

Guidance on Laser Safety Requirements for Control Measures, Training and Laser Safety Programs

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Acronyms

AEL	accessible emission limit
ANSI	American National Standards Institute
DOE	United States Department of Energy
EFCOG	(DOE) Energy Facility COntrollers Group
LCA	laser controlled area
LSTG	(DOE EFCOG) Laser Safety Task Group
LSO	laser safety officer
MPE	maximum permissible exposure
NHZ	nominal hazard zone
OJT	on-the-job training
PPE	personal protective equipment
SIS	safety interlock system
SOP	standard operating procedure

Definitions

Administrative control. Control measure that administratively mitigates the potential hazards associated with laser use. For example, training, safety approvals, LSO designation, signs, labels and SOPs.

Administrative Supervisor. Person a laser worker reports to and who is responsible for determining the worker's training requirements.

Alignment Eyewear. Protective eyewear for visible wavelengths with a reduced optical density (OD) from full protection.

Alignment Training. A hands-on laser beam alignment course and/or alignment training specific to the lasers used

Alternate controls. Control measures that take the place of explicitly specified control(s) in this document.

Barrier. A device used to block or attenuate laser radiation.

Baseline Eye Exam. This exam is performed by occupational health persons who are designated by the Occupational Medical Director. It includes: visual acuity, Amsler grid, and ocular history. Other optional tests may include color vision and retinal imaging.

Beam conduit. Used to transport a laser beam between two locations.

Class 1 Condition. Accessible laser radiation levels during operation are at or below applicable MPE levels.

Class 1 enclosure. An enclosure that surrounds a laser or laser system and prevents access to laser radiation levels above the MPE

Controls hierarchy. Engineering controls are first line of defense, followed by administrative controls, and then the last line of defense is PPE.

Cover Interlocks for Class 1 Enclosures and Protective Housings. When the cover of a Class 1 enclosure or a protective housing is removed, this interlock disables any additional accessible Class 3B or Class 4 laser hazard(s) to below the MPE.

Defeatable interlock. A mechanism that allows for the bypassing of the interlock feature when a cover/panel is removed for special operations (e.g., laser alignment or maintenance).

Deputy LSO. Has the same authority as the LSO for operation and approval of assigned lasers and laser facilities.

Emergency Stop (OFF) Device. When activated, this ensures any laser radiation within the LCA is below the Class 3R accessible emission limit (AEL).

Enclosure. surrounds and prevents access to laser radiation inside it. (e.g., protective housings, Class 1 enclosures, beam conduits and fiber transport)

Engineering control. Control measure designed or incorporated into the laser or laser system (for example, interlocks, shutters, enclosure, key controls).

Equivalent Protection. Provides the same level of risk mitigation to prevent injury.

Exclusion LCA. An LCA with engineered controls to ensure no persons are inside the LCA with Class 3B or Class 4 laser beams enabled.

Failsafe or redundant interlock. Interlock that does not permit an unsafe condition if there is a single component failure.

Fiber Transport Cable. An optical cable used to transport a laser beam between two locations.

Full Protection Eyewear. Protective eyewear that attenuates the laser beam to a safe level below the MPE.

Hands-on Training. Practical training where personnel learn and demonstrate how to operate equipment and use it for the intended application. The equipment may be similar, but not identical, to equipment in the work environment. This training takes place in the LCA or in a simulated work environment.

Laser controlled area (LCA). An area within which potentially hazardous beam exposure from a Class 3B or Class 4 laser is possible. Access and/or occupancy of the area are controlled. This area may be defined by walls, barriers, or other means.

Laser facility (laser lab). A work area where a Class 3B or Class 4 laser may operate. It may have one or more LCAs, but may also have no associated LCA if it is engineered and approved for fully enclosed Class 1 operation.

Laser Safety Officer (LSO). One who has authority and responsibility to monitor and enforce the control of laser hazards and effect the knowledgeable evaluation and control of laser hazards. For the purpose of this document, the LSO is the site-wide LSO with responsibility for the laser safety program at the site.

Laser Source Beam Stop/Attenuator. Prevents access to the source's laser radiation in excess of applicable MPE.

Laser Supervisor. One who is assigned authority and responsibility to supervise Class 3B and Class 4 laser operation and associated use of them by laser workers.

Laser Worker. Individuals who are trained and authorized to work with, or have the potential for exposure to greater than Class 3R laser radiation.

LCA Warning Device. Electronic illuminated indicator that displays when laser radiation above Class 3R AEL may be present within the LCA.

Maintenance operation. Performance of those adjustments or procedures (specified in the user information provided by the manufacturer, and considered preventative, to maintain optimal performance of the laser system), which are to be carried out by the user to ensure the intended performance of the product. Interlocked covers for protective housings and Class 1 enclosures may be removed for maintenance tasks.

Master key. A device (typically a mechanical key) that when removed prevents associated laser(s) from emitting laser radiation above the MPE.

Maximum permissible exposure (MPE). The level of laser radiation to which an unprotected person may be exposed without adverse biological changes in the eye or skin.

Nominal Hazard Zone (NHZ). The space within which the level of the direct, reflected, or scattered radiation may exceed the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE.

Non-beam Hazards. All hazards arising from the presence of a laser system, excluding direct human exposure to direct or scattered laser radiation.

Non-defeatable Interlock. Contains no means to bypass the interlock feature and is always active.

(Normal) Operation. The performance of the laser or laser system over the full range of its intended functions. Removable covers for protective housings and Class 1 enclosures are in place.

Informational Note: alignment tasks can be performed during (normal) operation.

Occupational Medical Director. For the purpose of this document the Occupational Medical Director is the individual with responsibility for the occupational medical program at the site.

On-the-Job Training (OJT). OJT takes place in a specific LCA where instructions on laser operation and laser safety are given. Instruction may also include, as needed, laser alignment and experimental procedures.

Personal Protective Equipment (PPE). Personal safety protective devices used to mitigate hazards associated with laser use (e.g., laser eye protection, protective clothing, and gloves).

Protective Housing. An enclosure that surrounds the laser or laser system and prevents access to laser radiation levels above the MPE. A protective housing does not include the aperture for the output beam.

Removable Cover. A cover for a laser's protective housing or Class 1 enclosure that may be removed to perform tasks with the laser's hazards enabled.

Remote interlock connector. Part of a laser source that interfaces with an LCA's safety interlock system (SIS). When the connector contacts are open or faulted, the laser source is disabled from emitting laser radiation above the MPE.

Safety shutter. A remotely controlled beam block that can be inserted to function as a machine guard (or sometimes as an energy isolating device in a LOTO procedure). It is often used to disable a laser hazard as part of an interlocked access control. It is also sometimes used in an LCA as part of a Class 1 enclosure if it is closed and disabled.

Safety Interlock System (SIS). A combination of devices and logic systems that are used at LCAs for access control, warning systems, permissives and/or control for safety shutters and laser power supplies.

Service. The performance of procedures, typically defined as repair, to bring the laser or laser system or laser product back to full and normal operational status. Service does not include operation or maintenance as defined in this section. Non-interlocked covers for protective housings, Class 1 enclosures and Beam Conduits may be removed for service tasks.

Shall. Mandatory

Should. Advisory (Recommended)

Skin Exam. This includes: observation of dermatological abnormalities, history of skin problems, current complaints of skin problems, and use of potentially photosensitizing drugs.

Skin PPE. Skin protection that reduces skin exposure to levels below the MPE.

Standard Operating Procedure (SOP). Formal written description of the safety and administrative procedures to be followed in performing a specific task.

Unattended Laser Operation. Operation of a Class 3B or Class 4 laser when no laser workers with authorization for that laser are present at the laser location or its associated laser controlled area.

Unsupervised Laser Operation. Operation of a Class 3B or Class 4 laser without authorization from an assigned laser supervisor.

Walk-in Protective Housing. See Exclusion LCA.

1. Introduction

1.1. Purpose

This document:

- provides guidance for laser safety policy requirements
- provides guidance on how to incorporate ANSI Z136.1-2014 requirements into laser safety programs. The *Control Measures*' requirements contained within are written so that they can easily be used in DOE site laser safety manuals
- assists harmonization of best laser safety practices
- should not be viewed as an attempt to set policy as this is left up to each of the individual contractor operated Laboratories and their DOE oversight

The motivation for this document results in part from three factors concerning the Z136 laser safety standards:

1. a lack of specificity for some requirements
2. a lack of clarity for some requirements
3. changes in requirements between the 2000, 2007, and 2014 revisions of Z136.1
4. differences in requirements between Z136.1 [3] and some of the application-specific Z136 safety standards such as Z136.8 [4] and Z136.9 [5]

This document does NOT address all of the laser safety policy requirements needed for a DOE site's laser safety program. Rather, it addresses those which have been reviewed by the LSTG to date [1, 2]. It will be updated as additional requirement topics are addressed.

1.2. Applicability

The guidance provided in this document applies to all Class 3B and Class 4 laser operations at DOE sites and to all workers who design, build or test Safety Interlock Systems for these operations.

Requirements recommended in this report are at least as stringent as in ANSI Z136.1-2014. Z136.1-2014 has many requirements that are “*should*” for Class 3B and “*shall*” for Class 4. This report generally makes the requirements “*shall*” for both Class 3B and Class 4. Alternate controls can be used though, if approved by the LSO, in certain applications such as <20 mW continuous wave (cw) visible lasers or configurations with very simple beam delivery and stable configuration. Alternate controls may include one or more of the following: no unattended operation, simple beam paths and perimeter barriers, and no out-of-plane beams.

This report generally assumes a DOE Facility with a laser program as follows:

1. more than one Class 3B or Class 4 LCA
2. LCAs often have more than one Class 3B or Class 4 laser
3. a typical laser lab, for which this report is based, is shown below in Figure 1 and Figure 2. It has:
 - a. a contained indoor LCA (enclosed within a room)
 - b. a single entrance
 - c. a SIS with an access control panel at the entrance
 - d. all lasers located within the LCA

1.3. Policies and Standards

This document meets the requirements of the following:

- *American National Standard for Safe Use of Lasers, Z136.1-2014*

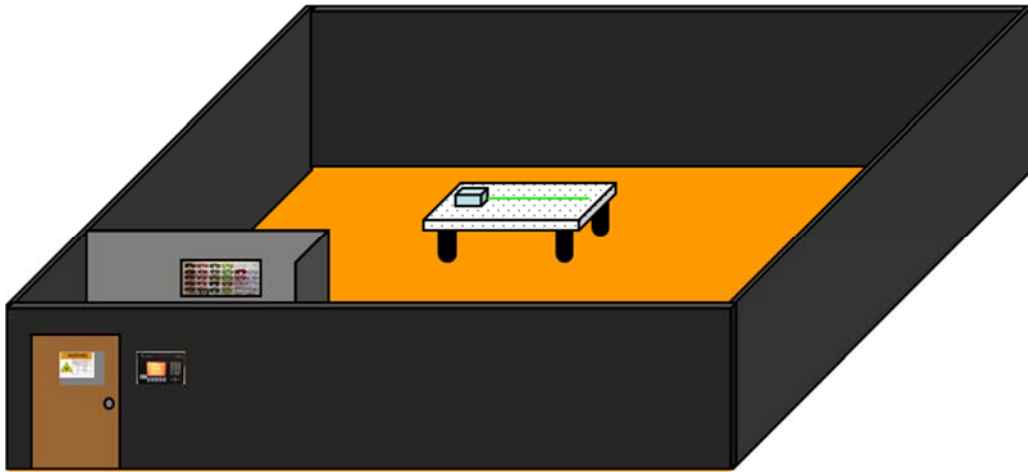


Figure 1. The Laser Controlled Area (LCA) is shown in orange and is bounded by four walls. On the front wall is the entry door with an associated laser hazard sign and an electronic laser status warning device.

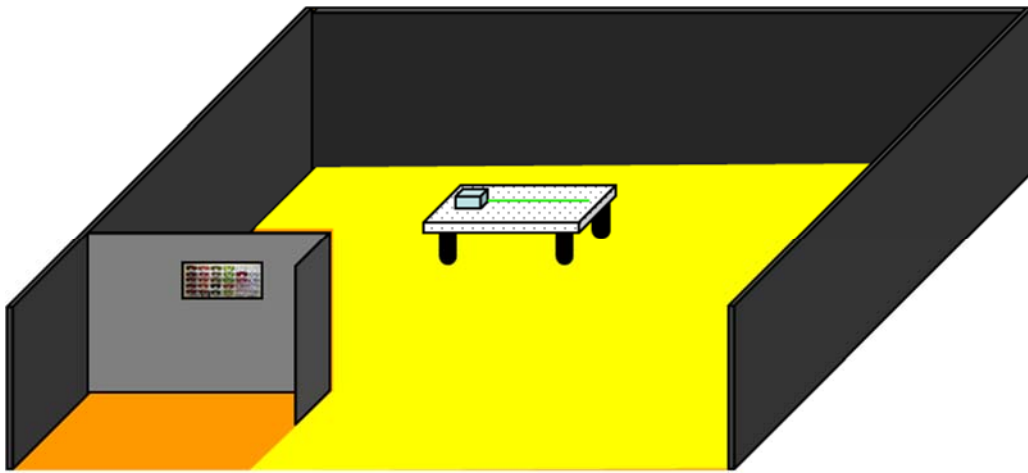


Figure 2. The LCA is shown with the front wall removed. The Nominal Hazard Zone (NHZ) is denoted in yellow. The orange part of the LCA near the entry is protected by a barrier wall and is considered a “safe” location outside the NHZ where one would put on or remove laser protective eyewear and any other required PPE.

2. Control Measures

2.1. Alternate Controls

Alternate controls may be used to replace control requirement(s) in this document, provided all of the following requirements are met:

- a. Alternate controls *shall* provide equivalent protection as would be accomplished with the specific control(s) not used
- b. Alternate controls *shall* be reviewed and approved by the LSO
- c. Alternate controls training *shall* be provided to all affected laser workers

Informational Notes:

- i. *Alternate controls may be needed when the primary controls specified in this document are not feasible or not reasonably practicable.*
- ii. *Examples of situations where an alternate control may be needed include:*
 - a. *acceptance testing of a newly received laser*
 - b. *service work by a service subcontractor*
 - c. *<20 mW cw visible laser operation*
- iii. *Examples of alternate controls may include one or more of the following:*
 - a. *no unattended operation*
 - b. *a guard be posted*
 - c. *if an enclosure is not interlocked, then it is secured and has a warning label*
 - d. *simple beam paths and perimeter barriers, and no out-of-plane beams*

2.2. Engineering Controls

2.2.1. LCA Warning Device

An LCA Warning Device *shall*:

- a. be installed at the LCA entryway so it is visible prior to entry
- b. be installed inside the LCA

An LCA Warning Device *should*:

- a. be easily viewable to persons in the LCA
- b. be electronically interfaced to a laser power supply, safety shutter, or SIS

An exception to the LCA Warning Device requirements above is permitted in cases where the Laser Safety Officer (LSO) determines that the NHZ within the LCA is very limited in extent. In this case the LSO *shall* require an NHZ warning device, sign or label to clearly communicate where laser radiation may be present above Class 3R levels.

2.2.2. Emergency Stop Device

A Class 4 LCA *shall*:

- a. have a clearly marked Emergency Stop (OFF) device

A Class 3B LCA *should*:

- a. have a clearly marked Emergency Stop (OFF) device

2.2.3. Remote Interlock Connector

Each Class 3B and Class 4 laser source *should*

- a. have a remote interlock connector

2.2.4. Master Key

A Master Key *shall*:

- a. be provided for all Class 3B and Class 4 lasers or laser systems

Informational Notes:

- i. A single Master Key can be used for multiple lasers. An LCA may have a single Master Key or multiple Master Keys.
- ii. A common practice is for an LCA to have a SIS with an associated Master Key that disables all Class 3B and Class 4 lasers within the LCA when it is removed or turned to the OFF position.

2.2.5. Beam Stop/Attenuator

A beam stop or attenuator *should*:

- a. be provided for each Class 3B and Class 4 laser or laser system

Informational Notes:

- i. This can be used when the laser output is not required.
- ii. This can be an insertable safety shutter interfaced with a SIS to disable a laser hazard when there is an interlock fault.
- iii. This can be an intensity control for the source laser, for example by reducing the repetition rate or by reducing the excitation source.

2.2.6. Enclosures (Protective Housings, Class 1 Enclosures, Beam Conduits and Fiber Transport)

Informational Notes:

- i. An enclosure that does not meet the requirements of a protective housing or a Class 1 enclosure is considered a barrier.
- ii. Protective housings and Class 1 enclosures may incorporate beam conduits and fiber transport cables.
- iii. A protective housing may or may not have an output aperture.
- iv. An enclosure may be a Class 1 enclosure for some wavelengths but only a protective housing or a barrier for other wavelengths.

2.2.6.1. Removable Covers for Protective Housings, Class 1 Enclosures, and Beam Conduits if used as part of a Class 1 Enclosure

- a. Covers that may be removed during normal operation or maintenance *shall* be provided with failsafe or redundant interlocks
- b. Covers that are only removed during infrequent service tasks *shall* either:
 - be interlocked (failsafe or redundant interlocks not required), or
 - be secured requiring a tool to remove
- c. If defeatable interlocks are used, it *shall* not be possible to replace the cover with the interlock defeated
- d. If defeatable interlocks are used, the cover *shall* have a warning label to identify this

2.2.6.2. Removable Connectors for Fiber Transport Cables

- a. Class 3B and Class 4 laser sources to the fiber transport cables *shall* be blocked or disabled prior to connecting or disconnecting the fiber
- b. Removable connectors *shall* either be:
 - interlocked, so the laser source is disabled when in the disconnected state; or
 - secured, requiring a tool to disconnect, unless the connector is within a secured or interlocked enclosure

2.2.6.3. Exclusion LCAs, Walk-in Protective Housings

- a. These *shall* have fail-safe or redundant access control interlocks to disable laser hazards in excess of Class 3R if a person enters
- b. An LCA Warning Device *shall* be used which indicates a *NO ACCESS* condition

2.2.6.4. Equipment Labels

2.2.6.4.1. Protective Housings

An equipment label providing hazard information for the output laser beam *shall*:

- a. be affixed to a conspicuous place on the housing
- b. be placed on the control panel if it is separated from the housing by more than 2 meters

2.2.6.4.2. Removable Covers on Protective Housings and Class 1 Enclosures

A warning label identifying the highest class of laser radiation contained within the enclosure or housing *shall*:

- a. be affixed to each removable cover
- b. include the following text (or equivalent)
 - if no interlocks for cover, “Class 3B Laser Radiation When Open” or “Class 4 Laser Radiation When Open”
 - if the cover has defeatable interlocks, “Class 3B Laser Radiation When Open and Interlocks Defeated” or “Class 4 Laser Radiation When Open and Interlocks Defeated”

2.2.6.4.3. Removable Fiber Connectors

A warning label identifying the highest class of laser radiation contained within the fiber *shall*:

- a. be affixed to each removable fiber connector
- b. include the warning statement (or equivalent) “Hazardous Laser Radiation may be Accessible when Disconnected”

2.3. Administrative and Procedural Controls

2.3.1. Standard Operating Procedures (SOPs)

SOPs for Class 3B and Class 4 lasers *shall*:

- a. be required and approved by an LSO
- b. include alignment procedures

SOPs for Class 3B and Class 4 lasers *should* include the following items -- if not included in the SOP, they *shall* be documented elsewhere:

- a. laser hazard parameters (power, pulse energy, pulse width, repetition rate)
- b. OD requirements and required PPE
- c. engineering and administrative controls
- d. schematic of the LCA including where the lasers, emergency stop buttons, and external safety shutters are located

Informational Note: Examples of alternative documentation could be:

- i. local posting of the LCA schematic
- ii. local posting of OD and PPE requirements at entry to LCA

2.3.2. Alignment Procedures

Each of the following actions *shall* be addressed in an SOP document:

- a. an alignment action that changes the wavelength hazard or eyewear requirement

Each of the following actions *shall* be addressed in training, an SOP document or by another method:

- a. Laser eyewear protection is required for accessible Class 3B and Class 4 beams
- b. Have good viewing diagnostics readily available (for example: fluorescent cards, cameras, UV/IR viewers)
- c. Block beams when not needed
- d. Use barriers or irises to prevent or block stray beams. Check for stray beams at each step in alignment procedure (e.g., before moving on to the next optical component) and prior to high power beam operation
- e. Perform safety inspection for proper beam containment and ensure all safeguards are in place when completing the alignment task
- f. Peeking over or under laser eyewear is not allowed
- g. Avoid bringing eyes near plane in which laser propagates

Each of the following actions *should* be addressed in training, an SOP document or by another method:

- a. Exclude unnecessary personnel
- b. When practical use low power alignment lasers
- c. Attenuate high power laser beams to the lowest practical power
- d. Place beam blocks or barriers behind optics (e.g., turning mirrors) to terminate beams that might miss mirrors during alignment

Informational Note: More attention is needed for implementing local beam blocks and barriers when optics are used outside a region that has associated perimeter barriers.

- e. Terminate beams down range of optics being aligned. Ensure proper beam termination prior to high power operation
- f. Ensure appropriate warning signs or displays are used for alignment or maintenance tasks
- g. Reduce unwanted reflections by using non-reflective tools and non-laminated viewing cards
- h. Practice good housekeeping to remove unnecessary tools, components and combustibles
- i. Document training for laser workers who perform alignment tasks

2.3.3. Unsupervised, Unattended Operation

2.3.3.1. Unsupervised laser operation

- a. Unsupervised laser operation *shall* not be permitted

Informational Note: some manufactured Class 1 laser systems do not require supervised operations. For example, laser printers and CD players do not require supervised operations. However, a manufactured laser welder would require supervised laser operation.

2.3.3.2. Unattended laser operation

Class 3B and Class 4 lasers or laser systems that are only used as part of a LSO-approved Class 1 laser system are exempt from the requirements in this section.

The unattended use of Class 3B or Class 4 lasers or laser systems *shall* be permitted only when all of the following are satisfied:

- a. the Laser Supervisor has ensured that control measures, consistent with the controls hierarchy, provide adequate protection to those who may enter the laser controlled area during times of unattended use
Informational Note: these controls may include interlocks, beam traps, barriers, other means of area control, or laser safety training.
- b. the laser supervisor has ensured that appropriate engineering controls restrict access to the LCA to authorized laser workers
- c. for Class 4 LCAs, the entryway to the LCA is interlocked to disable accessible Class 3B and Class 4 laser beams if there is an unauthorized entry to the LCA

The unattended use of Class 3B or Class 4 lasers or laser systems *should* require each of the following:

- a. the entryway to the LCA be locked, with access restricted to authorized laser workers
- b. for Class 3B LCAs, the entryway to the LCA be interlocked to disable accessible Class 3B laser beams if there is an unauthorized entry to the LCA

2.3.4. Annual Inspections/Audits

Annual inspections of laser facilities (or laser systems) by the LSO or Deputy LSO *shall* include, at a minimum, all of the following:

- a. review that the current SOP document(s) accurately reflects current laser operations
- b. verify that laser system interlock functionality checks have been completed
- c. review list of authorized laser workers, and verify that their training is current
- d. review lasers in use and that their operations are adequately described in the SOP document(s)
- e. review that LCA entryway postings meet requirements
- f. inspect eyewear and eyewear storage location that requirements met, including that the eyewear is not damaged and that only approved laser eyewear is present
- g. check if barriers and beam containment are adequate
- h. check if housekeeping is adequate
- i. review status of open action items from last inspection

2.4. Personal Protective Equipment (PPE)

2.4.1. Full Protection Laser Eyewear

Full protection laser eyewear *shall*:

- a. be required whenever Class 3B or Class 4 laser radiation is accessible within the NHZ, unless the LSO approves use of alignment eyewear
- b. be required for all routine laser operations and for most laser alignment procedures

2.4.2. Alignment Eyewear

Alignment eyewear *shall*:

- a. only be used for specific visible wavelength alignment procedures that have been appropriately evaluated, documented, and authorized by the LSO
- b. have a minimum OD requirement that provides full protection for viewing at 20 cm distance an ideal, point-source, diffuse reflection of the laser source.

Laser workers who use alignment eyewear *shall*:

- a. be notified that alignment eyewear will not protect them against a point source intrabeam exposure

2.4.3. Skin PPE

Skin PPE *shall* be used:

- a. if there may be UV radiation exposure above the MPE

Informational Notes: Consideration needs to be given for:

- i. *chronic exposures to diffuse laser radiation hazards*
- ii. *use of a full face shield in addition to gloves and long-sleeved clothing for high-powered laser operations*

3. Training

3.1. Laser Safety Officer (LSO) Training

LSO training *shall*

- a. be provided by management
- b. be commensurate to the highest Class of laser under the jurisdiction of the LSO
- c. include potential hazards, control measures, medical examinations, applicable standards, and non-beam hazards

LSO training *should*

- a. include obtaining LSO certification by the Board of Laser Safety

Informational Note: Minimal training for an LSO is typically a commercially available 5-day Laser Safety Officer Training course WITH Hazard Analysis.

3.2. Laser Supervisor Training

Laser supervisors *shall*:

- a. complete the National Training Center ESH-518 DOE Laser Worker Training or equivalent

Laser supervisors *should* complete each of the following:

- a. training required of laser workers for lasers that are under their authority
- b. laser beam alignment training
- c. training commensurate with their supervision responsibilities

3.3. Laser Worker Training

Workers *shall* complete all of the following:

- a. the National Training Center ESH-518 DOE *Laser Worker Training* or equivalent
- b. site-specific *On-the-Job Training (OJT)* for the laser systems and laser facilities they are authorized for
- c. hands-on training or demonstrate proficiency for specific lasers and laser systems the workers use
- d. laser beam alignment training or demonstrate proficiency in this, if they perform alignment tasks.
- e. additional training for non-beam hazards if applicable

Informational Note: this is particularly important for electrical and fire hazards.

Workers *should*:

- a. have their OJT, hands-on training and alignment training (or demonstrated proficiencies in these) documented as applicable

4. Medical Exams

4.1. Skin Exams (UV)

Laser Workers *should*:

- a. request a skin exam if they experience any symptoms from exposure to UV laser beams
- b. request a periodic skin exam if they are working with UV lasers and are at risk for exposure above the MPE, in particular if they have a history of photosensitivity

4.2. Baseline Eye Exam

Laser Workers *should*:

- a. have a baseline eye exam prior to commencement of their laser work in NHZs where Class 3B or Class 4 laser beams are present

5. Laser Safety Programs

5.1. Laser Safety Officer Responsibilities

LSOs *shall*:

- a. participate as a member of the DOE EFCOG Laser Safety Task Group (LSTG)

5.2. Laser Supervisors

5.2.1. Assignment and Authority

Laser supervisors *shall*:

- a. be assigned by their line management for a laser system, LCA or laser project; and
- b. have the authority granted by management to carry out the responsibilities of their job

5.2.2. Roles and Responsibilities

Laser supervisors *shall* fulfill all of the following requirements:

- a. be knowledgeable of the institutional laser safety policies and requirements
- b. understand the laser safety hazards and controls, including the SOPs, for the lasers under their authority
- c. only permit operation of Class 3B and Class 4 lasers with approval of LSO
- d. ensure SOPs and appropriate training, including site-specific OJT, are provided to laser workers on all laser hazards and their controls,
- e. ensure adequate work planning and control for safe laser operations
- f. ensure that proper controls are in place
- g. provide the LSO with the names of all laser workers
- h. suspend laser operation if there is inadequate control of laser hazards
- i. respond promptly and appropriately to all laser incidents or accidents, including to notify the LSO
- j. assist in obtaining appropriate medical response if needed, for all laser incidents or accidents
- k. notify the LSO of any new installations or modifications to laser systems that may deviate from the hazards and controls already approved

Laser supervisors *should* fulfill all of the following requirements:

- a. document site-specific OJT for laser workers, even if not formally required at their DOE site

5.3. Laser Workers

5.3.1. Authorization

Laser Worker authorization *shall*:

- a. require approval from their administrative supervisor and the laser supervisor; and
- b. be documented

5.3.2. Roles and Responsibilities

Laser Workers *shall* fulfill all of the following requirements:

- a. not operate a laser unless authorized to do so
- b. comply with all safety rules and procedures applicable to the laser system and the facility for which they are authorized
- c. immediately report all laser accidents/injuries or any incident that could have led to an injury to their supervisor, and if not available to the LSO

5.4. Approval Requirements (SOPs, Laser or LCA Operations, Laser Workers)

Informational Notes:

- i. *Different DOE sites have different terminology for SOP documents, or they may be incorporated into another document. Examples include: Work Control Document and Integrated Work Document.*
- ii. *Some DOE sites may use a “review and concur” requirement for the LSO, Deputy LSO, safety representative, manager or supervisor instead of “approve” for the requirements noted in this section.*

5.4.1. SOP Documents

SOP documents *shall* meet all of the following requirements:

- a. be approved by the LSO or Deputy LSO
- b. be approved by a safety representative, whose responsibilities include reviewing non-beam hazards
- c. be approved by a manager or supervisor responsible for the laser(s) described in the SOP or for the facility where they will be operated

5.4.2. Laser or LCA Operations

Laser or LCA operations *shall* meet all of the following requirements:

- a. be approved by the LSO or Deputy LSO
- b. be approved by a safety *representative*, whose responsibilities include reviewing non-beam hazards
- c. be approved by a manager or supervisor responsible for the laser(s) described in the SOP or for the facility where they will be operated
- d. be approved for a specified time period

5.4.3. Laser Workers

Laser workers *shall* meet all of the following requirements:

- a. be approved or authorized by a laser supervisor responsible for each applicable laser, laser system or LCA
- b. be approved by their administrative supervisor for each applicable laser, laser system or LCA
- c. have completed the required training at their DOE site for laser workers

References

1. LSTG Report, [*2017 Benchmark Study of ANSI Z136.1-2014 Controls Requirements*](#), September 28, 2017
2. LSTG Report, [*2016 Benchmark Study of ANSI Z136.1-2014 Controls Requirements*](#), August 31, 2016
3. ANSI Z136.1-2014, *American National Standard for Safe Use of Lasers*
4. ANSI Z136.8-2012, *American National Standard for Safe Use of Lasers in Research, Development, or Testing*
5. ANSI Z136.9-2013, *American National Standard for Safe Use of Lasers in Manufacturing Environments*