockout/tagout procedures may you use to temporarily test equipment to make sure your repairs have worked?**

- a. Full lockout/tagout procedures
- b. Temporary lockout/tagout procedures
- c. Abbreviated lockout/tagout procedures
- d. Shortened lockout/tagout procedures

**Shift Change**

How is the continuity of lockout or tagout protection maintained during shift or personnel changes?

Employers must ensure the continuity of employee protection by providing for the orderly transfer of lockout or tagout device protection between off-going and incoming employees. This will help to minimize exposure to hazards from the unexpected energization or start-up of the machine or equipment or the release of stored energy [29 CFR 1910.147(f)(4)].

**Shift change procedure:** If a lockout procedure will extend into the following shift, the employer will usually require the authorized employee who originally placed the lock to remove it. The ongoing authorized employee will then immediately replace the lock and continue the repair or maintenance on that equipment or machine for the following shift.

**Working with Contractors**

Whenever contractors and other outside servicing personnel perform tasks covered by the Lockout/Tagout standard, they must adhere to all the OSHA standard's requirements. The host employer and the contractor or outside employer must inform each other of the other's respective lockout or tagout procedures.
The host employer and the contractor must understand one another's lockout and tagout procedures. Make sure you review the contractor's energy-control program before the contractor does any on-site work. The host employer's workers must also understand and comply with the contractor's energy-control program.

**Note:** If you hire a one-person "independent contractor," he or she may claim they do not have to comply with State or Federal OSHA standards. They may be right, if they are not required to participate in a workers' compensation system. However, that does not relieve you, as the general or host employer, from legal liability under the OSH Act. Make sure you require all contractors, no matter what their business status is, to adhere, at a minimum, to OSHA standards. If the contractor puts up a fuss, I personally would not do business with the contractor.

If the sub-contractor is using their own LOTO procedures, the on-site general contractor or host employer must ensure that their workers understand and comply with the restrictions and prohibitions of the contractor or outside employer's energy control program.

Be sure to check out OSHA's [1910.147, Appendix A, Typical minimal lockout procedures](#) for examples of lockout/tagout procedures.

**10. What is the legal ramification if an independent subcontractor, who claims he or she does not have to comply with State or Federal OSHA regulations, performs servicing or maintenance tasks without using lockout/tagout procedures?**

- a. OSHA may not cite the host employer or the subcontractor
- b. No legal problems: the subcontractor is covered by workers' compensation
- c. The host employer is not relieved of legal liability under the OSH Act
- d. Generally, the subcontractor may still be cited by OSHA, but it's rare
Additional Resources

1. [1910.147, Appendix A, Typical minimal lockout procedures], OSHA

2. Guide to Controlling Hazardous Energy, OR-OSHA

3. Interactive LOTO Training, OSHA

4. Case Studies, OSHA

5. Sample LOTO Plan, DOL - Indiana

6. Napo's Films, Via Storia

7. Typical Lockout Tagout Procedures, Creative Safety Supply