Lockout/Tagout

Oregon OSHA's

guide to controlling hazardous energy

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About this guide

Lockout/Tagout is an Oregon OSHA Standards and Technical Resources Section publication.

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A Division of the Department of Consumer and Business Services

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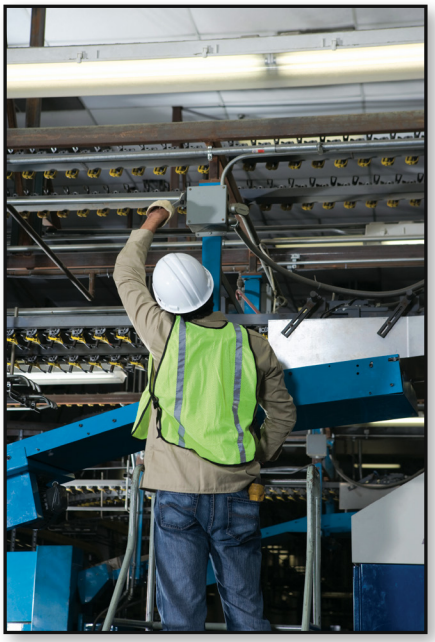
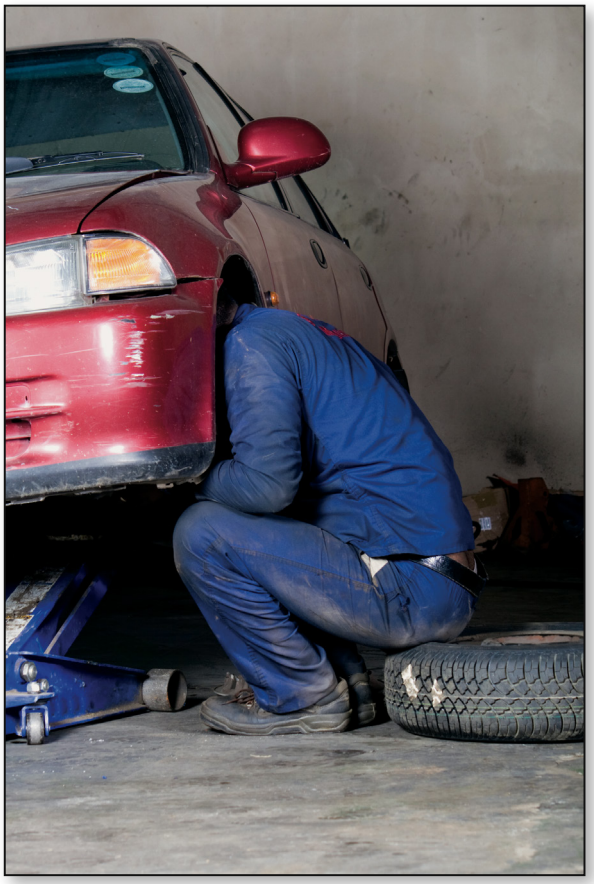




Oregon OSHA's guide to controlling hazardous energy

Introduction

Energy surrounds us as we work. Energy is critical in every place of business. Energy that is unexpected may be hazardous. Hazardous energy may be obvious, but often it is not. Hazardous energy threatens if you do the following:

- Service or maintain equipment that could start or move unexpectedly.
- Work near equipment when it's being serviced.
- Remove or go around machine guards.
- Fail to follow established energy control procedures.

This guide is based on the requirements in Oregon OSHA's standard for hazardous energy control – Subdivision 2/J, 1910.147, 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 guide, equipment means equipment** *and* **machines, whether fixed** *or* **mobile**.

What you will learn from this guide

- Why you should be concerned about hazardous energy.
- Safe practices for controlling hazardous energy.
- Key requirements of Oregon OSHA's hazardous-energy-control standard – Subdivision 2/J, 1910.147.

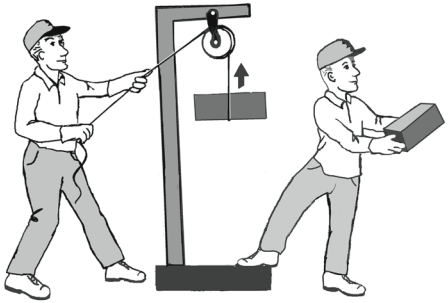
Remember: This guide will help you understand how to control hazardous energy and meet the requirements of 1910.147, but it does not take the place of 1910.147.

Understanding energy

Energy and motion

Energy is the power for doing work. Energy exists in different types (*see examples on Page 3*), but all are 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.

Tensioned objects have potential energy.



Moving objects have kinetic energy.

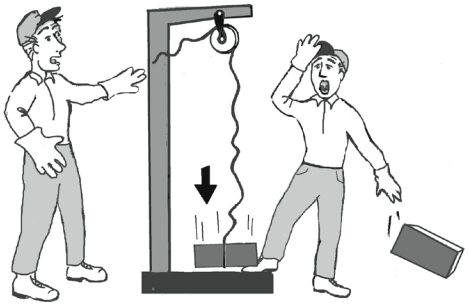


Illustration: Patricia Young, Oregon OSHA

This forklift truck, raised for repair work, has potential energy.

Forms of energy

Potential	***Stored*** energy that can 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.
Kinetic	Energy resulting from moving objects, such as released loads, uncoiling springs, and moving machinery. When these objects are released, their potential energy is converted to kinetic energy.

Types of energy

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 a 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.
Radiation	Visible light, infrared, microwave, ultraviolet, and X-rays. Non-ionizing radiation includes lasers, radio frequency (RF), and microwave (MW). Ionizing radiation includes computed tomography (CT) and X-rays.
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.

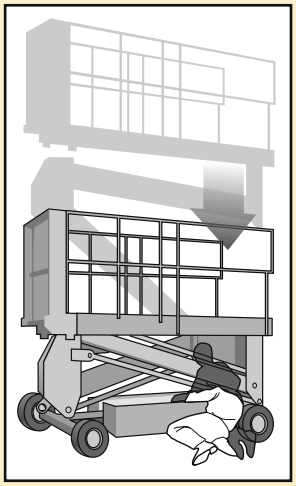
Energy transformation

Energy is often converted from one type to another to make it more useful. Chemical energy stored within a fuel such as natural gas 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 an air compressor. The 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.

How 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.

Hazardous energy in the workplace can kill



The son of the owner of a commercial drywall construction company, 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.

Investigation findings

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

The accident resulted in the following violations:

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

437-001-0760 – The employer failed to ensure that employees did not remove or tamper with required safety devices.

Controlling hazardous energy

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**
3. **Secure energy-isolating devices in a safe position**
4. **Dissipate or restrain potential energy that can't be isolated**
5. **Verify equipment isolation**

1. Identifying energy sources and energy-isolating devices

Identify equipment in your workplace 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.

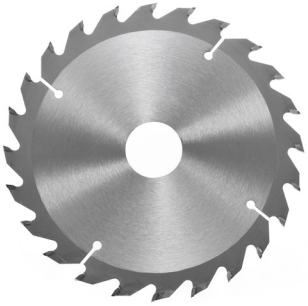
Example 1: ***Industrial coffee bean roasters must be serviced to maintain optimum bean flavor and reduce fire risk.***

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.

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. De-energizing equipment

Turn off or shut down equipment following established procedures. Stop buttons and on/off switches are used to shut down equipment, not to 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.

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

Dump truck safety blocks

OSHA.gov

Examples of energy-isolating devices

Main disconnect switch

Line valve

Motor disconnect

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.

WARNING

A word about energy-isolating devices:

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. See Page 22 for more information.

3. Secure energy-isolating devices in a safe position

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

The bolt is not a lockout device!

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. For more about tagout, see Page 12.

Examples of locked out and tagged out energy-isolating devices

Disconnect switch

Line valve

Circuit breaker

4. Dissipate or restrain potential energy that can't be isolated

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

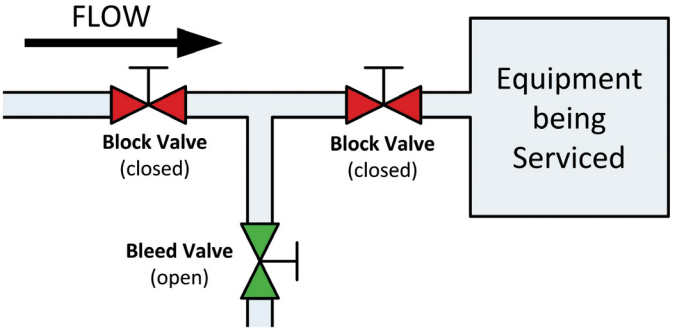
Capacitors; coiled springs; elevated machine parts; rotating flywheels; and air, gas, steam, chemical, and hydraulic systems are sources of stored energy. If the energy could return to a hazardous level, make sure that it remains isolated from the equipment until all service work is finished.

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 constitute 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).

Double Block and Bleed System



5. Verify equipment isolation

It's your last chance! Verification means purposely 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.
- 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.

A word about electrical testing:

"A qualified person shall use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and shall verify that the circuit elements and equipment parts are deenergized." [1910.333(b)(2)(iv)(B)]

Lockout (LO), tagout (TO) or lockout/tagout (LOTO)? How to decide

You have three options.

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.

Locked out (LO)

Tagged out (TO)

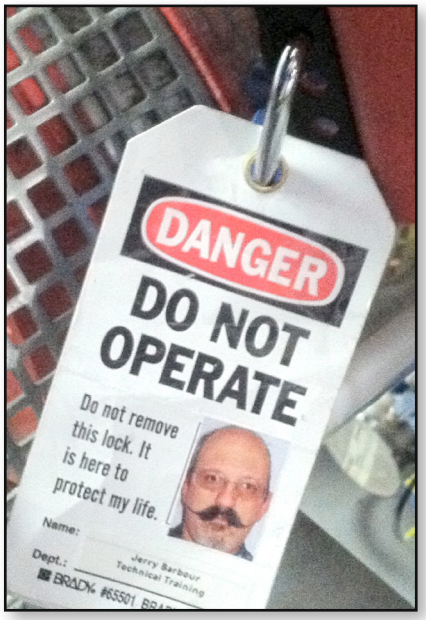
Option 3: Lockout/Tagout (LOTO). As a best practice, many employers use a combination of lockout devices and tags commonly referred to as lockout/tagout or LOTO. The lockout device, when secured on an energy-isolating device, provides the mandatory physical employee protection while the use of tags serves 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.

Locked out and tagged out (LOTO)

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.

Did you know?

Many energy-isolating devices, such as single-pole circuit breakers and line valves, were not designed with an integrated mechanism for attaching a lockout device. There are now a wide variety of accessories that allow lockout devices to be quickly and securely attached to energy-isolating devices, preventing the need for using tagout alone.



Custom tag

Facts about lockout and 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. It 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.

Your energy control program

You need to accomplish three critical activities to ensure employees' safety when they are servicing or working near equipment that could expose them to hazardous energy:

A. Develop written procedures for controlling hazardous energy

B. Train employees in the procedures

C. Conduct inspections of the procedures at least annually

A. Develop your written energy control procedures

You must document energy control procedures for use by authorized employees who lockout or tagout equipment to perform service and maintenance. Well-written energy control procedures accurately instruct 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

Written energy control procedures must include the following:

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

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.

Temporary removal

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.

Returning equipment to service

Energy control procedures also address the final removal of lockout or tagout devices and the re-energizing of equipment upon completion of service and maintenance. Energy control procedures should remind employers before re-energizing to do all of the following:

- Remove tools and replace equipment components, including guards
- Inform co-workers that lockout or tagout devices will soon be removed
- Ensure all workers are clear of the work area
- Verify power controls are off or in a neutral position
- Remove the lockout or tagout device
- Re-energize equipment

B. Train your employees

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.

Some employees need to know more about hazardous energy than others. What they need to know depends on whether they service the equipment or just work near the equipment while it is being serviced. Oregon OSHA uses the terms **authorized employees** for those who service equipment and **affected employees** for those who work in areas where the equipment is serviced.

Authorized employees lock out or tag out equipment and service or maintain the equipment. Required training:

- How to find and recognize hazardous energy source
- How to identify the types and magnitudes of energy used in the workplace
- How to isolate energy sources

Many companies train their authorized employees using equipment-specific written energy control procedures.

Affected employees use equipment serviced by others under lockout or tagout procedures or work in an area affected by the procedures. Required training:

- The purpose of energy control procedures
- How energy control procedures are applied
- How energy control procedures will protect them

An affected employee becomes an authorized employee when the employee is assigned to perform service or maintenance on the equipment.

Keep training records. Keep current training records for each authorized and affected employee. Document the employee's name and the training date.

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 do not follow established energy control procedures.

Best practice: Include a lesson plan or add additional information on the training record that can help when training is reviewed or someone steps into the training role in the future. It will be helpful to provide details, such as specifying the energy sources, explaining the hazards posed by the energy, the differences involving mobile equipment and vehicles, cord/plug equipment, working with contractors, shift changes, and group lockout (if done).

C. Perform periodic inspections

Periodic 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. 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

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 has the opportunity to be the inspector.

Each energy control procedure must be inspected 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. See Page 20 for more information. Also, inspections must include a review of the energy control procedure between the inspector and the employees using the procedure.

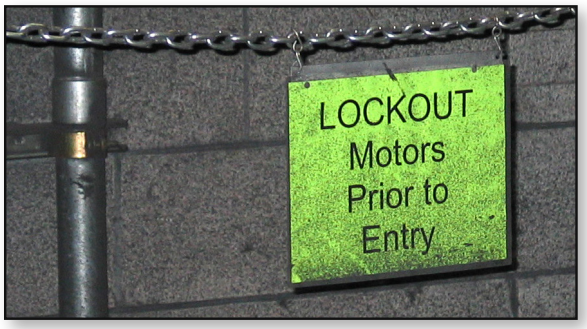
Reviewing a lockout procedure. If the inspection covers a procedure for equipment with an energy-isolating device that can be locked out, the inspector must review the procedure with the authorized employees who use it to service the equipment. The inspector can review the procedure with the authorized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



Putting it all together

Employee safety does not reside in a specific device, whether a tag or lock. Instead, safety is found in a comprehensive program that includes the use of controls, effective procedures, and careful training combined with the assurance of accountability.

Common questions

Can I use a lockout or tagout device to place equipment "Out of Service" when it is not related to servicing or maintenance?

No. Using lockout and tagout devices for purposes other than controlling hazardous energy causes these unique devices to lose their significance in the workplace. An employer may create an "out of service" program using tags/devices of a different color or design that cannot be mistaken for lockout or tagout devices.

Does the rule require a written energy control program?

No. The rule requires the employer to establish an energy control program with procedures, training, and periodic inspections. The rule does not require this **energy control program** to be in writing.

The program may not be required to be in writing; however, other written requirements exist in the rule. Certain energy control procedures, as well as the steps for removing a lock by someone else, must be in writing and training and periodic inspections must be documented.

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.

Do I need a separate written energy control procedure for each piece of equipment?

Not necessarily. A procedure must contain enough specific detail for authorized employees to have a clear understanding how to control the types and magnitudes of hazardous energy. Although the standard requires the procedure to be written in detail, this does not mean that a separate procedure must be written for each and every piece of equipment. Similar equipment can be covered by a single procedure when the equipment:

- Uses the same type and magnitude of energy
- Has the same or similar types of controls
- Is rendered safe using the same sequential procedural steps

For example, the equipment in a typical woodworking shop (e.g., table saws, planers, radial arm saws, and jointers) differ in function but are similar for purposes of energy control. They all use the same types of energy, have the same or similar controls for isolating the equipment from the energy source (e.g., electrical disconnect switches), and use the same procedural steps to achieve zero energy state.

Is there an exception to having energy control procedures in writing?

Yes. Standard 1910.147(c)(4)(i) contains a documentation exception with eight provisions. When all eight provisions are met for a specific machine or equipment, employers may forgo documenting the required procedure. It is considered a best practice to have all energy control procedures in writing.

What happens if I attach a lockout or tagout device, but I'm not available to remove it?

Your employer 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 you are not available to remove the device, that someone has tried to contact and inform you that another employee has removed the device, and that you know the device has been removed **before** you return to work. To ensure safe startup, the equipment should also be inspected and affected employees notified.

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.

How do I deal with locked-out or tagged-out equipment when work shifts change?

You must have a procedure covering shift or personnel changes that provide a continuity of protection during the transition. There must be an orderly transfer of lockout or tagout device protection between employees on outgoing and incoming shifts to ensure that the equipment is safe to work on. Another important element for assuring continual protection is to require each oncoming employee to verify the system was effectively de-energized and isolated (everyone must remove themselves from the equipment before re-verification is done).

How do I deal with locked-out or tagged-out equipment after long-term shutdowns?

You should also have an additional energy control procedure to protect employees 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 employees 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.

What if I contract service or maintenance on my equipment?

You and the contractor must understand one another's lockout and tagout procedures. Review your contractor's energy control program before the contractor does any on-site work. Your employees must also understand and comply with the contractor's energy control program. To prevent accidents, share with the contractor the unique aspects of your equipment.

Do I need a lockout/tagout program when working on motor vehicles?

Yes. You must ensure that vehicles, machinery, and equipment are isolated from their energy sources and made inoperable before service, maintenance, or repair work. Refer to Oregon OSHA's Program Directive A-156 (Ch. 3) for more information.

If multiple employees are servicing the same equipment, is it acceptable for me to place a lockout device on the energy-isolating device on behalf of the servicing employees?

No. Each affected employee must verify and affix a personal lockout device. Information about group lockout is available on Page 24.

Can I use control circuit type devices such as start/stop push buttons, e-stops, selector switches, presence sensing devices, or limiting switches instead of energy-isolating devices for equipment lockout?

No. These control circuit type devices do not physically isolate equipment from the equipment's energy source. Unanticipated circumstances such as welded contacts or a loose wire shorting out can cause unexpected energization or startup. For this reason, 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 B11.19 provides the alternative safeguarding measures required under the exception.

Control reliability is the capability of the control system and related interfacing to achieve a safe state in the event of a failure. For example, an interlock or e-stop having a dual channel (redundant) circuit with a self-monitoring safety module typically meets the control reliability requirements.

On the other hand, a basic start/stop circuit, used for decades and fulfilling the traditional e-stop function, is simply equipped with a single-contact button (single channel), even though it may be "safety-rated" (positive contacts). Although the probability of a single failure is low – due to the number of times the e-stop is cycled and the simplicity of the circuit – there are still several chances for a single component failing, leading to circuit failure. Because of the lack of redundancy and self-checking circuitry, this single channel e-stop circuit is not considered control reliable.

If you are considering incorporating control reliable safety control circuits, a thorough risk assessment must be done to document and verify the necessary integrity and performance levels of the control system. This ensures you are providing equivalent and effective employee protection.

Additional control circuit type device references:

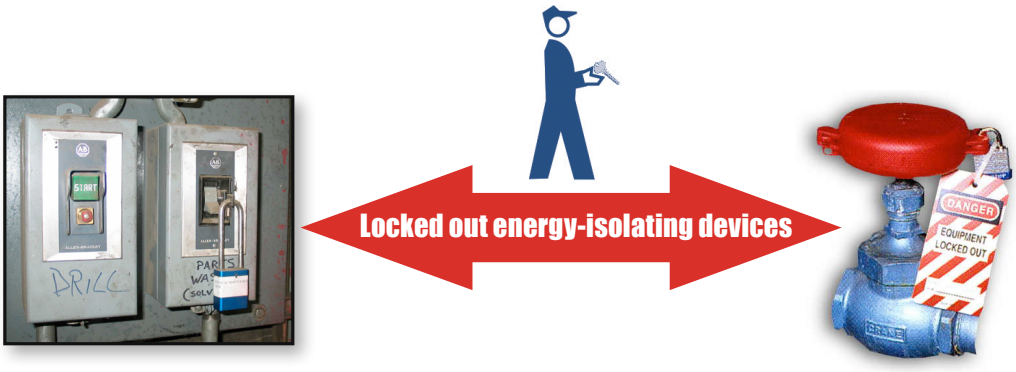
- **Oregon OSHA Program Directive A-156** *Control of Hazardous Energy – Enforcement Policy and Inspection Procedures (Lockout/Tagout)*
- **ANSI B11.19** *Performance Criteria for Safeguarding*
- **ANSI/RIA 15.06** *Safety Requirements for Industrial Robots and Robot Systems*
- **ANSI/ASSE Z244.1** *Control of Hazardous Energy – Lockout/Tagout: Alternative Methods*
- **ISO 13849-1** *Safety of Machinery – Safety-related parts of control systems*

Traditional lockout vs. group lockout

Traditional lockout

Recall that lockout means securing an energy-isolating device in an off, closed, or neutral position. Under traditional lockout, each authorized employee secures each energy-isolating device – typically with a lock as shown below. An authorized employee is one who locks out or tags out the energy-isolating device and services the equipment.

Traditional lockout with multiple energy-isolating devices and authorized personnel



Each authorized employee places his or her 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.

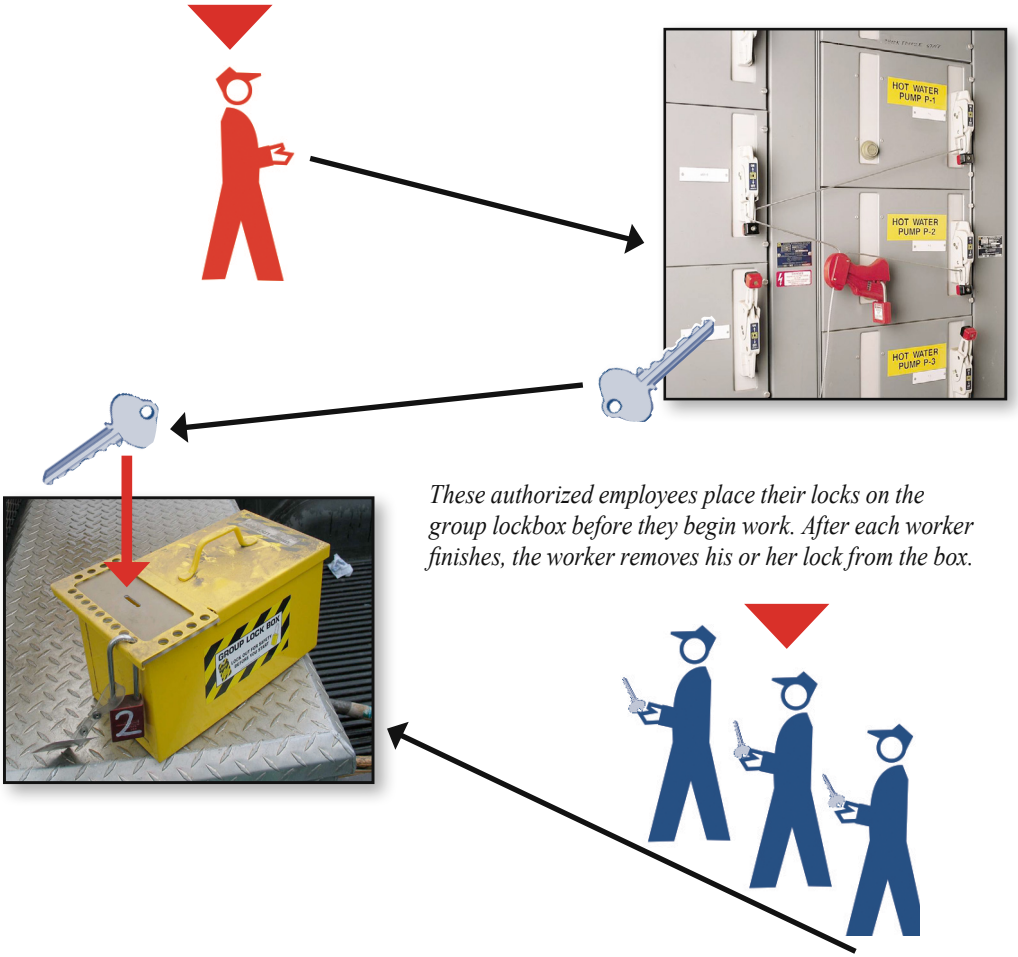
Under group lockout, just one designated person in the group assumes responsibility for securing each energy-isolating device. There are a number of variations of group lockout; the group lockbox variation (see the illustration on Page 25) reduces the number of locks and makes it easier for employees to coordinate their activities.

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.

Group lockout: Fewer lockout devices required

For complicated energy-control systems, group lockout can reduce the number of lockout devices that employees must use.

Here is an example: Ten employees 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 of the five energy-isolating devices. Each authorized employee places his or her own lock on the group lockbox containing the five keys.)

Group lockout can also reduce the risk of injury for service and maintenance employees, contractors, and other affected employees who do not regularly work with complicated energy control systems.

Example of a group lockout procedure – the group lockbox variation.

- **Step 1** A designated, authorized employee in the group secures each energy-isolating device with a personal lock.
- **Step 2** The same designated, authorized employee places the key that fits each lock in a group lockbox with a multilock hasp.
- **Step 3** The other authorized employees in the group secure the lockbox – they attach their personal locks to the box – before beginning their service work.
- **Step 4** After each employee finishes service work on the equipment, that employee removes his or her personal lock from the lockbox.
- **Step 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.
- **Step 6** The designated, authorized employee uses the key to remove the lock from each energy-isolating device.

Much more on group lockout can be found in Chapter 4 of Oregon OSHA's Program Directive A-156.

Working by the rules

Keep in mind the following:

- If you service equipment that could start or move unexpectedly, follow the requirements in 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*.
- Depending on your work, you may also need to comply with one or more of the other rules that specifically references 1910.147, such as 437-002-0146, *Confined Spaces* or 437-002-0256, *Stationary Compactors, Self-Contained Compactors, and Balers* as examples.
- Furthermore, depending on the nature of your work, other rules may refer to terms that guide you to the provisions of 1910.147. For example, 1910.263, *Bakery Equipment* states the following:

  "Where pan cooling towers extend to two or more floors, a lockout switch shall be provided on each floor in order that mechanics working on the tower may positively lock the mechanism against starting."
- If electricity is your primary hazard – for example, if you work on or near parts of fixed electrical equipment or circuits – follow the requirements in 1910.333, *Work On or Near Energized Parts*.
- Rules within Division 2, Subdivision O, (Machinery & Machine Guarding) and Subdivision P (Hand & Portable Power Tools & Other Hand-Held Equipment) protect employees during normal machine operations. When machine guards are removed or bypassed, the requirements in 1910.147 must be considered.

Definitions

Affected employee

A person who uses equipment that is being serviced under lockout or tagout procedures, or who works in an area where equipment is being serviced.

Authorized employee

A person who locks out or tags out equipment to do service work. An affected employee becomes an authorized employee when that employee's duties include service or maintenance work on equipment.

Disconnect

A switch that disconnects an electrical circuit or load (motor, transformer, or panel) from the conductors that supply power to it. An open circuit does not allow electrical current to flow. Under a lockout procedure, a disconnect must be capable of being locked in the open position.

Energized

Connected to an energy source or containing potential energy.

Energy-isolating device

A mechanical device that physically prevents transmission or release of energy.

Energy source

Any source of energy. Examples: electrical, mechanical, hydraulic, pneumatic, chemical, and thermal.

Hazardous energy

Any of the types of energy existing at a level or quantity that could be harmful to workers or cause injury through inadvertent release or startup of equipment.

Isolate

To physically separate a machine or equipment from its energy source by the use of an energy-isolating device.

Lock out

Placing a lockout device on an energy-isolating device as part of an established procedure to ensure the energy-isolating device and the equipment it controls cannot be operated until the lockout device is removed. (An energy-isolating device is capable of being locked out if it has a hasp that accepts a lock or if it has a locking mechanism built into it.)

Lockout device

A device that locks an energy-isolating device in the safe position.

Procedure

A series of steps taken to isolate energy and shut down equipment.

Servicing or maintenance

Workplace activities, such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining machines or equipment. Also includes lubricating, cleaning, unjamming, and making adjustments or tool changes if a worker may be exposed to the unexpected startup of the equipment during such activities.

Tag out

Placing a tagout device on an energy-isolating device as part of an established procedure to indicate that the energy-isolating device and the equipment it controls cannot be operated until the tagout device is removed.

Tagout device

A prominent warning sign, such as a tag, that can be securely fastened to an energy-isolating device to indicate that the energy-isolating device and the equipment it controls cannot be operated until the tagout device is removed.

References

- *The Control of Hazardous Energy (Lockout/Tagout)*, 2/J, 1910.147
- Oregon OSHA's Program Directive – A-156, *Control of Hazardous Energy – Enforcement Policy and Inspection Procedures (Lockout/Tagout)*

Oregon OSHA Services

Oregon OSHA offers a wide variety of safety and health services to employers and employees:

Appeals

503-947-7426; 800-922-2689; admin.web@oregon.gov

- Provides the opportunity for employers to hold informal meetings with Oregon OSHA on concerns about workplace safety and health.
- Discusses Oregon OSHA's requirements and clarifies workplace safety or health violations.
- Discusses abatement dates and negotiates settlement agreements to resolve disputed citations.

Conferences

503-378-3272; 888-292-5247, Option 1; oregon.conferences@oregon.gov

- Co-hosts conferences throughout Oregon that enable employees and employers to learn and share ideas with local and nationally recognized safety and health professionals.

Consultative Services

503-378-3272; 800-922-2689; consult.web@oregon.gov

- Offers no-cost, on-site safety and health assistance to help Oregon employers recognize and correct workplace safety and health problems.
- Provides consultations in the areas of safety, industrial hygiene, ergonomics, occupational safety and health programs, assistance to new businesses, the Safety and Health Achievement Recognition Program (SHARP), and the Voluntary Protection Program (VPP).

Enforcement

503-378-3272; 800-922-2689; enforce.web@oregon.gov

- Offers pre-job conferences for mobile employers in industries such as logging and construction.
- Inspects places of employment for occupational safety and health hazards and investigates workplace complaints and accidents.
- Provides abatement assistance to employers who have received citations and provides compliance and technical assistance by phone.

Public Education

503-947-7443; 888-292-5247, Option 2; ed.web@oregon.gov

- Provides workshops and materials covering management of basic safety and health programs, safety committees, accident investigation, technical topics, and job safety analysis.

Standards and Technical Resources

503-378-3272; 800-922-2689; tech.web@oregon.gov

- Develops, interprets, and gives technical advice on Oregon OSHA's safety and health rules.
- Publishes safe-practices guides, pamphlets, and other materials for employers and employees
- Manages the Oregon OSHA Resource Center, which offers safety videos, books, periodicals, and research assistance for employers and employees.

For more information, call the Oregon OSHA office nearest you.

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