Hampshire College

Lockout/Tagout and Electrical Safety Program and Procedures

January 2007

In Compliance with the
OSHA 29 CFR 1910.147 and
29 CFR 1910.331 through .335
And NFPA 70E

Environmental Health & Safety
559-6620

Hampshire College

Lockout/Tagout and Electrical Safety Program & Procedures

TABLE OF CONTENTS

Hampshire College

Lockout/Tagout and Electrical Safety Program & Procedures

29 CFR Part 1910.147 and 29 CFR 1910.331-1910 .335 and NFPA 70E

Purpose

This procedure establishes the minimum requirements for the lockout or tagout of energy isolating devices. It shall be used to ensure that equipment or machines are isolated from all potentially hazardous energy, and locked out or tagged out before employees do any servicing or maintenance activities where the unexpected energization, start-up, or release of stored energy could cause injury.

Exceptions

There are several situations in which the OSHA Lockout/Tagout Standard and the Hampshire College Lockout/Tagout Program do not apply. All employees working on a service or maintenance project must agree that an exception condition exists before deciding not to use the Lockout/Tagout procedure. The specific exceptions are:

- Service or maintenance when employees are not exposed to the unexpected release of hazardous energy.

- Normal production operations including lubrication, cleaning, unjamming, adjustments, or tool changes provided that these operations do not require the removal of a safeguard or the exposure of an employee to any hazardous energy.

- Work on plug and cord-connected electrical equipment if the plug is under the exclusive control of the employee performing the service or maintenance. Exclusive control means in the physical possession of the employee, or in arm's reach and in line of sight of the employee, or if the employee has affixed a lockout/tagout device on the plug.

Definitions

Arc-Blast -

- The explosive expansion of air and metal in the arc path. The dangers of an arc-blast include high pressures that can knock workers over, rupture eardrums and collapse lungs; exceedingly loud sounds that can be greater than 160 decibels; and molten metal/shrapnel moving at speeds that can exceed 700 miles per hour.

Arc-Flash -

- An electric current that passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors. The temperature of an arc-flash can exceed 35,000◦F and cause ignition of clothes and severe burns.

Conductive -

- Any material that is suitable for carrying an electric current

Deenergized -

- Free from any electrical connection to a source of potential difference and from electrical charge, and not having a potential different from that of the earth.

Electrical Hazard -

- A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Energized -

- Electrically connected to or having a source of voltage.

Insulated -

- Separated from other conducting surfaces by a non-conducting substance offering a high resistance to the passage of current.

Job Hazard Analysis -

- An evaluation procedure to be used when an electrical hazard exists prior to beginning work on or near live parts or energized equipment operating at 50 volts or more. Hazards associated with the job, work procedures involved, special precautions, energy source controls, and PPE requirements must all be established in the analysis. The Job Hazard Analysis must be performed and documented by a Qualified Person.

Lockout/Tagout Device -

- Locks and tags used to control exposure to electrical energy hazards. These devices will be readily identifiable and include a method of identifying the individual who installed the device.

Qualified Person -

- An individual that has the skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training of the hazards involved.

Voltage, Nominal -

- A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g. 124/240 volts, 480Y/277 volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Responsibility

It is the responsibility of all employees to observe the requirements of this procedure. The following specific designations will be used for the procedure.

Authorized Employees: Authorized employees are those employees who are responsible for servicing or maintenance of energized equipment. The following are authorized to apply locks or tags according to the following procedures.

For Electrical Systems: Physical Plant (PP) Electricians.

For Saws and Woodworking Equipment: Carpenters (PP Electricians, if needed).

For HVAC Equipment: HVAC Department electrician, mechanics, and operators (PP Electricians, if needed).

For Gas-fired Units/Heating System: HVAC personnel (PP Electricians, if needed).

For Farm Machinery and Equipment: Agricultural equipment is not covered by the standard, but for work on equipment and energy sources, Farm personnel and PP Electricians, if needed, will be responsible.

For Propane Gas Systems: Licensed gas plumbers are responsible for gas systems.

For Dining Services Equipment: Dining Services Contractor personnel (PP Electricians, if needed).

Affected Employees: Affected employees are employees whose job requires him/her to work on machines or equipment on which servicing is being done under lockout or tagout procedures or who are working in an area in which such procedures are being performed.

Other Employees: All other Hampshire College employees.

Training

At the time of adoption of this procedure, all authorized employees were given a training session and a copy of the written procedure. The session is repeated if the need is determined by the annual inspection. New or transferred employees are trained by their supervisor. Physical Plant supervisors of affected employees also attend the training session. All training records will be kept at the Environmental Health and Safety Office. Affected and other employees will be informed of the purpose and use of the Lockout/Tagout procedure by use of a workplace poster. The training session will cover the following topics:

- The OSHA Standard
- The NFPA 70E Standard
- Definitions used by these Standards
- The Hampshire College Lockout/Tagout and Electrical Safety Program
- Recognition of hazardous energy
- Type and magnitude of energy found in the workplace
- The means and methods of isolating or controlling energy
- The means of verifying effective energy control
- The limitations of tags

Personal Protective Equipment (PPE)

Protective clothing and equipment that protects workers from shock and flash hazards will be used when electrical hazards are present. PPE will comply with and be selected according to Table 130.7(C) (10) "Protective Clothing and Personal Protective Equipment (PPE) Matrix" of the NFPA 70E standard.

Note: Poly-blend clothing is not permitted to be worn for outer or inner layers. Watches, rings, and other potentially conductive jewelry and apparel, (i.e. metal buttons), must be removed.

The Electrical Foreman/Qualified Person must be able to identify potential hazards, (i.e. arc blast, arc flash, shock, etc.), and determine the proper level of PPE.

Lockout/Tagout Devices

Authorized employees will be issued a standardized lock(s) with an individual key. These locks are only used for this lockout procedure. Additional locks, again issued to a specific authorized employee, are available from the Physical Plant. Each lock must have a securely fastened tag with the employee's name and the date of application to a piece of equipment clearly written on the tag.

Standardized tags for use in tagging out equipment are available from the Physical Plant. Durable reusable plastic tags are used. The tag has the word "**Danger**" on a red field and the words "**Do Not Operate**." The tag is attached with a single use, self-locking nylon cable tie. The authorized employee's name and the date of application to a piece or equipment are written on the tag.

Locks must be used whenever possible, as tags are essentially a warning device and do not provide the physical restraint that is provided by a lock. If a tag must be used, the following conditions apply:

- A tag is to be removed only by the authorized employee responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.
- Tags must be legible and understandable by all employees in order to be effective.
- Tags and their means of attachment must be able to withstand environmental conditions.
- Tags may evoke a false sense of security and should be understood as part of an overall energy control program.
- Tags must be securely attached so they cannot be inadvertently or accidentally detached during use.

For electrical systems, use of a tag must be supplemented by "at least one additional safety measure that provides a level of safety equivalent to that obtained by the use of a lock." Examples given in the regulation are the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

Lockout/Tagout Procedure

The following is the general procedure used for all lockout/tagout applications

Prior to Applying Lock or Tag

1. Perform a Job Hazard Analysis and conduct a briefing with all involved and/or affected personnel. Make a survey to locate and identify all isolating devices to be certain which switch(es), breaker(s), valve(s), or other energy isolating devices apply to the equipment.

2. Notify all affected employees that the energized system will be shut down and, if possible, estimate for how long.

3. The authorized employee should know the type and magnitude of energy that the machine or equipment utilizes and should understand the hazards thereof and safe procedures for deenergizing the equipment.

4. Operate the switch (es), breaker(s), valve(s), or other energy isolating device(s) so that the equipment is isolated from its energy source(s).

5. Stored electrical energy, which might endanger personnel, must be released, (e.g. capacitors discharged, high capacitance elements short circuited and grounded).

6. Stored non-electrical energy such as springs, hydraulic systems, overhead doors, etc. must be restrained by methods such as repositioning or blocking. Air, steam, gas, or water pressure must be dissipated by bleeding down or other method.

Applying Lock or Tag

7. **Lockout All Energy Isolating Devices That Will Accept A Lock. Use A Tag Only If A Lock Cannot Be Used.**

   The individual that is applying the lock or tag must be wearing the same level of PPE that will be required for the person that is performing the work on the system.

   NOTE: For electrical systems the tag must be supplemented by "at least one additional safety measure that provides a level of safety equivalent to that obtained by the use of a lock." Examples given in the regulation are the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

   The authorized employee must write his/her name and the date of application to the piece of equipment on the lock or tag.

   The Authorized Employee Who Attached The Tag Is The Only Person That Can Remove That Tag, (except in the emergency procedure described below).

After Applying Lock or Tag

8. Before any work begins, the disconnected system should be tested in some way to confirm that the equipment will not operate. The test should verify that the energy-isolating device is controlling the source of hazardous energy and that other sources of hazardous energy are not present. If there is a possibility of reaccumulation of stored energy to a hazardous level, continued monitoring should be conducted.

   For electrical systems, only a qualified person, (that is a licensed electrician) can perform the test. The test must verify that the circuit elements and equipment parts are de-energized.

9. Perform equipment service and/or maintenance. When electrical hazards are present, personnel must wear the proper PPE, including safety glasses and/or face shields or hoods, FR-rated (fire rated) clothing, and V-rated (voltage rated) gloves that are rated for higher than the system being worked on. The Qualified Person must determine the need for PPE and establish the required level to be worn during the Job Hazard Analysis prior to the start of the work. Tools must be insulated and rated for the voltages on which they will be used. The Qualified Person is responsible for selecting the proper tools for the task and must inspect all tools prior to use to ensure that they are in good condition.

10. After the servicing or maintenance is complete and equipment is ready to return to normal operation, remove all tools from the machine or equipment, reinstall guards, and check to see that other employees are in the clear.

11. Inform affected employees that the lockout/tagout device is about to be removed.

Removing the Lock or Tag

12. Remove the lock or tag and operate the energy isolating device and restore the equipment to service.

Physical Plant Emergency Procedure: This procedure is to be used only in emergency situations. A lock or tag can be removed by someone other than the authorized employee **only when all of the following conditions exist:**

- The Foreman, Assistant Director of Physical Plant, or Director of Physical Plant has verified that the authorized employee that applied the device is not at the facility.

- The Foreman, Assistant Director of Physical Plant, or Director of Physical Plant has verified that no hazard will be created by operating the energy-disconnect device, that all tools have been removed from the vicinity, that all guards or safety devices are in place, and that all affected employees are informed before the disconnect device is operated.

- The Foreman, Assistant Director of Physical Plant, or Director of Physical Plant has made reasonable efforts to contact the authorized employee to inform him/her that his/her lockout or tagout device has been removed.

- The Foreman, Assistant Director of Physical Plant, or Director of Physical Plant has ensured that the authorized employee has this knowledge before resuming work.

Approval to use bolt cutters to remove a lock or a tag during an emergency must be obtained from the Director of Physical Plant or, in his/her absence, from any one of the following: Assistant Director of Physical Plant or the Foreman of the area where the locked-out/tagged-out equipment is located.

Testing Procedures and Equipment

Hampshire College has contact meters for use in testing voltage. A qualified person must test the circuit elements and electrical parts of equipment to which personnel will be exposed to verify that it is deenergized prior to starting work. The qualified person must also use the test meter on a known source, to verify that it is operating properly. PPE is required while testing the equipment.

Boundaries

Hampshire College personnel are not authorized to work on systems classified as greater than 480 volts, nominal. Working on energized systems should be a last resort. In the event that it is not feasible to work deenergized, the Limited Approach, Restricted Approach, and Prohibited Approach shock protection boundaries established by Table 130.2 (C) of the NFPA 70E standard must be strictly adhered to. Also, Flash Protection Boundaries must be calculated in compliance with Article 130.3 (A) of the NFPA 70E standard.

Outside contractors must follow their own Electrical Safety program and strictly comply with applicable OSHA and NFPA standards.

Equipment Specific Procedures

A written procedure detailing the required procedure for each piece of equipment that requires lockout or tagout is developed by the Department responsible for the equipment. This procedure will identify all energy sources, the system voltage, and required PPE and shock and flash protection boundaries, and be posted on or near the piece of equipment.

A written procedure is not needed if all of the following conditions are met:

1. The equipment has no potential for stored or residual energy after shutdown that could endanger employees.

2. The equipment has a single energy source that can be readily identified and isolated.

3. The isolation and locking out of that energy source will completely deenergize and deactivate the equipment.

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

5. A single lockout device can achieve a locked-out condition.

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

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

8. There have been no accidents involving the unexpected activation or reenergization of the equipment during servicing or maintenance.

Procedure Involving More Than One Authorized Employee

In the Lockout/Tagout Procedure, if more than one individual is required to lock out equipment, each shall place his or her own personal lockout device or tagout device on the energy-isolating device(s). When an energy-isolating device cannot accept multiple locks or tags, a hasp or lockbox may be used. Each person will remove his/her lock from the isolating device.

One authorized employee will be appointed to oversee the group lockout or tagout device. All employees participating in a group lockout/tagout procedure should be made aware of the type and magnitude of the hazardous energy.

Discipline

Failure to observe any portion of the College Lockout/Tagout Program will be viewed as a serious safety violation and may be subject to disciplinary action. Failure to make use of locks or tags, bypassing, ignoring or otherwise defeating a tag, or any other deviation from the established program will be considered a serious violation. The backside of each tag will bear the warnings "**Do Not Remove This Tag**" and "**Necessary Disciplinary Action Will Be Taken If These Orders Are Disregarded**."

New or Modified Equipment

After October 31, 1989, whenever major replacement, repair, renovation or modification of machines or equipment is performed, and whenever new machines or equipment are installed, energy-isolating devices for such machines or equipment shall be designed to accept a lockout device.

Outside Contractors

Whenever a Hampshire College employee is servicing a machine or equipment that has been isolated by an outside contractor, that college employee or his/her foreman should obtain information about the contractor's lockout/tagout procedure. Conversely, whenever a contractor is servicing machines or equipment that have been isolated by a Hampshire College employee, the college employee should provide information on the college's lockout/tagout procedure.

Periodic Inspection

This procedure will be inspected annually by the Director of Physical Plant or his/her designee. The inspection shall be designed to correct any deviations or inadequacies involved. All authorized employees will be asked to review the effectiveness of the procedure. The inspection will also ascertain the awareness of the limitations of tags as covered in the training programs.

APPENDIX A

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix

Protective Clothing and Equipment	Protective Systems for Hazard/Risk Category					
Hazard/Risk Category Number	-1 (Note 3)	0	1	2	3	4
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber						
a. T-shirt (short sleeve)	X			X	X	X
b. Shirt (long sleeve)		X				
c. Pants (long)	X	X	X (Note 4)	X (Note 6)	X	X
FR Clothing (Note 1)						
a. Long-sleeve shirt			X	X	X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X
c. Coverall			(Note 5)	(Note 7)	X (Note 9)	(Note 5)
d. Jacket, parka, or rainwear			AN	AN	AN	AN
FR Protective Equipment						
a. Flash suit jacket (multilayer)						X
b. Flash suit pants (multilayer)						X
c. Head protection						
1 Hard hat			X	X	X	X
2 FR hard hat liner					AR	AR
d. Eye protection		-	-	-	-	-
1 Safety glasses	X	X	X	AL	AL	AL
2 Safety goggles				AL	AL	AL
e. Face and head area protection		-	-	-	-	-
1 Arc-rated face shield, or flash suit hood				X (Note 8)		
2 Flash suit hood					X	X
3 Hearing protection (ear canal inserts)				X (Note 8)	X	X
f. Hand protection			-	-	-	-
Leather gloves (Note 2)			AN	X	X	X
g. Foot protection						
Leather work shoes			AN	X	X	X

AN = As needed AL = Select one in group AR = As required X = Minimum required

Notes:

1 See Table 103.(C)(11). Arc rating for a garment is expressed in cal/cm²

2 If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement.

3 Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 103.7(C)(9)(a).

4 Regular weight (minimum 12 oz/yd² fabric weight), untreated, denim cotton blue jeans are acceptable in lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.

5 Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.

6 If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants.

7 Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt.

8 A faceshield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternatively, a flash suit hood), is required.

9 Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer coverall with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR coveralls over FR shirt and FR pants over non-melting or untreated natural fiber clothing.

Reference: NFPA 70E Standard for Electrical Safety in the Workplace (2004 Edition)

APPENDIX B

Table 130.2(C) Approach Boundaries to Live Parts for Shock Protection.
(All dimensions are distance from live part to employee.)

(1)	(2)	(3)	(4)	(5)
	Limited Approach Boundary[1]			
Nominal System Voltage Range, Phase to Phase	Exposed Movable Conductor	Exposed Fixed Circuit Part	Restricted Approach Boundary[1]; Includes Inadvertent Movement Adder	Prohibited Approach Boundary[1]
Less than 50	Not specified	Not specified	Not specified	Not specified
50 to 300	3.05 m (10 ft 0 in.)	1.07 m (3 ft 6 in.)	Avoid contact	Avoid contact
301 to 750	3.05 m (10 ft 0 in.)	1.07 m (3 ft 6 in.)	304.8 mm (1 ft 0 in.)	25.4 mm (0 ft 1 in.)
751 to 15 kV	3.05 m (10 ft 0 in.)	1.53 m (5 ft 0 in.)	660.4 mm (2 ft 2 in.)	177.8 mm (0 ft 7 in.)
15.1 kV to 36 kV	3.05 m (10 ft 0 in.)	1.83 m (6 ft 0 in.)	787.4 mm (2 ft 7 in.)	254 mm (0 ft 10 in.)
36.1 kV to 46 kV	3.05 m (10 ft 0 in.)	2.44 m (8 ft 0 in.)	838.2 mm (2 ft 9 in.)	431.8 mm (1 ft 5 in.)
46.1 kV to 72.5 kV	3.05 m (10 ft 0 in.)	2.44 m (8 ft 0 in.)	965.2 mm (3 ft 2 in.)	635 mm (2 ft 1 in.)
72.6 kV to 121 kV	3.25 m (10 ft 8 in.)	2.44 m (8 ft 0 in.)	991 mm (3 ft 3 in.)	812.8 mm (2 ft 8 in.)
138 kV to 145 kV	3.36 m (11 ft 0 in.)	3.05 m (10 ft 0 in.)	1.093 m (3 ft 7 in.)	939.8 mm (3 ft 1 in.)
161 kV to 169 kV	3.56 m (11 ft 8 in.)	3.56 m (11 ft 8 in.)	1.22 m (4 ft 0 in.)	1.07 m (3 ft 6 in.)
230 kV to 242 kV	3.97 m (13 ft 0 in.)	3.97 m (13 ft 0 in.)	1.6 m (5 ft 3 in.)	1.45 m (4 ft 9 in.)
345 kV to 362 kV	2.68 m (15 ft 4 in.)	4.68 m (15 ft 4 in.)	2.59 m (8 ft 6 in.)	2.44 m (8 ft 0 in.)
500 kV to 550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	3.43 m (11 ft 3 in.)	3.28 m (10 ft 9 in.)
765 kV to 800 kV	7.24 m (23 ft 9 in.)	7.24 m (23 ft 9 in.)	4.55 m (14 ft 11 in.)	4.4 m (14 ft 5 in.)

Note: For Flash Protection Boundary, see 130.3(A) Appendix C.

[1] See definition in Article 100 and text in 130.2(D)(2) and Annex C in NFPA 70E.

Reference: NFPA 70E Standard for Electrical Safety in the Workplace (2004 Edition)

APPENDIX C

Table 130.3(A) Flash Protection Boundary.

For systems that are 600 volts or less, the Flash Protection Boundary shall be 4.0 ft, based on the product of clearing times of 6 cycles (0.1 second) and the available bolted fault current of 50 kA or any combination not exceeding 300 kA cycles (5000 ampere seconds). For clearing times and bolted fault currents other than 300 kA cycles, or under engineering supervision, the Flash Protection Boundary shall alternatively be permitted to be calculated in accordance with the following general formula:

$$D_c = [\, 2.65 \times MVA_{bf} \times t \,]^{½}$$

or

$$D_c = [\, 53 \times MVA \times t \,]^{½}$$

where:

D_c	=	distance in feet from an arc source for a second-degree burn
MVA_{bf}	=	bolted fault capacity available at point involved (in mega volt-amps)
MVA	=	capacity rating of transformer (mega volt-amps). For transformers with *MVA* ratings below 0.75 MVA, multiply the transformer *MVA* rating by 1.25
t	=	time of arc exposure (in seconds)

At voltage levels above 600 volts, the Flash Protection Boundary is the distance at which the incident energy equals 5 J/cm^2(1.2 cal/cm^2). For situations where fault-clearing time is 0.1 second (or faster), the Flash Protection Boundary is the distance at which the incident energy level equals 6.24 J/cm^2(1.5 cal/cm^2).

Reference: NFPA 70E Standard for Electrical Safety in the Workplace (2004 Edition)