

LLE INSTRUCTION 6300**SUBJECT: LLE Lockout/Tagout Program****REFERENCES:**

- a) **LLEINST 3000** – Laser Facility Organization and Regulation Manual
- b) **OSHA 1910.147** – The control of hazardous energy (lockout/tagout)
- c) **LLEINST 7700** – Laser Facility Project Management Process Manual
- d) **LLE Lockout/Tagout Form** – M-TM-M-045 (use most recent version in Team Center)

1 Purpose

- 1.1 The purpose of this instruction is to ensure the safety of personnel who could be injured by the unexpected operation of equipment or release of energy while servicing or maintaining equipment.

2 Definitions

- 2.1 **Affected worker** – A worker whose job requires him/her to operate equipment on which maintenance may be performed under lockout or tagout, or whose job requires him/her to work in an area in which such maintenance is being performed.
- 2.2 **Authorized worker** – A person who locks out or tags out equipment in order to perform maintenance. An affected worker becomes an authorized worker when that worker's duties include performing maintenance. An authorized worker must be trained in the hazards of the equipment being maintained, capable of identifying all connected energy sources, and qualified to isolate them from the equipment.
- 2.3 **Energy-isolating device** – A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.
- 2.4 **Group lockbox** – A box that contains the keys for all LOTO devices used on a job having multiple lockout locations. Each Authorized Worker on the job affixes his/her personal lock to the lockbox after LOTO is complete, before starting work.
- 2.5 **Group Lockout Device** – A device, such as a gang lock, installed on an individual lockout device that permits multiple authorized workers to affix their personal lock to before starting work.

- 2.6 **Hazardous energy** – Energy sources (such as chemical, electrical, laser, potential, kinetic, and thermal) that are capable of causing injury or equipment damage.
- 2.7 **ID tag** – A label that accompanies every lock that contains, at a minimum, the installer’s name and date of install
- 2.8 **Lead Worker** – An authorized worker who is initiating maintenance or repair of equipment where multiple authorized workers will be participating. This may include overseeing the implementation of a group lockout, a multipoint lockout, or both.
- 2.9 **LFORM, LLE Instruction 3000, LLEINST 3000** – Laser Facility Organization and Regulation Manual
- 2.10 **Lockout** – The placement of a lockout device on an 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. Energy-isolating devices must be locked unless it is not feasible to do so. In this event, a tagout will be employed.
- 2.11 **Lockout Device** – A device that uses positive means, such as a lock or blank flange, to hold an energy-isolating device in a safe position, thereby preventing the energizing of equipment.
- 2.12 **LOTO** – Lockout/tagout
- 2.13 **O & M Worker** – A trade-worker (e.g., electrician, plumber, mechanic) in the LLE Building Operation and Management (O & M) group
- 2.14 **Omega Facility** – Refers to work areas covered by Reference (a) including OMEGA, OMEGA EP, and the Cryo & Tritium Facility.
- 2.15 **Maintenance** – Refers to both servicing and/or maintenance 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 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.
- 2.16 **Tagout** – The placement of a tag on an energy-isolating device, indicating that it shall not be operated. Tagout is required in addition to lockout within Omega Facility areas. Tagout may be used as the sole means for securing an energy-isolating device only if it is infeasible to install a lock.
- 2.17 **Tagout device** – A prominent warning device, such as a tag and a means of attachment, that can be securely fastened to an 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.

2.18 **Work Area LOTO Supervisor** (a.k.a. LOTO Supervisor) – A designated individual responsible for specific work area(s) who is aware of hazard control measures and is responsible for managing tasks that require installation and removal of Lockout/Tagout devices. Authorized workers must coordinate all maintenance activities with the appropriate LOTO Supervisor listed in Table 1. The LOTO Supervisor listed below may delegate responsibility to a qualified individual when necessary.

Functional area	LOTO Supervisor	Alternate LOTO Supervisor
OMEGA Facility	Shot Director	OMEGA Laser Facility Manager/Associate Laser Facility Manager
OMEGA EP Facility	Shot Director	OMEGA EP Laser Facility Manager/ Associate Laser Facility Manager
Cryo & Tritium Facility (C&TF)	C&TF Manager	Associate C&TF Manager
Optical Manufacturing (OMAN)	OMAN Group Leader	
Laser Development Laboratory and MTW OPAL	MTW Shot Director	Laser Technology Development Group Leader
Mechanical Rooms, including all building services (power, lighting, plumbing, N2, LN2, HVAC, etc.)	Building Operations and Management Facility Manager	Administrative Division Director
All areas not listed above	Chief Safety Officer	Electrical Safety Officer, Mechanical Safety Officer

Table 1 - LOTO Supervisors for LLE Functional Areas

3 Lockout/Tagout Design Considerations

3.1 Energy-isolating devices are the primary means for protecting individuals who maintain equipment. All new fabricated or purchased equipment shall accept a lockout device on energy-isolating devices if hazardous energy is accessible within the equipment. Appropriate energy-isolating devices and LOTO hardware will be standardized and approved by the appropriate Safety Officer(s).

- 3.2 The following means may not be used for energy isolation, unless specifically designed for that purpose:
 - 3.2.1 Engineering safety features, such as cabinet interlocks
 - 3.2.2 Control system elements such as a PLC (programmable logic controller) or software GUI (graphical user interface).
 - 3.2.3 The LLE Building Management Software (BMS) used by O&M staff may not be used for energy isolation, as it can not be locked in a safe state.
- 3.3 Risk Assessment: As required by Reference (c), Safety Officers, in conjunction with the project and group leaders, will conduct a hazardous-energy risk assessment to determine affected equipment, types and magnitude of energy, and necessary maintenance tasks to be performed. Each maintenance task will be evaluated to determine if a lockout is required for its performance. If a lockout is required, the equipment shall be designed to accommodate a lockout device.

4 Lockout and Tagout Devices

- 4.1 LOTO devices must meet the following OSHA criteria to ensure that they are effective and not removed inadvertently:
 - 4.1.1 LOTO devices must be designated by color, shape, or size.
 - 4.1.2 Each LOTO device must indicate who attached it and its purpose.
 - 4.1.3 LLE will use ABUS brand keyed padlocks (e.g., model T65AL) for lockout where practical (available from Grainger Inc., part 5UKK9, Red, Unique Keyed Lock; shank length variations are allowed).
 - 4.1.3.1 Each lock must have a unique key or combination.
 - 4.1.4 Tagout devices must have a standardized print and warning format (Figure 1).



Figure 1 - LLE approved Tagout device

- 4.1.5 Tagout devices must be attached with a single-use, self-locking material that is non-reusable, attachable by hand, self-locking, with a minimum unlocking strength of no less than 50 pounds (e.g., nylon cable tie).

5 Lockout Devices

- 5.1 LLE will provide standardized key locks and lockout devices.
- 5.2 Only LLE-provided locks/devices may be used for LOTO (see Sec. 4.1.1)
- 5.3 Approved ID tags will accompany each lock with, at a minimum, the installers name and installation date clearly printed.
- 5.4 When locks are installed within the Omega Facility, tagout is also required (see Sec. 6.3).

6 Tagout Devices

- 6.1 Only the approved red Danger Tags may be used for Tagout at LLE (Figure 1).
- 6.2 Every tag must be filled out completely.
- 6.3 Within the Omega Facility, the Tag number will correspond to the appropriate Out-of-Commission (OOC) Log number entry; all other areas may mark the Tag No. "n/a".

7 Procedures

- 7.1 Written procedures shall be developed and utilized for the control of hazardous energy when workers are engaged in maintenance activities. Procedures must be reviewed and approved by competent person(s) who understand the:
 - 7.1.1 specific equipment being maintained,
 - 7.1.2 hazardous energy sources,
 - 7.1.3 method(s) for isolating, de-energizing, and verifying hazardous energy isolation.

For any foreseeable and likely LOTO, a dedicated procedure shall be published that has all the elements and signatures of Reference (d). In all other instances Reference (d) will be used to detail and approve the specific procedures. Copies of Reference (d) will be maintained in the individual work area in active and inactive sections. Inactive copies will be filed in the Safety Office after an audit is completed. Within the Omega Facility the procedures of Reference (a) section 4005 will be used. Authorized workers who lockout or tagout equipment or perform maintenance must follow appropriate dedicated LOTO procedure or the specific procedures of Reference (d) as applicable.

- 7.2 **OSHA Exception:** Written procedures are NOT required where all of the following elements exist and the Chief Safety Officer has approved:
 - 7.2.1 The equipment has no potential for stored or residual energy or re-accumulation of stored energy after shutdown that could endanger workers;

- 7.2.2 The equipment has a single energy source that can be readily identified and isolated;
 - 7.2.3 The isolation and locking out of that energy source will completely de-energize and deactivate the equipment;
 - 7.2.4 The equipment is isolated from that energy source and locked out during servicing or maintenance;
 - 7.2.5 A single LOTO device will achieve a locked-out condition;
 - 7.2.6 The LOTO device is under the exclusive control of the authorized worker performing the maintenance;
 - 7.2.7 The maintenance does not create hazards for other workers;
 - 7.2.8 No unexpected activation or re-energizing of the equipment has ever occurred during maintenance.
- 7.3 Lockout/Tagout Installation – An Authorized Worker must do the following before maintenance begins:
- 7.3.1 Review the maintenance procedure and obtain permission to proceed from the LOTO Supervisor (Table 1).
 - 7.3.2 Follow documented LOTO procedures.
 - 7.3.3 Inform all affected workers of equipment shutdown.
 - 7.3.4 Shut down equipment.
 - 7.3.5 Isolate or block hazardous energy.
 - 7.3.6 Lockout and/or tagout all required energy-isolating devices.
 - 7.3.6.1 If multiple workers are involved, the Lead worker shall employ either a group lockout device (Figure 2) or group lockbox (Figure 3) during LOTO (see Sec. 7.7 and 7.8).
 - 7.3.6.2 If multi-point LOTO is required, the Lead worker shall employ a group lockbox (Figure 3) during LOTO (see Sec. 7.8).



Figure 2 - A group lockout device (a.k.a., gang lock) is used when multiple workers need to LOTO one device.



Figure 3 - A group lockbox is used for multi-point lockout, or when a lockout device is not capable of supporting multiple locks.

- 7.3.7 Remove any potential (stored) energy, e.g., discharge capacitors, vent pressurized tanks, drain hazardous liquids, etc.
- 7.3.8 Verify the equipment is isolated from hazardous energy and de-energized.
- 7.4 Lockout/Tagout Removal – An Authorized Worker must do the following before removing LOTO devices:
 - Note:** A LOTO device shall only be removed by the Authorized Worker who installed it.
 - 7.4.1 If maintenance is complete and equipment is in a safe condition to be powered:
 - 7.4.1.1 Re-assemble equipment and remove all tools.
 - 7.4.1.2 Inform the LOTO Supervisor and affected workers of the intent to remove LOTO devices
 - 7.4.1.3 Ensure all workers are clear of the work area.
 - 7.4.1.4 Verify equipment power controls are off or in a neutral position.
 - 7.4.1.5 Remove the LOTO device(s)
 - 7.4.2 If maintenance is incomplete, and responsibility is being transferred to another authorized worker:
 - 7.4.2.1 Obtain authorization from the LOTO Supervisor to transfer responsibility
 - 7.4.2.2 Remove all unnecessary materials and tools
 - 7.4.2.3 The new authorized worker shall install his/her LOTO device and ID tag having owner's name and transfer date/time
 - 7.4.2.4 The current authorized worker shall remove his/her LOTO device
- 7.5 Re-Energizing – Workers must do the following before re-energizing equipment:
 - 7.5.1 Inform the LOTO Supervisor and affected workers of the intent to re-energize equipment
 - 7.5.2 Verify equipment power controls are off or in a neutral position
 - 7.5.3 Remove all unnecessary materials and tools
 - 7.5.4 Ensure all workers are clear of the work area
 - 7.5.5 Remove the LOTO per Sec. 7.4.1
 - 7.5.6 Equipment may be re-energized
- 7.6 Testing of Equipment During LOTO process
 - 7.6.1 A trained operator shall supervise and/or conduct equipment testing. When power is needed to test the equipment, temporary removal of LOTO devices is allowed, as follows:
 - 7.6.2 Remove the LOTO per Sec. 7.4.1

- 7.6.3 Re-Energize the equipment as per Sec. 7.5
- 7.6.4 Proceed with testing. If further repairs are required, reinstall LOTO per Sec. 7.3.
- 7.7 Multiple workers – Group lockout
 - 7.7.1 When multiple authorized workers are involved with a task that requires control of hazardous energy, one worker shall be designated Lead Worker, with overall responsibility for implementing energy control procedures. The Lead Worker shall execute the steps in Sec. 7.3 as needed. If a multipoint LOTO is also required, the Lead Worker will oversee the execution of Sec. 7.8
 - 7.7.2 Each additional authorized worker shall add his/her LOTO device and ID tag to the group lockout device or group lockbox before starting work.
 - 7.7.3 Each authorized worker shall remove his/her LOTO device either when his/her work is completed (Sec. 7.4.1), or when responsibility is transferred to another authorized worker (Sec. 7.4.2). The Lead Worker shall not remove his LOTO device until maintenance is complete and all authorized workers have removed their LOTO devices. The Lead Worker shall then perform steps 7.4.1 and 7.5, and testing as required per Sec. 7.6.
- 7.8 Multipoint lockout
 - 7.8.1 When multipoint lockout is required for multiple hazardous energy sources or multiple LOTO locations, a Lead Worker will be designated. The Lead Worker will ensure the completion of the LOTO procedure for each hazard, per Sec. 7.3, by properly qualified workers.
 - 7.8.2 The Lead Worker will ensure that following tasks are executed:
 - 7.8.2.1 Each energy-isolating device listed in the procedure has been placed in the required position
 - 7.8.2.2 LOTO devices with ID tags have been installed on each energy-isolating device
 - 7.8.2.3 Sign off each point on the procedure after locks are placed
 - 7.8.2.4 Place the key for each lock in the group lockbox
 - 7.8.3 When all procedural steps are completed, the Lead Worker will affix a master lock and ID tag to the group lockbox. This master lock must stay in place for the duration of all work, and is the last lock to be removed from the lockbox.
 - 7.8.4 Each additional authorized worker shall add his/her lock and tag to the group lockbox before starting work. These workers will treat the lockbox as the single energy-isolating device and remove or transfer their locks as described in Sec. 7.4.

7.8.5 When work is completed and all other locks removed, the Lead Worker will remove the master lock from the lockbox and then ensure that steps 7.4.1 and 7.5 are performed for each of the energy-isolating devices. Testing may proceed per Sec. 7.6. If further repairs are required, reinstall all LOTO devices per Sec. 7.3.

7.9 Shift changes and long-term shutdowns

7.9.1 Employers must ensure the continuity of worker protection by providing for the orderly transfer of lockout device protection between outgoing and incoming workers. The incoming worker will install his/her LOTO device and then the outgoing worker will remove his/her LOTO device; keys shall not be transferred between workers.

7.9.2 For long-term shutdowns, permanent disabling of hazardous energy sources should be done where possible, e.g., disconnect electrical supplies/connectors, use shorting bars on capacitors, remove isolation valves or pipe sections to prevent any energy source reaching the system, etc.

7.9.3 If a LOTO device must be removed by someone other than the installing worker:

7.9.3.1 Due diligence must be exercised in attempting to communicate with the installer to understand the state of the equipment and status of the work

7.9.3.2 The Chief Safety Officer or the appropriate LOTO Supervisor in Table 1 must approve removal of a lock by someone other than the installers.

7.9.3.3 In the case of lock removal by someone other than the installing worker, the LLE Chief Safety Officer must be informed and will investigate to understand how procedures failed.

8 Training

8.1 Workers who may be exposed to hazardous energy shall be trained to ensure that they understand LLE's energy-control and LOTO policy and acquire the skills to apply, use, and remove LOTO controls. The training includes the requirements of References (a), (b), and (c), specifically:

8.1.1 The purpose and use of LOTO procedures contained in this instruction.

8.1.2 Ability to recognize hazardous energy sources, the type and magnitude of energy in the workplace, the methods and means necessary for isolating and controlling energy, and the means to verify that the energy is controlled or de-energized to the greatest extent possible.

8.1.3 The prohibition against operating equipment that is locked or tagged out.

8.2 Workers shall complete annual refresher training to ensure their understanding of current policies.

- 8.3 Workers shall be retrained whenever job assignments change, energy-control procedures change, equipment or work processes present new hazards, or when LOTO procedures are violated.
- 8.4 Training records shall be maintained for each authorized worker including the worker's name and the training date.

9 Audit of Written Procedures that Require LOTO

- 9.1 An audit of all in-progress and completed LOTO procedures, Reference (d), will be performed at least annually to ensure that workers understand and use them effectively. This audit will be performed by the Laser Facility Manager for the Omega Facility per Reference (a) and by the respective Safety Officer for all other areas of LLE. After completion of the audit, all completed Reference (d) documents will be filed in the Safety Office.
- 9.2 Documentation of the audit will include the following:
 - 9.2.1 Identification of any deficiencies noted and in-progress equipment LOTO's audited.
 - 9.2.2 Record of corrective action for noted deficiencies.
 - 9.2.3 The date of the audit.
 - 9.2.4 The workers included in the audit.
 - 9.2.5 The Safety Officer or Laser Facility Manager performing the audit.
- 9.3 Each supervisor and maintenance technician will evaluate each maintenance action with respect to safety and the need to utilize these LOTO procedures.
- 9.4 The auditor must understand the procedure and must be someone other than those following the procedure at the time of the audit. Each procedure's accuracy, completeness, and effectiveness must be verified.
- 9.5 If the auditor finds that workers are not following a procedure or that the procedure is not complete and comprehensive, the deficiencies must be corrected and workers retrained.

10 Responsibilities

- 10.1 LLE Supervisors must enforce the use of lockout and tagout (LOTO) procedures when maintenance may expose workers to hazardous energy.
- 10.2 Authorized workers must follow the LOTO procedures described in this policy.
- 10.3 Affected workers must be trained and understand the purpose of LOTO procedures. Importantly, affected workers must not attempt to operate equipment that is locked or tagged out.

- 10.4 Contractors working at LLE must understand and comply with the LLE's LOTO procedures
- 10.5 Appropriate Safety Officer(s) and system expert(s) shall review all procedures requiring hazardous energy control
- 10.6 LLE Safety Officers
 - 10.6.1 Administer equipment and lockout/tagout (LOTO) procedures for non-OMEGA Laboratories
 - 10.6.2 Ensure that annual audits of these procedures are performed
 - 10.6.3 Provide LOTO training to Group Leaders, Supervisors, and Maintenance personnel
- 10.7 Group Leaders/Work Area LOTO Supervisors
 - 10.7.1 Ensure that equipment LOTO procedures are followed
 - 10.7.2 Ensure that personnel are trained and that training is up to date
 - 10.7.3 Authorize individual LOTO in his/her area of responsibility
- 10.8 Supervisors and Maintenance Personnel
 - 10.8.1 Initiate equipment LOTO in accordance with this instruction
 - 10.8.2 Ensure the provisions of this instruction are followed by subordinates
- 10.9 Omega Facility personnel
 - 10.9.1 Perform LOTO in accordance with this instruction and Reference (a)