ENVIRONMENT, HEALTH & SAFETY
UNIVERSITY OF MICHIGAN

Lockout/Tagout - Control of Hazardous Energy Sources

Guideline

Revision Date: 5/11/07

Applies To: All research and service units involved in service and maintenance of machines and equipment in which the unexpected energization or start up, or release of stored energy could cause injury to employees.

Table of Contents

Summary

Employees require protection from unintended release of energy or machine motion that could cause injury during set up, adjustment, repair, service, installation, or maintenance work on equipment, machinery or processes. Employees **must** receive training, know safe work practice procedures, and have available protective equipment and devices to insure their safety. This Guideline, along with Appendix A and Appendix B, when properly completed, will provide departments with an effective written program for locking/tagging out hazardous energy sources.

Scope

This Guideline applies to all research and service units involved in service and maintenance of machines and equipment in which the unexpected energization or start up, or release of stored energy could cause injury to employees.

Reference Regulations

- The Control of Hazardous Energy Sources: MIOSHA Part 85
- Electrical Safety-Related Work Practices: MIOSHA Part 40
- The Control of Hazardous Energy (Lockout/Tagout): 29 CFR 1910.147
- Selection and Use of Work Practices: 29 CFR 1910.333

For situations involving confined spaces, refer to the OSEH Guideline, "Confined Space Entry."

Glossary of Terms

TERM	DEFINITIONS
Affected Employee	An employee whose job requires them to operate or use equipment on which service or maintenance is being performed, or whose job requires them to work in an area in which such service is being performed.
Authorized Employee	An employee who locks or implements a lockout/tagout procedure on equipment or processes to perform maintenance or service.
Energized	Connected to an energy source or containing residual or stored energy.
Energy Isolating Device	A physical device that prevents the transmission or release of energy including but not limited to the following: a manually operated electrical circuit breaker, disconnect switch, manually operated switch, slide gate, slip blind, line valve and similar devices with a visible indication of the position of the device. Note: push buttons, selector switches, and other control circuit type devices are not energy isolating devices.
Energy Source	Energy is defined as movement or the possibility of movement. Potential energy sources are: electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and gravitational.
High Voltage Electrical Equipment	Equipment used for power transmission and distribution

TERM	DEFINITIONS
Lockout	The placement of a lockout device on any energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
Lockout Device	A device that uses a lock and key to hold an energy isolating device in a safe position and prevent the inadvertent energizing of equipment for the purpose of protecting personnel. The device shall only be used for controlling energy and shall not be used for other purposes.
Qualified Person	Those who have had training in avoiding electrical shock and are permitted to work on or near exposed energized electrical parts or to test circuits because they are familiar with the operation of the equipment and the hazards involved. All Qualified Persons are required to participate in an Electrical Safety Training for Qualified Persons class which will familiarize them with the MIOSHA Construction and General Industry standards, and the skills, techniques and safety precautions required for doing work on exposed energized electrical parts. Contact OSEH for further information regarding this training.
Service and/or Maintenance	Workplace activities such as construction, installation, set up, adjustment, inspection, modification, maintenance and/or service of machines or equipment. These activities include lubricating, cleaning or un-jamming machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.
Tagout	The placement of a tagout device on any energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.
Tagout Device	A prominent warning device capable of being securely attached, which forbids the operation of an energy-isolating device, for the purpose of protecting personnel. The tag shall indicate the name of the authorized employee, the equipment or installation of the equipment affected, the date, the reason for the tagout, and the estimated duration of down time. The device shall only be used for controlling energy and shall not be used for other purposes.

Responsibility

Deans, Directors and Department Heads

- Designate and empower individuals who will be responsible for the implementation of this program.
- Actively support this Guideline within individual units.
- Ensure an environment where principal investigators/supervisors and other personnel are encouraged to follow this Guideline.

Principal Investigators/Supervisors

- Train employees on the specific equipment they will be working with, how to properly de-energize and lock it out.
- Provide employees with locks, tags and other equipment necessary under this Guideline.
- Ensure that inspections are conducted periodically (at least annually) by an *Authorized Employee* to assure the procedures outlined below are properly implemented and certify the inspections have been performed.
- Follow Work~Connections procedures if there is an accident or injury. http://www.workconnections.umich.edu/forms.html.
- Contact OSEH to request technical assistance.

Employees

- Follow the procedures outlined in this Guideline whenever servicing or maintaining machines or equipment.
- Conduct assigned tasks in a safe manner, wear appropriate personal protective equipment, and only use equipment for which they have been formally trained.
- Report any job related injuries or illnesses, questions on health and safety, or any unsafe or unhealthy work conditions to their principal investigator/supervisor.
- May contact OSEH to evaluate health and safety conditions within their unit.

Facilities & Operations/Architecture, Engineering & Construction (AEC) and Departments Hiring Contractors

Assure that contractors comply with all applicable state and federal regulations as per the General Standard Conditions and contract specifications.

Inform contractors of UM Lockout/Tagout procedures where appropriate.

EHS

- Review and revise this Lockout/Tagout Guideline, as necessary.
- Assist in and evaluate departments implementing an effective program in their workplace.
- Provide training to the principal investigator/supervisor and staff regarding general lockout/tagout requirements and procedures, the hazards associated with the release of hazardous energy, and the content of this Guideline.
- Maintain records of EHS-provided training.

General Requirements

The regulation requires that procedures be developed, documented, and utilized for the control of potentially hazardous energy when employees service and maintain machines and equipment. The goal is to give the worker a clear understanding and exclusive control over the *energy sources*, so that accidental start up cannot occur. This Guideline provides the basis of required procedures, but **must** be supplemented with departmental procedures for each specific machine or equipment, unless the EXCEPTION below is met.

EXCEPTION: Employees are not required to document procedures for a particular machine or piece of equipment when **all** of the following elements exist:

- The machine/equipment has no potential for stored energy or reaccumulation of stored energy after shutdown, which would endanger employees.
- The machine/equipment has a single energy source that can be readily identified and isolated.
- Isolation and locking out the energy source will completely deenergize the machine/equipment.
- The machine/equipment is isolated from that energy source and is locked out during *service or maintenance*.
- A single *lockout device* will achieve a locked out condition.
- The lockout device is under the exclusive control of the authorized employee performing the service or maintenance.
- The service or maintenance does not create hazards for other employees.
- There have been no previous accidents involving the unexpected activation or re-energization of the machine/equipment being locked out/tagged out during service or maintenance using this exception.

If all eight (8) conditions described above are not met for a particular machine/equipment, use Appendix B to document specific lockout/tagout procedures. As an alternative, a schematic may be used to identify all points of lockout.

Shutdown Procedures

1. Notify the *affected employee(s)*, supervisor(s), and administrator(s) of the affected areas before any piece of equipment or machine is shut down. In many cases, advance notice of the shutdown **must** be given and approval received from the affected employee(s).
2. Have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the correct *Lockout*/*Tagout* procedures, before shutting down a machine or piece of equipment.
3. Shut down the machine/equipment using the sequence of steps established for that piece of equipment. An orderly shutdown **must** be followed to avoid adding or increasing to the hazards of the equipment stoppage. Make sure that **all** energy-isolating devices (switches, circuit breakers, etc.) have been located and turned off or shut down.

Locking and/or Tagging

The appropriate lockout/*tagout devices* are applied to the equipment by each authorized employee working on the equipment or process. The authorized employee(s) **must** use lockout devices, unless the

hazardous energy source cannot be locked out and the supervisor shows that tagout devices alone will provide the same level of protection. In this case, attach the tag at the same location that a lock device would have been attached. Where feasible, supplement each tag with additional safety measures, such as isolating circuit elements, blocking control switches, opening extra disconnect devices, or opening or closing a valve handle. Also see Tagging Devices below.

Lockout devices **must** meet the following criteria:

- Hold the *energy isolating device* in a safe or "off" position
- Be standardized in color, shape, or size
- Be substantial enough to prevent removal without the use of excessive force, e.g., bolt cutters
- Be accompanied by a tagout device that identifies the employee applying the device

Tagging Devices

- When only tagout devices are used, all affected employees will be trained on the following topics: the limitations of tags; that when a tag is not to be removed without consent of the person that attached it; and that a tagout device is never to be by-passed, ignored, or otherwise defeated.
- Tags **must** be legible and understandable and attached in a manner that will clearly indicate the safe or "**off**" position.
- Tags, and means of attachment, **must** be made of materials which will withstand the environmental conditions of the workplace.
- Tags **must** be securely attached to energy isolating devices so they cannot be inadvertently or accidentally detached during use.

Release of Stored Energy and Verification of De-Energization

Following the application of lockout/tagout devices, all potentially hazardous stored or residual energy will be relieved, released, disconnected, or otherwise rendered safe. The machine or equipment should be at a zero energy state.

Prior to working on equipment that has been locked or tagged out, verify isolation and de-energization of that machine by trying to activate the system.

Lockout/Tagout Device Removal

Before lockout/tagout devices are removed:

1. Remove all non-essential items such as tools and materials from the work area.
2. Check that equipment/machine components are operationally intact.
3. Ensure that all employees are at a safe distance from the affected machine or equipment.
4. Notify affected employees, supervisors and administrators that equipment/machine/processes are going to have the lockout/tagout devices removed.

Only the authorized employee who placed the lock and tag on the machine or equipment will remove it.

EXCEPTION: If the authorized employee that applied the lockout/tagout device to the machine or equipment is not available to remove the lock/tag, the authorized employee's supervisor may remove the lockout/tagout device after:

1. Verifying that the authorized employee is not at the facility
2. Making all reasonable efforts to contact the authorized employee to inform them that their lockout/tagout device is going to be removed
3. Ensuring that the authorized employee who applied the device will be properly informed that the lockout/tagout has been removed, upon returning to work.

Special Requirements

Group Lockout/Tagout

When service or maintenance on a machine or equipment will be conducted by more than one person, then group lockout/tagout devices will be used to provide protection to all authorized employees. Each authorized employee **must** have their own individual device as part of the group lockout/tagout device. Locks will be applied to prevent the machine/equipment from being reenergized until all of the individual lockout/tagout devices of each authorized employee have been removed.

One of the authorized employees will be assigned primary responsibility for the entire group's lockout/tagout protection.

The authorized employee with primary responsibility shall be able to ascertain the exposure status of each individual authorized employee within the group, with regard to the locked out/tagged out equipment/machine. When more than one group of authorized employees are working on a machine or equipment, the authorized employee with primary responsibility **must** be able to coordinate between groups and ensure the continuity of protection for all authorized employees in each group.

Shift or Personnel Changes

When work on a locked out/tagged out machine or equipment continues through a change in authorized employees servicing and/or maintaining the machine or equipment, the authorized employees continuing to service or maintain the machine or equipment will apply their lockout/tagout devices prior to the removal of the lockout/tagout devices of the authorized employees ending their work. At no time will all lockout/tagout devices be removed from a machine or equipment without first implementing the removal procedures listed above.

Electrical Equipment

Energized parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the supervisor approves and can demonstrate that de-energizing introduces additional or increased hazards, or is not feasible due to equipment design or operational limitations. Energized parts that operate at less than 50 volts to ground do not need to be deenergized, if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

Only qualified employees are permitted to work on energized circuits/equipment. They **must** be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and

shielding materials, and insulated tools. When work involves electrical equipment that could permit exposure 440 volts or greater, two (2) qualified employees **must** work together.

When de-energizing electrical devices, the electrician conducting the work will:

- Place lockout/tagout devices on the disconnecting means used to de-energize the equipment and circuits.
- Test the circuit or equipment to ensure it is de-energized and that no energized condition exists as a result of feedback.

Before re-energizing, the qualified employee will ensure that all lockout removal procedures have been followed and that equipment-guarding panels are installed, prior to removal of lockout/tagout devices.

High Voltage Equipment

In addition to the requirements in the Electrical Equipment section above, the following steps **must** be taken when isolating *high voltage electrical equipment*:

- The high voltage electrician shall write a step-by-step switching order. **EXCEPTION**: The switching order may be written by the high voltage foreman or omitted in the event of an emergency.
- No one other than high voltage electricians will lockout/tagout or operate primary equipment, or remove lockout/tagout devices, up to and including secondary mains. **EXCEPTION**: The high voltage foreman may remove lockout/tagout devices and restore power after a thorough inspection is made to assure that no one will be exposed to hazardous energy when power is restored.
- All high voltage switching shall be performed by at least two (2) high voltage electricians or one of the following:
  - One (1) high voltage electrician and their foreman
  - A high voltage electrician and a non-high voltage electrician under direct supervision of a high voltage foreman
  - In the case of a secondary main shutdowns, one (1) high voltage electrician and one (1) non-high voltage electrician.

Compressed Gases or Air

- Compressed gas pressure systems will be included in this section and are required to be locked out/tagged out if pressures could result in unexpected movement of the equipment or components.
- Equipment using air or other compressed gas must be equipped with a main line shut off valve capable of being locked out or tagged out in the "off" position.
- Unless the compressed gas valve allows pressure release, a portion of the pipe shall be disconnected to allow pressure release if the trapped energy could create a possible hazard.
- All compressed gas lines will be labeled.

Hydraulic Energy

Equipment using hydraulic pressure shall be locked out by placing the hydraulic pump motor electrical disconnect switch in "**off**" position, and applying a lockout/tagout device to the electrical disconnect. Bleed off residual pressure in the piping system.

Gravity and Stored Energy

Regardless of the lockout/tagout procedure used, safety blocks or mechanical devices will be used to protect employees from any accidental equipment movement.

Bleed off, or otherwise dissipate, residual pressure in steam, air, gas, electrical, mechanical, and/or hydraulic systems.

Outside Contractors

Whenever outside contractors plan to engage in activities covered by the scope of this Guideline, the UM representative and the outside contractor will inform each other of their lockout/tagout procedures for the job. They will both ensure their personnel understand and comply with any restrictions and prohibitions of the energy control procedures to be used. Appendix C can be used to document compliance with this provision.

Related Documents

- EHS Confined Space Entry Guideline
- MIOSHA Lockout Brochure
- MIOSHA Lockout Poster
- MIOSHA Lockout Sticker

Technical Support

All referenced guidelines, regulations, and other documents are available through EHS (734) 647-1142.

Attachments

- Appendix A – Example of Departmental Specific Lockout/Tagout Program
- Appendix B – Lockout/Tagout Procedure Form
- Appendix C – Contractor Notification Form
- Appendix D – Lockout/Tagout Training Guide for Plant Operations