

Energy Control Program (Lockout/Tagout)



This important course focuses on the requirements of the Energy Control Program, commonly called the Lockout/Tagout Program. When lockout/tagout is not performed correctly, it usually results in a serious injury or fatality. With lockout/tagout being OSHA's fifth most commonly cited violation, this course is a must for any employee who is responsible for servicing and maintaining equipment or machinery.

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OSHAcademy Course 710 Study Guide

Energy Control Program (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 710.

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:

OSHAcademy

15220 NW Greenbrier Parkway, Suite 230

Beaverton, Oregon 97006

www.oshatrain.org

instructor@oshatrain.org

+1 (888) 668-9079

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Course Introduction

Control of Hazardous Energy (Lockout/Tagout)

This course is based on the requirements in [OSHA regulation 1910.147, The Control of Hazardous Energy \(Lockout/Tagout\)](#), which protects employees who could be injured as a result of the unexpected release of hazardous energy. The requirements apply when an employee doing service or maintenance on a machine or equipment could be injured by the unexpected startup or release of hazardous energy.

Lockout (LO) and tagout (TO) are the primary methods of controlling hazardous energy. Service or maintenance includes erecting, installing, constructing, repairing, adjusting, inspecting, unjamming, setting up, trouble-shooting, testing, cleaning, and dismantling machines, equipment, or processes. In this course, equipment means equipment and machines, whether fixed or mobile.

Course Objectives

1. Describe the purpose and components of the Energy Control Program (ECP).
2. Define "lockout/tagout" and when it is required in the workplace.
3. List the forms of energy that may require lockout/tagout.
4. Describe the ECP training requirements for authorized, affected, and other employees.
5. Describe the requirements for periodic inspection and evaluation of the ECP.
6. Identify and give examples of the use of lockout/tagout materials and hardware.
7. List and describe the basic steps in the lockout/tagout process.
8. Describe the procedure for release from lockout/tagout.
9. Describe the group lockout/tagout process, and requirements during shift change.

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.

So, let's find out more about LOTO!

Module 1: Purpose, Scope, and Application

1.1 Purpose of the Energy Control Program (ECP)

An 18-year-old worker died after becoming entangled in a portable mortar mixer at a residential construction site. The victim was cleaning the mixer at the end of his shift to prepare it for the following day. A painter working near the victim heard yells for help and saw the victim's arm stuck in the machine and his body being pulled into the rotating mixer paddles. Emergency medical services were called and responded within minutes. Rescue workers dismantled the drive mechanism to reverse the mixing paddles and extricate the worker. He was pronounced dead at the scene. (Source: OSHA)

The purpose of the Energy Control Program (ECP) is to provide written policies and rules within your safety management system that help prevent accidents like this. No worker should die or be injured due to the unexpected startup of machines and equipment, or release of stored energy.

Information about the Energy Control Program (ECP) is contained in [29 CFR 1910.147, Control of Hazardous Energy \(Lockout/Tagout\)](#). The regulation addresses the practices and procedures necessary to disable machinery or equipment, thereby preventing the release of hazardous energy while employees perform servicing and maintenance activities. It also details measures for controlling hazardous energies - electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and other energy sources.

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. What management action should occur to help prevent fatalities or injuries due to the unexpected startup of equipment or the release of stored energy?

- a. Discipline employees whenever an accident occurs
- b. Develop an Energy Control Program (ECP)
- c. Ensure 100 percent compliance
- d. Accept nothing less than zero accidents

1.2 Scope of the Lockout/Tagout Rule

Employers must establish an Energy Control Program (ECP) to ensure that before service and maintenance is performed, machines and equipment that could unexpectedly startup, become energized, or release stored energy, are isolated from their energy source(s) and rendered safe.

To do that, employers need to accomplish three critical activities to ensure employee safety when they are servicing or working near equipment that could expose them to hazardous energy:

1. Energy control procedures: Employers must 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 utilized for the control of hazardous energy. See this sample.
2. Periodic inspections: Inspections help employers ensure compliance with their energy control program and discover deficiencies. An inspection of each energy control procedure must be done at least annually by an authorized employee. Inspections of energy control procedures can be scheduled or random audits.
3. Employee training: All employees must be trained to know basic hazardous-energy concepts and the purpose of the devices used to control it. They should also know what tasks might expose them to hazardous energy and how it can be controlled.

2. The purpose of lockout/tagout is to prevent injury due to the unexpected startup of machines and equipment, or ____.

- a. release of stored energy
- b. failure of equipment
- c. unapproved operation of machinery
- d. failure of operation

1.3 What is "Lockout/Tagout"?

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 lock or tag 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 reaccumulation 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.

3. The purpose of lockout/tagout is to prevent injury due to the _____ start-up of machines and equipment, or release of stored energy.

- a. usual
- b. unexpected
- c. scheduled
- d. regulated

1.4 Lockout/Tagout Devices

Lockout Devices

Lockout devices, typically locks, hold energy-isolation devices in a safe, off, or neutral position.

They provide protection by preventing machines or equipment from becoming energized because they are positive restraints that no one can remove without a key or other unlocking mechanism, or through extraordinary means, such as bolt cutters.

Tagout Devices

Tagout devices, by contrast, 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.

4. Lockout devices hold energy-isolation devices in a _____ position.

- a. safe or on
- b. energized
- c. safe, off, or neutral
- d. down

1.5 Performing LOTO Procedures

Whenever your employees perform servicing and/or maintenance on machines or equipment, they can be exposed to the unexpected energization, startup, or release of hazardous energy. Hazardous energy sources include electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other forms of harmful energy.

Servicing or Maintenance

Servicing or maintenance refers to constructing, installing, setting up, adjusting, inspecting, modifying, maintaining and/or servicing machines or equipment, including lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes, where workers could be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Passive monitoring during normal production operations is not considered servicing or maintenance.

What's "Unexpected?"

The term "unexpected" also covers situations in which the servicing and/or maintenance is performed during ongoing normal production operations if:

- A worker is required to remove or bypass machine guards or other safety devices; or
- A worker is required to place any part of his or her body into a point of operation or into an area on a machine or piece of equipment where work is performed, or into the danger zone associated with the machine's operation.

5. During which of the following activities is a lockout/tagout procedure LEAST likely to be required?

- a. Installing internal parts in equipment while it is in operation
- b. Working within a machine's moving parts area
- c. Monitoring equipment or making adjustments remotely
- d. Removing or bypassing machine guards

1.6 What is Hazardous Energy?

Energy in any form becomes hazardous when it builds to a dangerous level or is released in a quantity that could injure a worker. Workers servicing or maintaining machines or equipment may be seriously injured or killed if hazardous energy is not properly controlled. Injuries resulting from the failure to control hazardous energy during maintenance activities can be serious or fatal! Injuries may include electrocution, burns, crushing, cutting, lacerating, amputating, or fracturing body parts, and others.

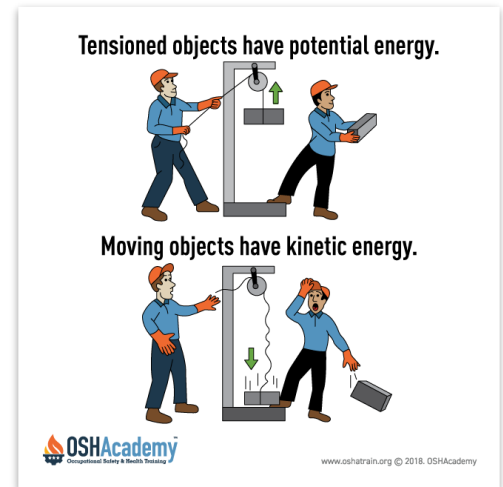
- A steam valve is automatically turned on burning workers who are repairing a downstream connection in the piping.
- A jammed conveyor system suddenly releases, crushing a worker who is trying to clear the jam.
- Internal wiring on a piece of factory equipment electrically shorts, shocking worker who is repairing the equipment.

Forms of Energy - Electricity is Not the Only Hazard!

Energy is the power for doing work. Energy exists in different types, but all are associated with motion. Regardless of the type, energy exists in two basic states:

1. **Potential energy** - Energy possessed by a body by virtue of its position relative to others, stresses within itself, electric charge, and other factors.
2. **Kinetic energy** - Energy that a body possesses by virtue of being in motion.

Reference the infographic at the right: Releasing the load causes it to drop, converting potential energy to kinetic energy. It's the harmful transfer of energy at impact between an object and the worker that can cause injury. Note: It's the "harmful transfer of energy" that is always the direct cause of injury in an accident event.



Potential energy is converted to kinetic energy.

6. What are the two basic states of energy?

- Physical and electrical energy
- Thermal energy and actual energy
- Potential energy and kinetic energy
- Kinetic energy and expendable energy

1.7 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 hoisted vehicles, raised dumpster lids, objects supported by a crane, and elevated dump truck beds.

- **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 vapor expanding explosion is called (BLEVE).

7. Which of the following is the most common form of hazardous energy requiring lockout/tagout procedures to protect employees?

- a. Explosive
- b. Electrical
- c. Mechanical
- d. Thermal

Module 2: Energy Control Program Components

Employer Obligations

Employers must ensure written LOTO procedures are developed, documented and used for the control of potentially hazardous energy when employees are engaged in activities covered by 1910.147.

Written Procedures

Employers must develop, document, and make sure authorized employees use specific written LOTO procedures to control potentially hazardous energy when they perform servicing or maintenance. Well-written energy control procedures accurately instruct authorized employees to do all of the following:

- Inform all affected employees of equipment shutdown.
- Shut down equipment in the proper order.
- Identify and engage energy-isolating devices or block hazardous energy.
- Lockout or tagout the energy-isolating devices.
- Remove, drain, neutralize, or block any potential (stored) energy.
- Verify the equipment is isolated from hazardous energy and rendered inoperative.

Best Practice: It is considered a best practice to have a written program, or policy, to support the energy control program, in addition to clearly outlining expectations and accountability.

1. Authorized employees must be provided _____ when they perform servicing or maintenance.

- a. OSHA 10-hour training
- b. written certification
- c. written LOTO procedures
- d. a LOTO program manual

The 8 Exceptions

The employer must document and provide LOTO procedures in writing for each particular machine or unique piece of equipment unless ALL of the following 8 exceptions exist:

- The machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shut down which could endanger employees.
- The machine or equipment has a single energy source which can be readily identified and isolated.
- The isolation and locking out of the energy source will completely deenergize and deactivate the machine or equipment.
- The machine or equipment is isolated from the energy source and locked out during servicing or maintenance.
- A single lockout device will achieve a lock-out condition.
- The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance.
- The servicing or maintenance does not create hazards for other employees.
- The employer, in utilizing this exception, has had no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance.
- Remember, if any one of the above exceptions exists, written LOTO procedures are required. Most likely, one or more of the exemptions will exist.

2. The employer must document and provide LOTO procedures in writing for each particular machine or unique piece of equipment unless _____.

- a. multiple lockouts are necessary
- b. all of the 8 exceptions exist
- c. the employer has only had minor accidents
- d. identified energy sources may not cause serious injuries

2.3 LOTO Procedure Scope, Purpose, and Authority

Written procedures for equipment with one or more sources of energy must clearly and specifically outline the following:

- **Scope:** The scope of lockout/tagout procedures may be limited to a single piece of equipment or machinery or a 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.
- **Compliance.** The procedures must state the means to be used to enforce compliance. Typically, this requirement is met by stating the procedure is mandatory and may result in disciplinary action if not followed.

3. The scope of lockout/tagout procedures may be limited to _____.

- a. all identified equipment/machinery
- b. a single piece or a group of similar equipment/machinery
- c. all equipment/machinery within a process
- d. any group of equipment/machinery from the same manufacturer

2.4 Use of Tagout Devices

At a minimum, the procedures must include the points listed below.

- **Intent:** A specific statement of the intended use of the procedure.
- **Procedure steps:** Specific procedural steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy.
- **Devices and authority:** Specific procedural steps for the placement, removal, and transfer of lockout devices or tagout devices, and a description of who has responsibility for them.
- **Testing:** Specific requirements for testing a machine or piece of equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

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

4. Specific lockout/tagout procedural steps are required for ____.

- a. reviewing OSHA equipment rules
- b. identifying equipment
- c. isolating equipment
- d. assigning authorized employees

2.5 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.

That's about it for a discussion of the basic components of the ECP. Remember, make sure all three components have been developed and deployed. If OSHA comes inspecting, they will not cut you any slack when it comes to the LOTO program because if something goes wrong, a serious injury or fatality is likely to result.

5. Whenever new machines or equipment are installed or replaced, energy isolating devices for such machine(s) or equipment must ____.

- a. be designed to accept a lockout device
- b. be installed with tagout devices until operational
- c. meet strict NFPA standards for lockout/tagout
- d. have OSHA/Manufacturer identification plates attached

Module 3: Training and Communication

3.1 Employee Training and Communication

The employer is 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, skills, and abilities (KSAs) 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.

Man Survives Going through a Wood Chipper

An employee at a wood chip company in Washington State, USA went through a wood chipper and survives. According to a recent television news story, Frank Arce works at a company that shreds up bark into wood chips.

In January 2014, something got stuck inside the machine and Arce went into the wood chipper to get the object. He thought everything was turned off. However, a fellow employee turned on the machine while Arce was inside.

Arce spent some time in the hospital with a broken pelvis, shattered ankle, bruised liver, broken leg and a cut that runs the length of his body on the backside. The cut was so deep, it crushed his knee. He said he received the right care quickly because of the training and help from his co-workers at the Swanson Bark and Wood Products Company in Longview, Washington. The company paid 100% of Arce's medical bills.

The Washington State Bureau of Labor and Industries investigated the accident.

Source: KATU-TV, Portland, Oregon, January 2014.

1. All workers must be trained to know basic hazardous energy program _____ and to how to _____ hazardous energy.

- a. concepts, control
- b. principles, prevent
- c. objectives, observe
- d. goals, monitor

3.2 Three Categories of LOTO Training

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

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 lock out or tag out equipment and service or maintain the equipment. Required training for authorized employees includes:

- How to find and recognize hazardous energy sources;
- 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
- how energy-control procedures will protect them

Other Employees

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

2. Which employee category must know how to find and recognize hazardous energy sources, the types of magnitudes and energy used, and how to isolate energy sources?

- a. Other employees
- b. Affected employees
- c. Certified employees
- d. Authorized employees

3.3 LOTO Retraining

Employees must be retrained for changes in equipment or machinery or for deficiencies in KSAs.

There are many reasons to retrain your employees. Here are a couple examples:

- introduce new or revised control methods and procedures as necessary
- re-establish employee proficiency

You do not need to retrain your employees on an annual basis. However, if your employees do not actually use LOTO procedures often, it's a good idea to practice the procedures at least annually.

Retrain employees when work conditions change. Authorized and affected employees must be retrained whenever:

- their job assignments change;
- energy-control procedures change;
- equipment or work processes present new hazards; or
- when they don't follow energy-control procedures.

Other triggers that indicate training may be necessary include:

- periodic inspections reveal that there are deviations in the energy control procedure; or
- the employer believes that there are deviations from, or inadequacies in, the employee's knowledge or use of the energy control procedures.

3. Authorized and affected employees must be retrained whenever any of the following occurs, EXCEPT _____.

- a. when equipment or processes present new hazards
- b. when their job assignments change
- c. when energy-control procedures change
- d. it has been a year since they were previously trained

3.4 Tagout Training

There is an important safety practice to follow when tags are used during lockout/tagout: "Never use tags when locks will work." When tags are used in lockout/tagout procedures, you 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.

4. When tags are used during lockout/tagout, it's important for authorized and affected employees understand that _____.

- a. tags are necessary to provide a minimum level of physical security
- b. tags are only warning devices, they do not protect the employee
- c. tags may be removed only by affected employees after lockout/tagout is completed
- d. tags are the preferred method of providing protection to employees

3.5 Training Certification

OSHA Requirements

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

- each employee's name
- dates of training and/or retraining

You should certify that training or retraining took place and that the employee is kept up to date. However, we encourage you to also include a statement of proficiency as well as the employee's identification number or a unique certificate number for training. It should also contain the signature of the trainer who conducted the training.

ANSI Guidelines

If your training program aspires to conform to [ANSI Z490.1](#), Criteria for Accepted Practices in Safety, Health, and Environmental Training, you will need to certify authorized employees are:

1. **Initially qualified** - at the conclusion of training, the trainer certifies the authorized employee has demonstrated proficiency in the learning environment, and
2. **Fully qualified** - after training has been completed and while performing the lockout/tagout procedure on the job, a competent person certifies the authorized employee has successfully applied what they have learned.

5. To conform to ANSI Z490.1 lockout/tagout training guidelines, the employer should certify authorized employees _____.

- a. have completed minimum OSHA training requirements
- b. have completed classroom instruction basic lockout/tagout
- c. are initially and fully qualified
- d. have been trained annually

Module 4: Periodic Inspections

4.1 Evaluating Written Energy-Control Procedures

An evaluation of lockout/tagout procedures is required annually and must be conducted by an authorized employee other than the person who performs the procedures. If your authorized employee(s) perform all of the lockout/tagout procedures, you might have to have a supervisor designated as an authorized employee. The supervisor can then conduct the evaluation of lockout/tagout procedures.

Either the employer or the inspector must document each inspection with the information listed below.

- equipment on which the procedure is used
- date of the inspection
- workers included in the inspection
- person who did the inspection

If an inspector finds that workers are not following an energy-control procedure or that the procedure is not protecting them, those workers must be retrained, and the procedural deficiencies corrected.

The authorized employee who does the inspection must understand the procedure and must not be among those following the procedure at the time of the inspection. Each procedure must be verified for its accuracy, completeness and effectiveness in energy control.

1. If your authorized employee(s) perform all the lockout/tagout procedures, who may perform the lockout/tagout procedure inspections?

- a. A supervisor who is also an authorized employee and does not perform the procedures
- b. Any supervisor in operations who is not performing lockout/tagout procedures
- c. Only the lockout/tagout leader performing the specific procedures
- d. Any member of the group of authorized employees performing the procedures

4.2 The Purpose of Periodic Inspections

The purpose of periodic inspections is to ensure that the energy control procedures continue to be implemented properly, workers are familiar with their responsibilities and any deviations or procedural inadequacies that are observed are corrected. The inspection should determine if:

1. workers are following the written procedure and
2. the procedure is correct.

Reviewing a Lockout/Tagout Procedure

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

2. What is listed as one of the purposes of periodic inspections?

- a. Keep workers in compliance with OSHA
- b. Determine if workers are following procedures
- c. Reduce OSHA fines and penalties
- d. Keep upper management happy

4.3 Periodic Inspection Requirements

As we mentioned earlier, an authorized employee who is not involved in the energy control procedure should inspect the area on an annual basis. The employer must identify any deficiencies or deviations and correct them.

- Where lockout is used, the inspector must review each authorized employee's responsibilities under the procedure with that employee (group meetings are acceptable).
- Where tagout is used, the inspector must review both the authorized and affected employee's responsibilities with those workers for the energy control procedure being inspected, and the additional training responsibilities.

3. How often should an authorized employee, who is not involved in the energy control procedure, inspect the area?

- a. Annually
- b. Weekly
- c. Monthly
- d. Daily

4.4 Hazardous Energy in the Workplace: A Recent Accident

The son of the owner of a commercial drywall construction company, an employee of the company, was preparing an aerial lift for a job and had replaced two battery terminals. He had 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.

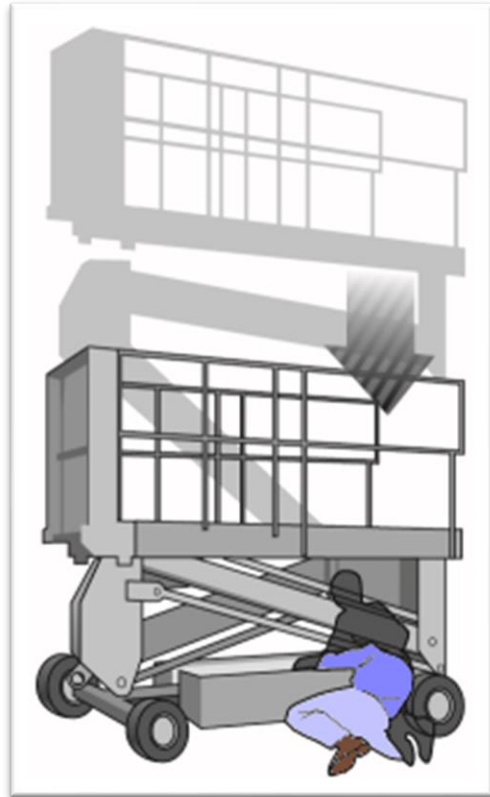
Investigation findings

1. 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.
 2. 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.
 3. 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.
 4. The owner had not reviewed the lift's instruction manual with the victim or other company employees.
-

1. Although the company had more than 10 employees, it did not have a safety committee.

The accident resulted in the OSHA violations listed below.

1. The employer failed to ensure that employees did not remove or tamper with required safety devices.
2. The employer did not develop, document, and require employees to use lockout procedures to control hazardous energy during maintenance work.
3. The employer had more than 10 employees but did not have a safety committee. (Oregon requirement)



Source: Oregon OSHA

Module 5: Materials and Hardware

5.1 Lockout/Tagout (LOTO) Devices

You must provide protective materials and hardware required for LOTO procedures.

You must provide locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware for isolating, securing or blocking machines or equipment from their energy sources.

As mentioned in Module 1, lockout/tagout devices hold energy-isolation devices in a safe or "off" position. Below are a few examples of locks and tags used to lockout or tagout main disconnects, line valves, and circuit breakers.

1. Lockout/tagout devices hold _____ in a safe or "off" position.

- a. selector buttons
- b. energy-isolation devices
- c. moving parts
- d. sensors and meters

5.2 Hardware Requirements

There are specific requirements for LOTO devices to make sure they fulfill the purpose for which they are used. They must ensure authorized employees are safe from injury while working on equipment and machinery.

LOTO devices must prevent other workers from accidentally energizing equipment or machinery while authorized employees are exposed to the various hazards of unexpected startup or shutdown.

To do that, LOTO devices must be substantial enough to prevent removal without the use of excessive force or unusual techniques such as with the use of bolt cutters or other metal cutting tools.

2. According to the lockout/tagout standard, LOTO devices must be _____, so they are capable of withstanding the environment to which they are exposed.

- a. usable
- b. painted
- c. rust-proof
- d. durable

5.3 LOTO Device Criteria

There are many requirements for the lockout and tagout devices:

- **Durable:** LOTO devices must be durable, so that they are capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected. Lockout devices must work under the environmental conditions in which they are used.
- **Substantial:** Lockout devices and tagout devices must be strong enough that they can't be removed inadvertently. Tagout devices must be attached with a single-use, self-locking material such as a nylon cable tie.
- **Singular:** They must be singularly identified.
- **Sole purpose:** They must be used only for controlling energy. They must not be used for other purposes.
- **Standardized:** They must be standardized within the facility in at least one of the following criteria: color, shape, or size.
- **Identifiable:** Any employee who sees a lockout or tagout device must recognize who attached it and understand its purpose. Each lock must have a unique key or combination; this means that only the employee who uses the lock has the key or the combination to that lock.
- **Payment:** The employer must pay for and provide lockout and tagout devices to employees who need to shut down equipment to service or maintain it.

3. To prevent lockout/tagout devices must be being removed inadvertently, they must be

_____.

- a. uniquely keyed
- b. one color
- c. labeled
- d. substantial

5.4 Tagout Device Criteria

In addition to the requirements listed previously, tagout devices must meet the following specific hardware requirements:

- **Durable:** Tags 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. They must not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.
- **Legible:** Warnings on tagout devices must be legible even in wet, damp, or corrosive conditions.
- **Standardized:** Tags must be standardized in print and format.
- **Substantial:** Tags must be substantial to prevent inadvertent or accidental removal.
- **Attachment:** Tags must have an attachment means of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece all-environment-tolerant nylon cable tie.
- **Warning:** Tags must warn against hazardous conditions if the machine or equipment is energized. Remember, tags only warn: they do not protect.
- **Legend:** Tags must include a legend such as: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate.

4. Tagout devices must have a minimum unlocking strength of no less than _____ pounds.

- a. 20
- b. 50
- c. 30
- d. 70

Module 6: Application of Energy Control Devices

6.1 Basic Steps in Controlling Energy

To safely apply energy controls to machines or equipment (using either lockout or tagout devices), authorized workers must perform lockout/tagout procedures in the following specific order:

1. notify all affected employees of the requirement for lockout/tagout;
2. identify all energy sources;
3. de-energize equipment by isolating or blocking the energy sources;
4. dissipate the potential (stored) energy that could affect the equipment (such as capacitors);
5. lock out the equipment's energy-isolating devices (switches, valves, etc); and/or
6. tag out the equipment's energy-isolating devices if you can't lock them out.

To safely apply energy controls to machines or equipment (using either lockout or tagou

1. After isolating or blocking equipment energy sources during lockout/tagout, what is the next step in controlling hazardous energy?

- a. Tag out energy-isolation devices that can't be locked out
- b. Lock out the energy-isolation devices (switches, valves, etc.)
- c. Dissipate potential (stored) energy such as capacitors
- d. Isolate or block energy sources to de-energize the equipment

6.2 Preparing for Shutdown

The first step in controlling energy is to identify equipment in your workplace that needs service or maintenance. Once the equipment or machinery has been identified:

- determine the form of energy that powers the equipment, including potential energy that may remain when the energy source is disconnected; and
- label the energy sources so that workers will know what equipment is powered by each energy source.

Before an authorized or affected employee turns off a machine or equipment, the authorized employee 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.

2. What is the next step after equipment has been identified for shutdown?

- a. Determine the form of energy powering the equipment
- b. Energize equipment after warning employees
- c. Label all energy sources and affix tags
- d. Dissipate kinetic and potential energy

6.3 Shutting Down Machinery or Equipment

The machine or equipment must be turned off or shut down using the procedures established for it to avoid any additional or increased hazards to workers as a result of the unexpected machine or equipment startup or stoppage.

Isolating Machinery or Equipment

All energy-isolating devices that are needed to control the machine's energy source must be located. These devices must then be used to isolate the machine or equipment from its energy source(s).

De-energizing equipment means isolating it from its energy source and controlling potential energy so that no energy can flow to the equipment. The method you use to de-energize equipment depends on the form of energy and the means available to control it.

Below is a list of safe practices for de-energizing equipment.

- disconnecting motors from the equipment
- isolating electrical circuits
- disconnecting equipment from energy sources
- blocking the fluid flow in hydraulic, pneumatic, or steam systems with control valves or by capping or blanking the lines
- blocking equipment parts that could be moved by gravity

3. During shutdown, what must be identified and used to isolate the equipment or machine from its energy source(s)?

- a. LOTO devices
- b. Energy-isolating devices
- c. Electrical energy-isolating devices
- d. Primary LOTO devices

6.4 Dissipating Stored Energy

Stored energy must be released after equipment has been de-energized. Below is a list of possible sources of stored energy.

- capacitors
- coiled springs
- elevated machine members
- rotating fly wheels
- air, gas, steam, chemical, and water systems

If the energy could return to a hazardous level, make sure that it remains isolated from the equipment until all service work is finished. Below is a list of safe practices for dissipating potential energy.

- Vent pressurized fluids until internal pressure levels reach atmospheric levels.
- Discharge capacitors by grounding them.
- Release or block tensioned springs.
- Ensure all moving parts have stopped completely.

4. Releasing the potential energy in capacitors can be accomplished by ____.

- a. releasing pressure
- b. grounding them
- c. releasing tension
- d. completely stopping the moving parts

6.5 Energy-Isolation Devices

Energy-isolating devices prevent energy from being transmitted from an energy source to equipment. Energy-isolating devices are the primary means for protecting those who service equipment. Examples of energy-isolation devices include:

- manually operated electrical circuit breakers;
- main disconnect switches;
- line valves; and
- blocks.

Control circuit devices

Control circuit devices such as start/stop push buttons, e-stops, selector switches, presence sensing devices, or limiting switches do not physically isolate equipment from the equipment's energy source. For this reason, OSHA 1910.147 explicitly rejects control circuitry in the definition of an energy-isolating device.

However, under the "minor servicing" exception provided in 1910.147(a) (2)(ii), circuitry meeting the control reliability requirements of [ANSI B11, Machinery Safety Standards](#), provides the alternative safeguarding measures required under the exception.

Applying Lockout/Tagout Devices

Locking out. Locking out is a procedure for securing an energy-isolating device in an off, closed, or neutral position. When an energy-isolating device is locked out, a worker can safely service hazardous equipment. A lockout device - typically a lock with a unique key or combination - secures the energy-isolating device in a safe position. When an energy-isolating device is locked out, the equipment it controls will not work until the lockout device is removed.

Tagging out. Tagging out is a procedure for placing a warning tag or sign - a tagout device - on an energy-isolating device. Remember, tagout devices must control hazardous energy at least as effectively as lockout devices.

Bottom line: If you can lock it out, do not use tags.

5. Lockout devices must secure energy-isolating devices _____.

- a. in the off, closed, or neutral position
- b. using tags with plastic tie
- c. with insulating disconnect switches
- d. by opening circuit breakers

6.6 Key Criteria When Applying Lockout/Tagout Devices

- Lockout or tagout devices must be attached to each energy-isolating device by authorized workers.
- 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.
- The tags must be attached where the lockout devices would be located.
- You must demonstrate (prove) that the tagout system will provide protection at least as effective as locks and will assure full employee protection.

6. What should be done if a worker cannot lockout an energy-isolating device?

- a. Place a guard around it
- b. Tag it out
- c. Post a warning sign
- d. Place tape over it

6.7 Lockout, Tagout, or Lockout/Tagout

If you can lock out an energy-isolating device, then you must lock it out before you service the equipment that it controls. If you can't lock out an energy-isolating device, then you must tag it out. Remember that you must ensure that the hazardous energy is controlled just as effectively with the tagout device as it would be with a lockout device.

Full Employee Protection

You must demonstrate the protection achieved using the tagout program is equivalent to the level of safety obtained by using a lockout program.

So, how do you do it? You 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 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.

7. If you use tagout devices, you must prove they ____.

- a. prevents inadvertent exposure to equipment isolation
- b. successfully protect employees
- c. provided safety equivalent to lockout
- d. will provide a minimum level of employee protection

6.8 Verifying Machinery or Equipment Isolation

Each authorized employee must place his or her personal lock on each energy-isolating device before beginning service work. Service work involving many workers and many energy-isolating devices can make traditional lockout complicated.

Before any work begins on machines or equipment that have been locked out or tagged out, an authorized employee must verify that the machine or equipment has been properly isolated and de-energized. To do that, the authorized employee will attempt to turn the equipment or machinery on by cycling the energy isolation devices.

Attempting to restart the equipment is one way to confirm isolation; however, the authorized person should also test, as necessary, all components ensure they have been properly discharged, hazardous heat has dissipated, and excessive pressures have been relieved (zero-energy states).

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

8. To properly confirm isolation of equipment, what should the authorized employee do in addition to attempting to restart the equipment?

- a. Identify the equipment to be isolated
- b. Ensure proper documentation of LOTO steps
- c. Get permission to begin servicing or maintenance
- d. Test all components for zero-energy states

Module 7: Release from Lockout/Tagout

7.1 Basic Steps for 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 lockout or tagout devices are removed, and energy is restored, there are some procedures the authorized employee must follow:

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 safely 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.

1. Before lockout or tagout devices are removed and energy restored, what must the authorized employee do first?

- a. Clear the area of all essential workers
- b. Inspect and clear the area of non-essential items
- c. Remove warning signs
- d. Install energy-isolating devices

7.2 Absence of the Authorized Employee

If the authorized employee who affixed lockout/tagout devices is not present, you can authorize another employee to remove the device if that employee is properly trained and follows a documented energy control procedure. The procedure must ensure that the authorized employee is not available to remove the device, that someone has tried to contact and inform the authorized employee that another employee has removed the device, and that the authorized employee knows the device has been removed before returning to work. To ensure safe startup, the equipment should also be inspected and affected employees notified.

Here's what must be done if a worker who didn't apply the lockout/tagout device actually 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 the authorized employee knows that the lockout device has been removed before he/she resumes work at the facility.

Best Practice: Some companies have developed a "Lock Removal Form" and require it to be completed before a lock is removed by another authorized employee. This form identifies the lock owner and equipment, how the owner was contacted, the reason it was left on, confirmation the job was complete, why the lock is being removed, and actions taken to ensure safe startup. The form is signed by a supervisor and kept on file for annual review.

2. Which of the following is a condition that must be met if another authorized employee actually removes the device?

- a. The other authorized employee must show his or her authorization card
- b. Verify that the authorized employee who applied the LOTO device is not present
- c. Make an effort to tell the supervisor that the LOTO device has been removed
- d. Ensure the authorized employee knows the LOTO device has been removed

7.3 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.

Written energy control procedures will address the temporary removal of lockout or tagout devices. Temporary removal is allowed when re-energizing equipment is necessary, for example, when power is needed to test or position the equipment. This applies only for the limited time required to perform the task and the procedure must be documented.

Although lockout/tagout devices may be removed temporarily to perform testing, 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.

3. Which type of modification may be made to lockout/tagout entry or release procedures for testing purposes?

- a. Temporary removal of one energy-isolation device may be made for testing
- b. None - full lockout/tagout procedures must be used for testing
- c. An abbreviated entry and release from the lockout/tagout condition may be made
- d. OSHA does not have a position with regard to testing during lockout/tagout

7.4 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.

4. During lockout/tagout, which of the following actions should occur before authorized workers proceed to energize and test or position equipment or machinery?

- a. Clear tools and materials from the machine or equipment
- b. Verify workers are at least 10 feet from the machine or equipment area
- c. De-energize and reapply energy control measures
- d. Affix lockout or tagout devices prior to testing

7.5 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. Make sure you do the following:

- 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.

5. If there has been a long-term shutdown of equipment or machinery, what action should you take prior to startup?

- a. Be absolutely certain the equipment is working properly
- b. Get permission from the safety officer to perform startup
- c. Determine the date and time shutdown occurred
- d. Coordinate startup activities with the safety department

Module 8: Sub-Contractors, Group Lockout/Tagout, and Shift Changes

8.1 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. 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 his or her workers understand and comply with the restrictions and prohibitions of the contractor or outside employer's energy control program.

1. Whenever contractors and other outside service personnel perform tasks covered by the lockout/tagout standard, when do they have to adhere to OSHA standard's requirements?

- a. Always
- b. Only when the contractor asks
- c. Once OSHA shows up on site
- d. Never

8.2 Group Lockout

<http://steellockoutboxes.com/index.html> In many workplaces a group of authorized workers may need to service equipment that has several energy sources and several energy-isolating devices. In these instances, group lockout may be used.

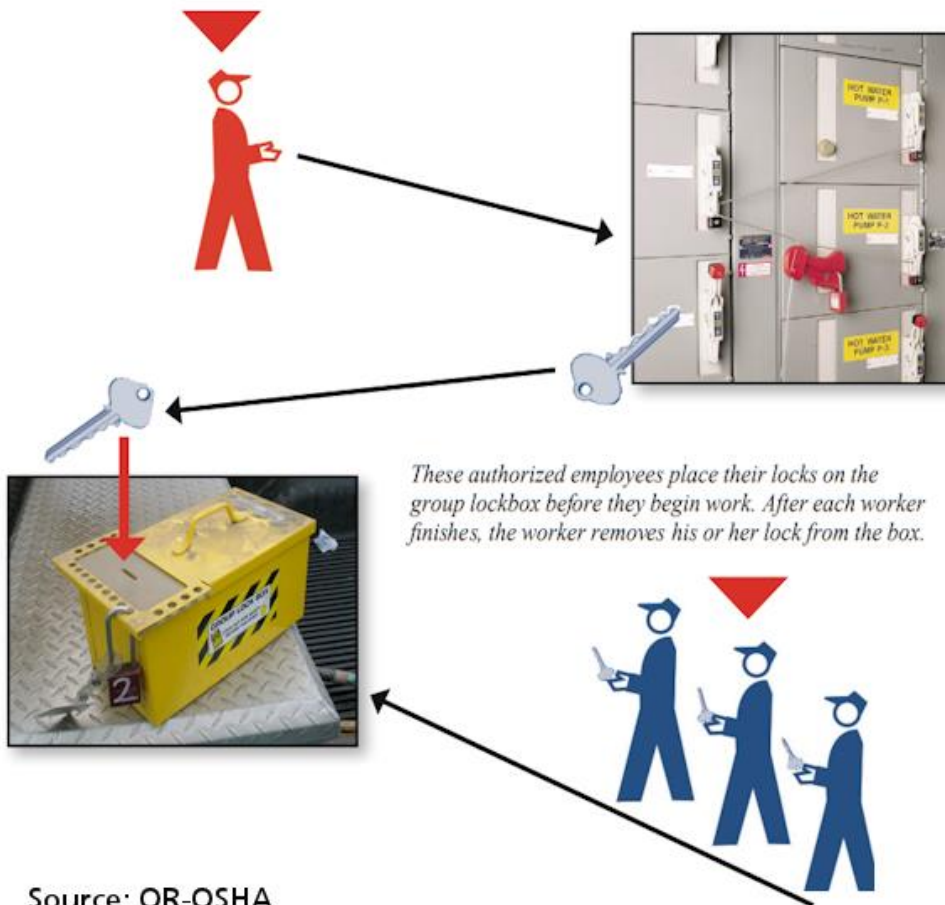
Under group lockout, protection must be used which affords the employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.

Group lockout with multiple energy-isolating devices

The designated person (shown in red) locks out each of these energy-isolating devices and puts the key into a group lockbox with a multi-lock hasp.

These authorized employees (shown in blue) place their locks on the group lockbox before they begin work. After each worker finishes, the worker removes his lock from the box. The designated person's lock is the last lock removed.

This designated person locks out each of these energy-isolating devices and puts the key into a group lockbox with a multi-lock hasp.



These authorized employees place their locks on the group lockbox before they begin work. After each worker finishes, the worker removes his or her lock from the box.

Source: OR-OSHA

The Primary Responsible Authorized Employee

The primary responsibility for a set number of employees working under the protection of a group lockout or tagout device must be vested in a single authorized employee. In other words, just one designated person in the group assumes responsibility for securing each energy-isolating device.

However, each authorized employee should be assured of his or her right to personally verify that the hazardous energy has been isolated and/or de-energized.

2. When performing group lockout/tagout, who is responsible for securing each energy isolation device?

- a. Each authorized employee in the group
- b. A single designated authorized employee
- c. All authorized and designated affected employees
- d. The authorized employee and the lockout supervisor

8.3 Example of a Group Lockout Procedure

1. A designated, authorized employee in the group secures each energy-isolating device with a personal lock.
2. The same authorized employee places the key that fits each lock in a group lockbox with a multi-lock hasp.
3. The other authorized workers 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 his personal lock from the lockbox.
5. After all the workers have finished their service work and removed their personal locks from the lockbox, the authorized employee who placed the key in the box removes it.
6. The authorized employee uses the key to remove the lock on each energy-isolating device.

3. In a group lockout/tagout procedure, what does the authorized employee do with the key that fits each lockout device?

- a. Gives it to an authorized employee
- b. Places it in the group lockbox
- c. Puts it into his pocket for safe-keeping
- d. Gives the key to the maintenance supervisor

8.4 Variations in Group Lockout

There are a number of variations of group lockout; the group lockbox variation reduces the number of locks and makes it easier for workers to coordinate their activities.

If there will be more than one crew, department, or group involved in the activity, a single authorized employee must be designated to coordinate affected workforces and to ensure continuity of protection. For these more complicated energy-control systems, group lockout can reduce the number of lockout devices that workers must use. Here's an example: Ten workers do maintenance on a machine that has five energy sources that need to be isolated.

- Traditional lockout requires 50 locks. (Each employee places a lock on each energy-isolating device.)
- Group lockout requires 15 locks. (A designated person in the group places a lock on each energy-isolating device. Each authorized employee places a lock on the group lockbox.)

Group lockout can also reduce the risk of injury for service and maintenance workers, contractors, and other affected workers who don't regularly work with complicated energy-control systems.

Master Lockbox: The lockbox into which all keys and tabs from the lockout or tagout devices securing the machine or equipment are inserted and which would be secured by a "job-lock" during multi-shift operations.

4. When crews from multiple departments are performing lockout/tagout ____ must be designated to coordinate affected workforces and to ensure continuity of protection.

- a. at least two authorized employees to direct operations
- b. a supervisor and crew authorized employees
- c. a single authorized employee
- d. a single authorized employee in each department

8.5 Shift Change Procedures

A high percentage of accidents occur shortly after a shift change and are often due to a lack of communication. Therefore, employers must make sure that there is a continuity of lockout or tagout protection. This includes the orderly transfer of lockout or tagout device protection between outgoing and incoming shifts to control hazardous energy.

- When lockout or tagout devices remain on energy-isolation devices from a previous shift, the incoming shift members must verify for themselves that the machinery is effectively isolated and de-energized.
- The off-going shift personnel should meet oncoming personnel at the lockout/tagout device.
- The oncoming authorized employee should place his/her lock or tag on the energy isolating device before the exiting authorized employee removes his /her lock or tag. If this is not possible, the oncoming authorized employee should place his/her lock or tag on the energy isolating device immediately after the exiting authorized employee removes his/her lock or tag.
- The exiting employees should inform oncoming employees of any problems or concerns regarding the service and maintenance of machinery or equipment.

5. Why does a high percentage of accidents occur shortly after a shift change?

- a. Lack of communication
- b. Lack of enforcement
- c. Lack of professionalism
- d. Lack of equipment