
***Control of Hazardous
Energies
Lockout/Tagout Program
(LOTO)***



DARTMOUTH

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Section 1 - Scope

This Program applies to all Dartmouth College employees who are “authorized” to work on sources of hazardous energy and to employees and students who are “affected” by the Program. The Control of Hazardous Energy Program – Lockout/Tagout (LOTO Program) applies to the servicing and maintenance of machines and equipment. The unexpected energization or start-up of machines or equipment, or the release of stored energy, could cause injury to employees. This Program establishes minimum performance requirements for the control of hazardous energy.

Section 2 - Purpose

The purpose of the LOTO Program is to provide practical implementation, operation, and recordkeeping of the College’s LOTO Program in compliance with 29 CFR 1910.147 (effective January 2, 1990). This Program describes general procedures for affixing appropriate lockout devices or tagout devices to energy-isolating devices and for otherwise disabling machines or equipment to prevent unexpected energization, start-up, or release of stored energy, thereby preventing employee injury.

Section 3 - Regulatory Requirements

This Program was developed to meet the Occupational Safety and Health Administration’s (OSHA) requirements found in 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout), 29 CFR 1910.333 Selection and Use of Work Practices (Electrical Safety-Related Work Practices), and other standards incorporated by reference.

Section 4 - Applicability

This Program covers energy control during the servicing and/or maintenance of machines and equipment. Dartmouth campus buildings vary in age from centuries-old to modern. Many buildings on campus have unique systems that are independent of other areas and were built during different periods. This Program applies to simple and complex systems where hazardous energy is used, including, but not limited to, electrical energy, mechanical energy, potential energy, hydraulic energy, steam, and other forms of energy.

This program **DOES NOT** cover the following instances:

- Work on cord and plug-connected electric equipment when unplugged, and the employee working on the equipment always has complete control over the plug.
- Hot tap operations involving gas, steam, water, or petroleum products, if the College can show that continuity of service is essential, the shutdown is impractical, and documented procedures and special equipment are used to provide proven effective employee protection.

Section 5 - Selected Definitions

Definitions are provided in ***Appendix A***.

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Section 6 - Roles and Responsibilities

The LOTO Program roles and responsibilities are identified and delineated in this section. The Program's success relies on and charges Dartmouth employees to adhere to and provide full support for this Program. Due to the high hazards associated with LOTO that could result in serious injuries or fatalities, it is EVERYONE'S responsibility to identify gaps in the Program or procedures and inform their supervisor and/or EHS of these gaps.

6.1 Environmental Health and Safety (EHS)

- Maintain the Program per applicable regulations and College guidelines.
- Support departments with the implementation of the Program. **See Appendix B**
- Provide support and training for employees subject to the Program's requirements.
- Develop and maintain an annual inspection process for the LOTO Program.
- Evaluate and make recommendations for improvements based on observed and reported discrepancies between actual practice and the intent of OSHA requirements.
- Annually review LOTO audit findings and make recommendations.

6.2 Supervisor of Authorized Employees

- Shall attend the annual training.
- Establish specific procedures for shutdown, locking out, and tagging out specific equipment and reenergizing for each machine or piece of equipment covered by this Program.
- Make procedures available to Authorized employees who may perform service or maintenance on the machinery or equipment.
- Ensure employees are aware of and follow lockout or tagout procedures before starting work.
- Ensure re-training occurs when procedures change.
- Coordinate multi-shift or Group lockout or tagout.
- Ensure new machines or equipment, or machines or equipment that undergo major repair, renovation, or modification, are designed or modified to contain energy-isolating devices capable of being locked out.
- Report issues with program implementation to their manager and/or EHS, as applicable.
- Ensure that when contractors are performing lockout or tagout procedures, employees exposed to the work understand and comply with the restrictions and prohibitions of the contractor's energy control program.
- Will perform an annual audit for locking out and tagging specific equipment.
- Provide applicable locks, tags, and other equipment to Authorized employees.

6.3 Authorized Employees

- Shall attend the annual training.
- Recognize applicable hazardous energy sources before performing maintenance or service.
- Communicate changes to LOTO procedures when equipment is modified.
- Use only the assigned locks.
- Know the type and magnitude of energy available in the workplace.

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- Know the methods and means necessary for energy isolation and control.
- Follow specific procedures for shutdown, lockout, or tagout and reenergizing for each machine or piece of equipment covered by the Program.
- Report problems with the Program implementation to their supervisor and/or EHS, as applicable, to help ensure continual Program improvement.
- Engage in periodic audits.
- Notify Affected or other personnel during LOTO procedures.

6.4 Affected Employees

- Shall attend the annual training.
- Inform Authorized employees when service or maintenance of their equipment or machinery is necessary.
- Understand the purpose and use of energy control procedures.
- Stay clear of the area when required during shutdown and re-energization of equipment or machinery.
- Never remove or tamper with a lockout or tagout device and never attempt to reenergize equipment or machinery until the Authorized employee removes the lockout or tagout device.
- Report problems with the implementation of this program to their supervisor and/or EHS, as applicable, to help ensure continual program improvement.

6.5 Other Employees Who Work in The Area

- Understand the purpose of the lockout or tagout procedure.
- Stay clear of the area when required during shutdown and re-energization of equipment or machinery.
- Never remove or tamper with a lockout or tagout device and never attempt to reenergize equipment or machinery until the Authorized Employee removes the lockout or tagout device.

6.6 Project Managers

- Shall attend affected employee training on an annual basis.
- Confirm contractors have their own Control of Hazardous Energies Program.
- Coordinate Group LOTO procedures with supervisors when hiring a contractor that will be implementing a LOTO procedure.
- Notify Affected Employees of the application and removal of lockout or tagout devices and coordinate with other subcontractors as necessary.
- Provide accurate as-builts to the Dartmouth Engineering Documents Office at completion of the project.

6.7 Contractors

- Must maintain and train their employees in a compliant Control of Hazardous Energies Program.
- Conduct work on campus following the contractor's Program before beginning any service or maintenance on machinery or equipment requiring energy control.
- Before starting work, submit lockout or tagout procedures to the project manager, building manager, or other controlling entity.

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- Notify the Dartmouth College project manager, building manager, or other controlling entity (for example, shop supervisor) when equipment is being locked and tagged out to perform work and communicate any unforeseen issues to Dartmouth College staff as applicable.
- If modifications are made to equipment, update the LOTO procedures and communicate with the project manager.
- Remove affected and other employees during LOTO procedures.
- Communicate to the Project Manager any modifications made to equipment and update the LOTO procedure at completion of work.

Section 7 - Types of Hazardous Energy

Types of hazardous energy include, but are not limited to:

7.1 Chemical Energy

It is the energy released when a substance undergoes a chemical reaction. The energy is usually released as heat, but could be released in other forms, such as pressure. A common result of a hazardous chemical reaction is fire or explosion. Examples include liquids, such as gasoline, diesel, benzene, acids, and caustics; gases, such as propane, natural gas, and methane; and solids, such as fertilizer, wet and dry cell batteries, and combustible dust.

7.2 Electrical

Alternating current (AC) and direct current (DC) include equipment and conductors at household and industrial voltages, as well as photovoltaic systems, circuit breakers, transformers, capacitors, inverters, motors, and electric/hybrid vehicles.

7.3 Gravitational

Energy is related to the mass of an object and its distance from the ground when it is put in motion. The heavier the object and the further it is from the ground, the greater its gravitational energy. Example: a 10-pound load falling from a loader 20 feet above the ground has greater gravitational energy than the same load falling from 12 feet high. Elevators, hoists, objects such as hoisted vehicles, raised dumpster lids, objects supported by a crane, and elevated dump truck beds.

7.4 Hydraulic

Systems that have hydraulic energy must be bled and blocked or blocked by a substantial means to prevent sudden release and potential injury. Follow all manufacturers' recommendations for the proper means to do this work. This form of energy is stored within liquid pressurized by an outside source. When under pressure, the fluid can move heavy objects, machinery, or equipment. Examples: 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 injection molding machine

7.5 Hydronic

Hydronics is a type of heating system that uses water. The system comprises a boiler and pipes to run the hot water throughout the building. This form of radiant heating creates a more comfortable environment within the building. Water, a better conductor than air, is circulated through the building and reheated when it returns to the boiler. By using hydronics

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instead of a central air unit, there is significantly less heat loss.

7.6 Mechanical

Mechanical energy is contained in an item under tension. A coiled or compressed spring releases stored energy in the form of rapid movement when it expands. Examples include refrigeration and HVAC equipment, robotic systems, rotating wind turbines, moving paddle wheels, belts, pistons, vehicle/mobile equipment movement, compressed springs, and counterbalances; extreme sound is also a form of hazardous mechanical energy.

7.7 Pneumatic

Pneumatic energy refers to the power associated with pressurized air. The pressure can be relatively static (such as surge or pressure tanks) or in motion through tubing or hoses. Air under pressure can be used to move heavy objects and power equipment. Examples: spraying devices, air hoses, air compressors, or air cylinders.

7.8 Radiation

Examples of radiation include lasers, radio frequency, infrared, microwave, ultraviolet, and X-rays.

7.9 Stored Energy

Equipment can store energy even after the power source is isolated. Common examples of stored energy include capacitors, springs, elevated components, rotating flywheels, hydraulic lift systems, compressed air, gas, steam, and water pressure. Methods to control stored energy can be:

- 7.9.1 Release or restrain stored energy BEFORE beginning service or maintenance.
- 7.9.2 Lockout and tagout electrical & other power sources.
- 7.9.3 Depressurize the lines.
- 7.9.4 Use blocking devices.

7.10 Thermal

Thermal energy can be hot or cold. Examples include boilers, hot water, heated oil, steam, and equipment that needs time to cool, while liquefied gases, such as nitrogen, need time to warm to safe thermal levels.

Section 8 – Procedures for De-energization and Re-energization

Failing to control hazardous energy can result in serious and sometimes fatal consequences for workers operating equipment and machines, as well as those in the surrounding area.

8.1 General Steps

The steps to be followed when locking out equipment or systems are listed below. Only trained, Authorized employees are permitted to conduct LOTO activities.

Note: Verification of zero energy (which includes voltage testing and metering) is considered energized electrical work.

8.1.1 Pre-Shutdown:

8.1.1.1 Notify affected employees that equipment or systems must be shut down or taken offline for servicing/maintenance.

8.1.1.2 If the lockout or tagout affects an entire building (such as the

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shutdown of electricity or water supply), signs must be posted throughout the building to inform the employees and occupants of the shutdown at least 48 hours in advance.

8.1.2 Identification:

8.1.2.1 Identify the types of energy present, their hazards, and the methods to control the energy safely.

8.1.2.2 Identify the type(s) and location(s) of the control points (switches, valves, gates, etc.). More comprehensive procedures may need to be developed, documented, and utilized for more complex systems. Labeling these locations using approved, standardized labels for complex systems. Consult 1910.147 App A for typical minimal lockout procedures.

8.1.2.3 Identify additional personal protective equipment (PPE), equipment, or training that may be needed to perform work successfully. Review the Safety Data Sheet (SDS) information and consider waste disposal needs if applicable.

8.1.3 Shutdown Procedures

8.1.3.1 The equipment or machine must be disconnected from all energy sources using procedures developed and/or established for the equipment or machine.

8.1.3.2 Shutdown must be carried out to avoid any additional or increased hazard(s) to the employees because of the equipment stoppage.

8.1.3.3 Control circuit devices, such as push buttons, selector switches, and interlocks, may not be the sole means for shutdown.

8.1.3.4 Some examples of shutdown (or de-energizing) are the following: disconnect/shut down engines/motors, de-energize electrical circuits, block fluid (gas or liquid) in pneumatic/hydraulic systems, and block machine parts against motion.

8.1.4 Isolation

8.1.4.1 All energy-isolating devices needed to control the energy to the machine or equipment must be physically located and operated in such a manner as to isolate the machine or equipment from the energy source(s).

8.1.4.2 Alternate or emergency energy sources programmed to turn on when the main energy source is turned off must also be shut down and isolated.

8.1.4.3 Examples of energy sources include chemical, electrical, gravitational, hydraulic, hydronic, mechanical, pneumatic, radiation, stored energy, and thermal.

8.1.4.4 The isolating energy device must be capable of withstanding more than two times the anticipated loads, with at least two blocks.

8.1.5 Lock/Tag Application

8.1.5.1 Authorized employees apply locks and tags at the control

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point(s) according to established College procedures.

8.1.5.2 If more than one Authorized employee works on the same equipment or machinery, each employee must affix their own lock and the **DO NOT OPERATE** tag to the energy-isolating device. Lockout devices must be affixed to hold the energy-isolating device in a "safe" or "off" position. Tags must be affixed to indicate that the operation or movement of energy-isolating devices from the "safe" or "off" position is prohibited. Locks or tags must be attached so that they cannot be removed without the use of undue force or tools.

8.1.6 Release of Stored Energy

Following the application of lockout and/or tagout devices to energy-isolating devices, all potentially hazardous stored or residual energy must be relieved, disconnected, restrained, and otherwise rendered safe. If there is a possibility of re-accumulation of stored energy to a hazardous level, verification of isolation must be continued until the work is completed or until the possibility of such accumulation no longer exists. Some examples of releasing stored energy are the following: discharge capacitors by grounding, release or block springs that are compressed or tensed, vent pressurized vessels/tanks/accumulators until pressure is at atmospheric levels, relieve or block non-electrical energy that may reenergize electric circuit parts restrain object that may be affected by gravity (such as elevators), allow the system to come to a complete stop after shutdown and isolation before beginning work.

Verifying that the system is in a Zero Energy State.

Before starting work on machines or equipment that have been locked or tagged out, the Authorized employee must verify that isolation and de-energization have been accomplished and that the equipment/machine will not unexpectedly re-energize. The procedures are as follows:

8.1.6.1 Inform affected and other employees of verification procedures.

8.1.6.2 Attempt to start the machine by operating controls. The machine should not start.

8.1.6.3 If any part of the machine or equipment attempts to start, the lockout or tagout is ineffective. Identify and isolate the missing energy source and recheck all other energy sources.

8.1.6.4 Repeat verification procedures.

8.1.6.5 If the machine/equipment does not respond in any way to all operating controls, service/maintenance on the machine or equipment, work may be initiated.

8.1.6.6 After verification, return the machine to the off position.

Electrical Equipment

Verification of de-energization of electrical parts/circuit elements must be performed using proper testing equipment, such as voltage meters. Testing must also determine if any energized condition exists due to inadvertently induced voltage or unrelated voltage backfeed, even though specific circuit parts have been de-energized and presumed to be safe. If the circuit to be tested is over 600 volts, the test equipment must be checked for proper operation immediately after this test. Refer to Dartmouth's

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Electrical Safe Work Practices Program for additional information.

8.1.7 Perform Work on Equipment.

8.1.8 Lockout and Tagout Release and Re-Energization

To ensure safe energy restoration after work on a locked or tagged-out machine or equipment is completed; the following actions must be taken:

1. The work area must be inspected to ensure that all nonessential items (such as tools) have been removed and that the machine or equipment components are operationally intact (including guards and other safety features).
2. The work area must be checked to ensure all employees have been safely positioned or removed.
3. Remove the lockout or tagout device(s). Lockout or tagout devices must be removed by the responsible Authorized employee only.
4. Affected Employees must be notified that the machine or equipment is no longer locked or tagged out after the device(s) have been removed and before a machine or piece of equipment is restarted.
5. Inform affected and other employees that the machine is about to be re-energized.
6. Unblock any sources of stored energy; allow pneumatic or hydraulic fluid to flow; release blocks on springs; release restraints on the object affected by gravity; remove blocks on machine parts; close vents on pressurized tanks or lines, etc.
7. Reconnect the machine or equipment to the energy-isolating device.
8. Recheck the work area to ensure all employees are safely positioned.
9. Turn on the machine or equipment to resume function.

8.2 Re-Energizing Equipment

The following energy control procedures must be performed before re-energizing equipment:

1. Inspect the area to remove all tools and debris.
2. Replace machine/equipment guards.
3. Ensure all employees are clear of the work area.
4. Inform Affected Employees that the equipment will be returned to service.
5. Verify that the machine or equipment power controls are in the “off” or “neutral” position.
6. Remove the lockout or tagout device(s).
7. Re-energize equipment.

Section 9 - Group or Shift Change

When more than one person performs servicing and/or maintenance, the following procedure must be used. This procedure has been designed to provide an equivalent level of protection as that provided by individual lockout or tagout devices.

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1. One Authorized employee must be designated as responsible for a set number of employees working under the protection of a Group lockout or tagout device.
2. Each employee in the group must review the lockout or tagout procedure to be used.
3. If more than one crew, craft, etc., is involved, one Authorized employee must coordinate the lockout or tagout to ensure that all control methods are applied and that there is continuity of protection for the group.
4. Re-testing must be done to ensure the de-energized state of the equipment. Employees must discuss the status of maintenance or servicing, as well as any notifications regarding start-up or testing to be performed.
5. Each Authorized employee must affix a personal lockout or tagout device to the Group lockout device, group lockbox, or comparable device before beginning work and must remove it upon completion.
6. Personal locks and tags should be switched out at every shift change when work continues to be performed on equipment. Group locks can remain.
7. If a personal lock or tag is lost, contact Access Control in FO&M.

Section 10 - Locks and Tags

Only College-supplied locks, tags, and isolation devices may be used by Dartmouth-Authorized employees. Locks and tags have been standardized. If the equipment is capable of being locked out before the start of work, it must be locked out.

10.1 Locks

Each employee who has been trained to lockout and tagout a piece of equipment will be provided with locks. Each lock must have the employee's name, department, and phone number, or other identifying information, such as a serial number, attached to a tracking spreadsheet.

Each group of Authorized users has been supplied with color-coded locks to differentiate between them. Although this is not a fail-safe method for identifying the group that has applied a lock, it is a good starting point. **See Appendix B**, which lists Authorized user groups and the colors assigned to the group.

10.2 Tags or Tagout Device

A tag must be used when a lock controls hazardous energy. Each tag should list the date, the name of the person, and the reason for tagging out. Tags shall be formatted to meet the requirements in ANSI Z535.5.

A tag consists of a 6-inch by 3-inch laminated tag, which can be attached using a nylon cable tie, wire, string, or other equivalent fastening device. Writing on tags must be clear and ink impervious to fading, such as a ballpoint pen or "Sharpie." These tags are not to be substituted or used for any purpose other than their intended use. Each tag should have the employee's name, department, and phone number.

10.3 When a Lock Cannot be Applied

When a lock cannot be applied due to the configuration of the device being worked on, the tag or tagout device should be attached at the exact location that the lockout device

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would have been attached in these circumstances; a supervisor must ascertain that the tag will provide an equivalent level of safety that a lock would provide.

A tag used without a lock is acceptable if the Authorized user provides equivalent protection by ensuring at least one additional safety measure is in place. In other words, at least one added safety measure must be used before applying the tag. Such additional safety measures might include the following examples:

1. Closure of a second-in-line valve (double block and bleed).
2. Remove a valve handle to minimize the possibility that machines or equipment might be inadvertently energized or started.
3. Remove an additional isolating circuit element (e.g., fuse).
4. Opening an extra disconnecting device (e.g., disconnecting switch; circuit breaker).
5. Opening and then racking out a circuit breaker.
6. Grounding of an electric circuit, if the grounding practice would protect the employee if the tagged isolating device were operated.
7. A dead piece, or an out-of-service piece of equipment awaiting replacement, that is part of a system is physically located in the same area and has been removed from service, so the tag makes other employees aware.
8. If the equipment is still connected to an energy source and the energy is being controlled, a lock and tag should be used. If the equipment is not connected to an energy source (i.e., there is no hazardous energy), an "out-of-service" tag should be used.

Section 11 - Special Conditions for the Removal of Locks

Under almost all circumstances, the only person authorized to remove a personal lock is the individual who attached it. Departments may write a department-specific Standard Operating Procedure (SOP) for the removal of the lock by people other than the individual who attached it, provided that the following conditions are met within the SOP:

1. The person was notified, or attempts were made to notify them (attempts to notify them must be documented).
2. The manager/supervisor or, in the absence of the manager/supervisor, the shop lead or other individual responsible for the shop approves the special circumstances that warrant the removal.
3. After the approval in step 2, a different person who is a senior leader with knowledge of the risks involved audits the lock removal request to determine if it is necessary and if it is safe to do so.
4. The affected systems' manager/supervisor(s) are notified of the need to remove the lock and express no concerns. In cases where it may impact a building's operations, the impact is communicated to the appropriate building representative or facilities contact.
5. A traceable record of the date, time, location, and individuals authorizing the lock removal will be maintained. The supervisor of the employee whose lock was removed will maintain the documentation.

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6. When the employee returns to work, document that the employee was notified their lock was removed.

11.1 Temporary Lift

A temporary lift is when an Authorized employee needs to re-energize the system temporarily and re-tag it 'out of service'. Examples include a bump test of a motor and rotating a machine step-by-step to remove parts, among others.

Section 12 - Training

All employees (Authorized and Affected) involved in the control of hazardous energy work must be trained to ensure they possess the necessary knowledge, understanding, and skills for the safe performance of their duties. Training describes the necessary measures and precautions that must be taken when working around energized equipment. Employee training records, which include the training date, employee attendance, and the names and signatures of the instructor(s), will be maintained by EHS.

Note: No employee will be issued a lock until they have attended training.

12.1 Training Includes

The College shall provide training to ensure that employees understand the purpose and function of the energy control program and acquire the knowledge and skills required for the safe application, use, and removal of energy controls. The training shall include the following:

- Each Authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.
- Each Affected employee shall be instructed in the purpose and use of the energy control procedure.
- All other employees whose work operations are or may be in an area where energy control procedures may be utilized shall be instructed about the procedure and the prohibition relating to attempts to restart or reenergize machines or equipment locked out or tagged out.

12.2 Lockout or Tagout Device Application.

When tagout systems are used, employees shall also be trained in the following limitations of tags:

- 12.2.1 Tags are warning devices affixed to energy-isolating devices and do not provide physical restraint on devices provided by a lock.
- 12.2.2 When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.
- 12.2.3 Tags must be legible and understandable by all Authorized employees, Affected Employees, and all other employees whose work operations are or may be in the area to be effective.
- 12.2.4 Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace.

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

12.2.6 Tags must be securely attached to energy-isolating devices so they cannot be inadvertently or accidentally detached during use.

12.3 Employee Training Requirements

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

12.4 Authorized Employee Training

The lockout and tagout standard requires that, before the machine or equipment is turned off, the Authorized employee must be knowledgeable of the following:

12.4.1 Recognition of applicable hazardous energy sources.

12.4.2 Details about the type and magnitude of the hazardous energy sources present in the work area.

12.4.3 The methods and means necessary to isolate and control hazardous energy sources.

12.4.4 What is the purpose of a Yellow Mechanical Lock used at Dartmouth? **See Appendix E.**

12.5 Affected Employee Training

Affected employees and all other employees are required to recognize when energy control procedures are being used, understand the purpose of these procedures, and understand the critical importance of not attempting to start up or use equipment that is locked out or tagged out.

12.6 Training Frequency - Initial

12.6.1 Authorized employee: Initial training is required for each Authorized employee involved in lockout and tagout operations before they are issued a lock or assigned any lockout and tagout duties. Annually, after the initial training, the Authorized employee shall attend in-person LOTO training.

12.6.2 Affected Employees: annually receive lock and tag-out awareness training through online or in-person training.

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12.7 Training Frequency - Retraining

12.7.1 Retraining shall be provided for all Authorized and Affected Employees whenever there is a change in their job assignments, a change in machines, equipment, or processes that present a new hazard, or when there is a change in the energy control procedures.

12.7.2 Additional retraining shall also be conducted whenever a periodic audit or inspection identifies issues or whenever the College has reason to believe that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

12.7.3 The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

12.7.4 The College keeps a record of employee training that has been accomplished and is being kept up to date. The record shall contain the name of each employee and their corresponding training date(s).

12.7.5 Any time changes are made to this Program.

12.7.6 When Federal or State Regulations change.

12.8 Job-Specific Training

12.8.1 Conducted by the employee's supervisor and will include:

12.8.1.1 Recognition of hazardous energy sources.

12.8.1.2 Type and magnitude of the energy source.

12.8.1.3 Methods and means required for energy isolation and control.

12.8.1.4 Machine-specific instructions and procedures for the department's equipment.

Section 13 – Annual Inspections

Supervisors will conduct a hands-on lockout and tagout inspection, which will identify the machine or equipment on which the energy control procedure was being used, the date of the inspection, the employees included in the inspection, and the person performing the inspection, satisfying the requirement found in 29 CFR 1910.147 of a yearly control of hazardous energies audit. Copies will be maintained electronically within the online training management system. **See Appendix C and D.**

EHS will audit the Control of Hazardous Energies Program at least annually to ensure that employees authorized in lockout and tagout understand and adhere to the energy control procedure and that the standard's requirements are being followed. When lockout and tagout are used for energy control, the periodic inspection will include a review between the inspector and each employee of that employee's responsibilities under the energy control procedure being inspected.

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Appendix A – Definitions

Affected Employee - anyone whose job requires him/her to operate or use a machine, equipment, or system on which maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such service or maintenance is being performed.

Authorized Employee - anyone who locks out or tags out machines, equipment, or systems to perform servicing or maintenance on that machine or piece of equipment. An employee becomes an Authorized employee when that employee's duties include performing servicing or maintenance. All Authorized employees must be trained in the provisions of this Program and safe work practices before being allowed to lock out or tag out.

Contractor - a contractor, subcontractor, or service contractor who performs servicing/maintenance, alteration, repair, or construction and utilizes lockout or tagout procedures, or who may need to work near equipment that has been locked or tagged out.

Energized - machines and equipment are energized when connected to an energy source or containing residual or stored energy.

Energy Isolating Device - a mechanical device that physically prevents the transmission or release of energy.

Energy Source - any chemical, electrical, hydraulic, mechanical, pneumatic, thermal, or other energy source.

Group LOTO (two or more employees) - allows authorized individual employees to be protected from hazardous energy when they are part of a group performing servicing or maintenance. Group LOTO is a process by which each Authorized employee performing servicing and/or maintenance exercises control over the associated hazardous energy by attaching their personal lockout or tagout device to a Group LOTO mechanism. It consists of personal LOTO devices, Group LOTO devices/mechanisms, and equipment LOTO devices.

Hasp - a lockout hasp is a lockout tagout device that allows the placement of multiple lockout tagout padlocks. It consists of a slotted plate that slides over a staple and jaws that can clamp over handles and switches. Because a lockout tagout hasp can accommodate multiple locks, it can be used in group lockout tagout procedures. The hasp can be installed on a switch or used with another lock, such as a valve lock, circuit breaker lock, or other similar devices.

Hazard - The potential in an activity, condition, or situation for sequence(s) of errors, oversights, changes, and stresses to result in unwanted transfer of energy with resultant damage to persons, property, or equipment.

Hot Tap - a procedure used in repair, maintenance, and service activities that involves welding on a piece of equipment (such as pipelines, vessels, or tanks) under pressure to install connections or appurtenances. It is commonly used to replace or add sections of pipelines without interrupting service for air, gas, water, steam, and petrochemical distribution systems.

Lockout - the placement of a lockout device on an energy isolating device, following an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

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Lockout Device – a device that utilizes a positive means, such as a lock, either key or combination type, to hold an energy-isolating device in a safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

LOTO - the physical restraint of all hazardous energy sources that supply power to a piece of equipment, machinery, or system. LOTO also includes applying a warning tag to the physical restraint device.

Normal Production Operations – the utilization of a machine or equipment to perform its intended production function.

Personal Lock - a uniquely keyed lock color-coded to the shop to be used by an Authorized employee for personal protection only.

Qualified Person - an employee who has knowledge, skills, ability, and training in avoiding the hazards associated with the energy systems they work with.

Repair, Servicing, and/or Maintenance - workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning, or unjamming of machines or equipment, as well as adjusting or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment, or the release of hazardous energy.

Setting Up - any work performed to prepare a machine or equipment to perform its normal production operation.

Stored Energy - stored energy (also residual or potential energy) is energy that resides or remains in the power supply system. When stored energy is released in an uncontrolled manner, individuals may be crushed or struck by objects, moving machinery, equipment, or other items. Methods to dissipate or restrain stored energy include grounding, repositioning, bleeding, venting, blocking, etc.

Tagout - the placement of a tagout device on an energy isolating device, following 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, such as a tag and a means of attachment, which can be securely fastened to an energy-isolating device following 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.

Yellow Mechanical Lock - a keyed-like yellow padlock for locking equipment or systems. **It is not to be used for personal protection**, and it may only be used by Troubleshooters or a Department to temporarily lock out a component or system as an interim measure until the responding Shop coordinates further action.

Verification- ensures that hazardous energy sources have been thoroughly isolated from the equipment, guaranteeing its safe state before any work commences.

Zero Energy State - a system condition in which power or other forms of energy have been

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demonstrated to be safely isolated--by verification--and therefore removed from the system, rendering it safe to work on.

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Appendix B – Lock Distribution

Lock distribution for Authorized LOTO users on campus. The following colors of lock(s) used on campus are noted here. Color configurations of locks will be updated as conditions or new developments arise, and as the college expands in its future growth.

Group / Shop	Color of Locks
Access Control	Brown
Athletics	Black
Building Repair	Siver
Building Automation	Green
Electrical	Red
Equipment Maintenance	Blue
Geisel School of Medicine	TBD
Grounds	TBD
Heating Plant	Color designation depends on the energy source
Fire Systems Maintenance	Orange
Science Facilities	Purple
Skiway	TBD
Troubleshooters	*See Appendix E*
Tuck School of Business	Green

NOTE- Contractors may use similar colored locks, (RED) being the predominant color used in general industry and construction applications.

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Appendix C – Lockout/Tagout Training Worksheet

✓ Why lockout/tagout?

12.8.1.4.1 It is the best way of ensuring that there is no energy available to hurt you!

12.8.1.4.1.1 Injuries from the unexpected startup of equipment

12.8.1.4.1.2 With lockout/tagout, there is zero possibility!

12.8.1.4.2 OSHA says so.

✓ From worksheet

12.8.1.4.3 Identify hazardous energy or energies.

12.8.1.4.4 Review basic procedures for locking and tagging out equipment.

12.8.1.4.5 Review basic procedures for taking equipment off lockout/tagout.

12.8.1.4.6 Ensure the procedure for the specific equipment is followed.

12.8.1.4.6.1 All lockout locations

12.8.1.4.6.2 Stored energy identified and dissipated.

12.8.1.4.6.3 Parts blocked; linkages removed.

12.8.1.4.6.4 Verification of removal of residual energy.

12.8.1.4.7 Verification of completed lockout/tagout.

12.8.1.4.8 Notification to Affected Employees of Lockout/Tagout.

12.8.1.4.8.1 Pre- and post-lockout/tagout

12.8.1.4.9 Verification of completion of the removal of lockout/tagout

12.8.1.4.10 Procedure for the removal of another person's lock

12.8.1.4.11 Lockout/Tagout Equipment Review and Demonstration of Lockout/Tagout on Equipment.

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Appendix D – Control of Hazardous Energies Checklist

Equipment ID: (mfr., model#, 10 #): _____	
Equipment Location(s): _____	Date Performed _____
Task(s) to be performed: _____	
Name of Person performing assessment: _____	

Energy Form (Circle all that apply)

1. Chemical Energy

Explosion, pressure, extreme heat, fire, corrosive, reactive, oxidizer, toxic.

2. Electrical

Voltage at, or above 50V

3. Gravitational

The heavier the object, and the further it is from the ground, the greater its gravitational energy.

4. Hydraulic

This form of energy is stored within liquid that is pressurized by an outside source.

5. Hydronic

Hydronics are a type of heating system that uses water.

6. Mechanical

Mechanical energy is contained in an item under tension.

7. Pneumatic

Pneumatic energy pertains to the power related to pressurized air. The pressure can be relatively static (such as surge tanks or pressure tanks) or in motion through tubing or hoses.

8. Radiation

Examples of radiation include lasers, radio frequency, infrared, microwave, ultraviolet, and X-rays.

9. Stored Energy

Equipment can store energy even after the power source is isolated. Common examples of stored energy include capacitors, springs, elevated components, rotating flywheels, hydraulic lift systems, air, gas, steam, water pressure, coiled or compressed springs, etc.

10. Thermal

Thermal energy can be hot or cold.

B. LOTO Procedure Development Tool

Lockout Procedure

1. Notify all affected personnel of LOTO
2. Turn off power at disconnect points listed in C1.
2. LOTO or tag each energy control point listed in Column C1.
3. Dissipate/disconnect any stored energy (see column 2)
4. Block any mechanical parts, remove any mechanical links. Lock blocking in place (see column C3).

Note: Two physical blocks are required to break and secure any gas/liquid line.

6. Verify personnel clear of hazards.
7. Verify no hazardous energy. Use a circuit tester/meter if electricity is involved. (see column C4).
8. Attempt to restart machinery or re-energize equipment.
9. Perform required work.

C1. Specific Lockout/tagout locations

C2. Dissipate stored energy at the following point

C3. Block these parts, remove these linkages

C: Procedure to Return Tool to Operation

10. Verify hazard zone is clear of equipment, workers, tools, and test equipment. 11. Unlock and remove any blocking devices, replace linkages. 12. Reposition any safety devices. 13. Warn workers to stay clear of the area. 14. Remove all locks and tags from energy control points. 15. Verify the area is clear of personnel. 16. Restart/reenergize the equipment. 17. Notify all affected employees and other people that the lockout has been cleared.	C4. Verification (no residual energy by these methods
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Appendix E-Yellow Mechanical Lock- (*Troubleshooters*)

- Dartmouth utilizes a yellow mechanical lock (*internally called a Troubleshooters lock*), which is a temporary lock used to lockout a piece of equipment as an interim measure and to provide a means to temporarily render a device or system inoperable and locked out from hazardous energy until a responding shop can repair or replace the failed component.
- The yellow lock is not an isolation lock, it is an access control lock.
- This provides a more prescriptive safety protective measure than a DO NOT OPERATE tag.
- Dartmouth shops follow the practice that an Authorized User responding to the repair or replacement can remove the lock with a universal key and immediately place their lock back on when they assume final control.
- Workers can mutually agree on the return of mechanical locks.
- For example, during off hours, weekends, and/or holidays, when troubleshooters provide checks of systems on campus, they may find a machine component involving hazardous energy that has failed but is beyond their scope of work or skill, requiring replacement by another shop.
- The Troubleshooter would place a yellow lock and tag explaining the failure (other names: Managers Lock or Troubleshooters lock) on the failed equipment. The Troubleshooter logs the failed equipment in the Troubleshooter's report.
- The Troubleshooter's report, managed by the Customer Service Center, is distributed each morning to Dartmouth Shops, lists the failed equipment, and is flagged for the relevant Shop.
- The responding Shop would then take off the Troubleshooter's yellow mechanical lock, attach their personal Shop Lock on the failed pump, and continue with the repair under their exclusive control until placed back in service.
- When more than one trade and/or a contractor/subcontractor are working on an unexpected/uncontrolled release of hazardous energy during maintenance, service, or repair, a hasp should be employed.
- It is the college policy during the repair that the responding shop removes their lock from the hasp when their work is completed.
- Once the energy-containing device is restored to service, the last responding shop, building group, contractor, or sub-contractor will follow the restore-to-service sequence of the lockout tagout procedure, and then their lock can be removed.