

LASER SAFETY PLAN



California State University, Chico

Department of Environmental Health and Safety

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REVISION RECORD

Revision	Changes	Date
KW	Original Version	12-11-19

Legend:

KW: Kenny Wahl, Laser Safety Officer

1.0 **PURPOSE**

The purpose of this plan is to establish clear and consistent procedures for the safe use of lasers in research and instructional laboratories at California State University, Chico (Chico State).

2.0 **SCOPE**

The contents of this manual apply to all University personnel, employees, students and visitors, who operate lasers or work in locations where lasers are used.

3.0 **AUTHORITY**

The recognized standard and primary guidance for laser hazards is the American National Standard for Safe Use of Lasers (ANSI Z136.1). Additionally, laser safety falls under the General Industry Safety Orders, California Code of Regulations (CCR), Title 8, Subchapter 7, Section 3203 (Injury and Illness Prevention Program).

4.0**ROLES AND RESPONSIBILITIES****Laser Safety Committee (LSC)**

The Laser Safety Committee may be formed when the number, hazards, complexity, and/or diversity of laser activities warrants.

Environmental Health and Safety / Laser Safety Officer (LSO)

The LSO has the authority to authorize, suspend, and specify conditions of use of all lasers at facilities and areas of administration by CSU Chico. The LSO shall be responsible for the following:

- Laser safety program development and oversight.
- Maintain registrations for Class 3B or Class 4 laser or laser systems.
- Classify or confirm classifications of lasers or laser systems.
- Maintain inventory for all laser classes.
- Approve and/or perform hazard evaluations for all class 3B and 4 lasers, laser systems and laser controlled areas.
- Approve and/or specify control measures for all class 3B and 4 lasers, laser systems and laser controlled areas.
- Review standard operating procedures (SOPs), signs, and labels.
- Review safety training and maintain program records.
- Investigate laser incidents.

The LSO may appoint a Laser Safety Supervisor (LSS) and may delegate duties to the LSS in accordance with ANSI Z136.1.

Laser Safety Supervisor (LSS)

The LSS shall maintain the Laser Safety Program for assigned laser use areas and may call on the LSO for assistance as needed. Duties include, however are not limited to:

- Supervise the use of lasers under their authority.
- Maintain an inventory for all lasers under their authority.
- Monitor 3B and 4 lasers and laser system.
- Immediately report any accident, eye exposure, or suspected eye exposure to the LSO.
- Report any safety concerns to the PI or LSO.

Principal Investigator (PI)

The Principal Investigator (PI) shall be designated for each class 3B and 4 lasers. The PI shall have the responsibility and authority to ensure laser safety compliance for their personnel and equipment. The PI shall:

- Register each Class 3B and Class 4 laser and laser systems with the LSO.
- Maintain proper classification of all lasers and laser systems under their authority.
- Maintain an inventory for all lasers and laser systems under their authority.
- Generate SOPs for Class 3B and Class 4 laser and laser systems use, alignment, and laser specific training and submit that to LSO.

- Ensure approved SOPs are available to laser users and followed.
- Implement approved control measures for all 3B and 4 lasers, laser systems and LUA.
- Provide appropriate safety training to laser users under their authority.
- Immediately report any accident, eye exposure, or suspected eye exposure to the LSO.
- Report any safety concerns to the LSO.
- Inform the LSO prior to all class 3B and 4 lasers and laser system acquisitions, transfers and disposals.

Laser User (LU)

A LU is a person who works with Class 3B and Class 4 lasers and laser systems (including embedded lasers). The general responsibilities of a LU include, however are not limited to:

- Complete all appropriate laser safety training.
- Read, understand, and comply with lab specific laser standard operating procedures (SOPs).
- Wear appropriate Personal Protective Equipment (PPE).
- Immediately report any accident, eye exposure, or suspected eye exposure to the PI or LSS.
- Report any safety concerns to the PI or LSS.

Visitors and Short-Term Researchers

Visitors and short-term researchers are individuals who are present in the laboratory as an invited guest of any Chico State employee or student researcher for the purpose of doing research or visiting a laboratory environment.

- Short-term researchers must meet the same laser safety-training requirement as campus laser users.
- The Principal Investigator will provide a laser safety orientation and safety equipment for their laser controlled areas.

5.0**LASER CLASSES**

Class 1

Lasers and laser systems are incapable of producing damaging radiation levels during normal operation and are exempt from any control measures. Class 1 laser systems may contain embedded higher-class lasers and may produce laser hazards if operated with interlocks defeated.

Class 1M

Lasers and laser systems are incapable of producing hazardous exposure conditions during normal operation unless the beam is viewed with optical instruments.

Class 2

Lasers and laser systems emit wavelengths in the 400 to 700 nm range and are incapable of causing eye injury unless intentionally viewed directly for an extended period. The normal aversion response to bright light is adequate protection.

Class 2M

Lasers and laser systems emit visible light only. The normal aversion response to bright light is adequate protection for unaided viewing. However, viewing the beam with optical aids is potentially hazardous.

Class 3R (Formerly Class 3A)

Lasers and laser systems are potentially hazardous under some viewing conditions, but the probability of an actual injury is small, and the control measures for safe use are straightforward. (Most lasers previously classified as class 3a fall in this category.) Risk of injury increases when viewed with optical aids.

Class 3B

Lasers and laser systems are eye hazards for intrabeam viewing and specular reflections, even for momentary exposures, but diffuse reflections are not usually hazardous.

Class 4

Lasers and laser systems are eye hazards and skin hazards for intrabeam exposures, specular reflections, and diffuse reflections. They are also fire hazards and may produce laser generated air contaminants.

6.0 LASER ACQUISITION & REGISTRATION

All purchases of Class 3B and Class 4 lasers must be approved by the EH&S Laser Safety Officer prior to purchase to ensure that appropriate safety measures will be available and implemented.

All Class 3B and Class 4 lasers must be registered with the EH&S Laser Safety Officer prior to installation and use. The Laser Registration Form is available on the Environmental Health and Safety webpage.

7.0 LASER TRANSFER AND DISPOSAL

Transfer

Complete and submit the Laser Transfer/Disposal form found on the EHS website prior to a transfer of Class 3B or Class 4 lasers or laser systems from one PI to another PI on-campus, or if the laser is to be sold or transferred off-campus. Use of this form is different from any Property Management transaction form. If equipment is tracked by the Property Management Department, equipment owners still need to notify them separately.

Disposal

Complete and submit the Laser Transfer/Disposal form found on the EHS website prior to the disposal of a Class 3B or Class 4 laser or laser system.

- Lasers and laser systems should be rendered "inoperable" prior to disposal.
- The LSO will coordinate with the hazardous waste program, as appropriate.
- The laser or laser system shall be removed from the laser inventory upon disposal.

8.0 TRAINING REQUIREMENTS

All operators of Class 3B and 4 lasers and laser systems, all incidental personnel, and visitors who may be allowed to enter laser controlled areas shall receive approved laser safety training before operating the laser or entering laser controlled areas.

Primary users are required to complete the Laser Safety Training module available in CSULearn. This training is assigned by EHS and is required to be completed in 30 days of assignment or prior to the use of lasers, whichever is first. Primary users are identified by the department chair who is responsible for the laser.

Students and incidental employees will be trained to the extent needed to ensure their safety while near the laser. The level of training will be determined by the LSO or the faculty member in control of the area. The training will be conducted by the responsible faculty member. The training will be documented and the documentation will include topics covered, date, name of instructor presenting the training, individual being trained, and their signature. Training will be documented and maintained for no less than three years.

9.0**MANUFACTURE/CONSTRUCTION**

Any classification of laser or laser system that is manufactured from components for formal transfer to an entity outside the University, shall meet US Food and Drug Administration requirements per 21CFR Part 1040, Federal Laser Product Performance Standard.

A laser or laser system which is manufactured or assembled for internal Chico State use, or which is designed for specific temporary use at another entity with explicit intent to return the laser directly to Chico State is exempt from this requirement.

An operator manual shall be generated for class 3B or 4 lasers or laser systems manufactured or assembled from components.

10.0**MEDICAL SURVEILLANCE**

Baseline eye exams are not required. A medical eye exam may be required immediately following a suspected injury or adverse effect from a laser, based on the guidance of medical personnel.

11.0**CONTROL MEASURES**

When used as intended Class 1, 2, and 3R laser systems are generally low hazard devices; however, some requirements still apply.

- Exposure to laser radiation must be kept below the Maximum Permissible Exposure (MPE) under all conditions of operation or maintenance.
- Laser systems must have the appropriate warning labels and the appropriate cautionary statement.
- Removal of protective housing or system modification can increase a laser's classification and requires approval from the LSO.
- All class 3B and 4 lasers and laser systems shall be operated in a laser controlled area. The requirements for individual laser controlled areas shall be determined by the LSO. The minimum requirements for laser controlled areas are:
 - Entryway controls to allow only authorized personnel or approved spectators to enter the laser control area. (Administrative controls are acceptable.)
 - Conspicuously posted sign or signs with instruction for the protection of personnel.
 - Laser safety eyewear readily available and used in accordance with the SOP for class 3B and class 4 lasers and laser systems.
 - Beam control (barriers and beam blocks) to limit laser hazards within the controlled area.
 - Class 3B and Class 4 lasers and laser systems written SOP's shall include beam and non-beam hazards.
 - Training of operators of all class 3B and 4 lasers and laser systems.
 - Maintenance & repair of lasers or laser systems performed by contractors must be coordinated with the LSO prior to work commencing.

Class 3B lasers and Class 4 lasers shall have written alignment procedures that must be followed.

12.0**NON-BEAM HAZARDS**

Non-beam hazards often exist in laser-related operations and can pose significant health and safety risks. All non-beam hazards must be addressed in SOPs. Examples of non-beam hazards may include:

- Electrical hazards from power supplies.
- Laser generated air contaminants (LGAC), which may be generated when a Class 4 or some Class 3B lasers interact with matter.
- Fire hazards from Class 4 lasers.
- Compressed gases.
- Laser dyes and solvents may contain complex fluorescent organic compounds.
- Poor housekeeping especially in dimly lit areas.

13.0**LASER USE OUTDOORS**

The Principal Investigator shall inform the LSO of any Class 3R, 3B, or 4 lasers used outdoors for research projects. The application and operation of the laser system(s) shall be evaluated by the LSO to ensure that appropriate safety measures are in place prior to operation.

- FAA notification is required (for Class 3R, 3B or 4 lasers) if the laser is being used in navigable airspace.

14.0**LASER USED FOR PUBLIC DISPLAYS / ENTERTAINMENT (NON-RESEARCH)**

Any Class 3B or 4 laser used for entertainment, displays, demonstrations, or any related use intended for public viewing (indoors or outdoors) on university property shall be operated in accordance with federal, state, local, and campus regulations/requirements.

- Campus departments and campus-affiliated groups shall notify the LSO of any laser light show (indoor or outdoor) to be performed on university property.
- The operators of laser systems used for entertainment are required by law to file a variance document with the Food and Drug Administration's Center for Devices and Radiological Health (FDA/CDRH). If the venue is outdoors and the beam(s) may terminate in navigable airspace, then the operators are also required to file a report with the Federal Aviation Administration (FAA).

15.0 **LASER POINTERS**

Laser Users must comply with the manufacturer’s operating and safety instructions. The manufacturer is required by the FDA Center for Devices and Radiological Health to provide correct labeling for their laser pointers. This information should be clearly visible on the laser pointer.

16.0 **EYEWEAR**

Laser safety eyewear is required for the operation of class 3B and class 4 lasers and laser systems with exposed beams. The LSO will require eyewear or approve laser operation without eyewear on an individual basis, based on a hazard evaluation.

Eyewear shall be selected to provide an adequate level of protection from the laser and for suitability to the wearer and environment. Eyewear shall be inspected periodically to ensure that the protection level has not degraded through use and beam exposure.

17.0 **EXPOSURE INCIDENTS**

- Seek immediate medical attention in the event of an exposure or suspected exposure to laser radiation capable of an eye or skin injury.
- If an exposure incident occurs, the PI or the person operating the laser must notify the LSO.
- In the case of a suspected eye injury, an eye examination may require by a qualified medical expert.
- ANSI Z136.1 “ANSI Standard for Safety User of Lasers”, Appendix F, provides guidance for medical referral following suspected or known laser injury.

18.0 **AUDITS**

An audit of all class 3B and 4 lasers and the Laser Safety Program shall be conducted periodically by the LSO or designated personnel.

19.0 **RECORDS**

The LSO shall maintain records, which document the Laser Safety Program. These records shall include:

- Laser hazard analysis reports for all class 3B and 4 lasers
- Training records for all operators of class 3B and 4 lasers
- Standard Operating Procedures for all class 3B and 4 lasers
- Approvals of alternate laser control measures
- Laser Safety Audit reports
- Laser Inventory
- Laser Incidents

20.0**DEFINITIONS**

American National Standards Institute (ANSI) - The technical body which releases the Z136.1 Standard for the Safe Use of Lasers and Z136.3 Standard for Safe Use of Lasers in Health Care Facilities.

Aversion Response – Closure of the eyelid, eye movement, pupillary constriction, or movement of the head to avoid an exposure to noxious or bright light stimulant. The aversion response to an exposure from a bright, visible, laser source is assumed to limit the exposure of a specific retinal area to 0.25 s or less.

Diffuse Reflection - When an incident radiation beam is scattered in many directions, reducing its intensity. A diffusely reflecting surface will have irregularities larger than the wavelength of the incident radiation beam.

Embedded Laser – An enclosed laser that has a higher classification than the laser system in which it is incorporated, where the system's lower classification is appropriate due to the engineering features limiting accessible emission.

Intrabeam Viewing - The viewing condition whereby the eye is exposed to all or part of a laser beam. **Irradiance** - The power being delivered over the area of the laser beam. Also called power density, irradiance applies to CW lasers and is expressed in W/cm

Laser – Light Amplification by Stimulated Emission of Radiation.

Laser Controlled Area (LCA) – An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation.

Laser User - Any person who uses a laser for any purpose on or off-campus property.

Laser Safety Officer (LSO) - A member of the EH&S staff, the Laser Safety Officer (LSO) is responsible for implementation of the Laser Safety Program.

Radiant Exposure - The energy being delivered over the area of the laser beam. Also called energy density, radiant exposure applies to pulsed lasers and is expressed in J/cm

Specular Reflection - Results when an incident radiation beam is reflected off a surface whose irregularities are smaller than the radiation wavelength.

Ultraviolet (UV) Radiation - Invisible radiation with a wavelength between 10 nm and 400 nm. The near ultraviolet (UV-A) is the 315 to 400 nm band, the mid ultraviolet (UV-B) is the 280 to 315 nm band, the far ultraviolet (UV-C) is the 100 nm to 280 nm band, and the extreme ultraviolet is the 10 to 100 nm band. Note: Wavelengths below 200 nm are absorbed in the atmosphere and are known as the vacuum ultraviolet.

Visible Light - Radiation that can be detected by the human eye. These wavelengths are between 400 and 780 nm

Laser Information

Location Location Phone

Manufacturer If Other, please specify

Model Serial # CI Tag #

Type: Class:

If Type is Other, please specify:

Operating Wavelengths (nm): Typical Ranges

Beam Diameter at aperture (mm) Beam Divergence (mrad)

Mode of Operation (CW, pulsed)

For CW

Power: Units

Typical Maximum Minimum

For Pulse

Pulse Duration: Units	<input type="text" value="fs"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
		Typical	Maximum	Minimum
Repetition Rate: Units	<input type="text" value="Hz"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
		Typical	Maximum	Minimum
Energy/Pulse: Units	<input type="text" value="mJ"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
		Typical	Maximum	Minimum

Description of Laser and Lab Setup:

Laser Information

Location Location Phone

Manufacturer If Other, please specify

Model Serial # Chico #

Type: Class:

If Type is Other, please specify:

Operating Wavelengths (nm): Typical Ranges

Beam Diameter at aperture (mm) Beam Divergence (mrad)

Mode of Operation (CW, pulsed)

For CW

Power: Units

Typical Maximum Minimum

For Pulse

Pulse Duration: Units

Typical Maximum Minimum

Repetition Rate: Units

Typical Maximum Minimum

Energy/Pulse: Units

Typical Maximum Minimum

Description of Laser and Lab Setup:

Laser Transfer/Disposal Form

This form provides notice of relocation or disposal of a Class 3B or 4 laser or laser system.

PI Name: Registration #: L-
Laser Safety Supervisor:

Laser Information:

Manufacturer: Model:
Serial Number:
Type: If other, please specify:
Wavelength(s): nm
Max. output power/energy: Pulse mW
Pulse Rate (Hz):
Pulse Length: ns

System or device in which the laser is housed (if applicable):

Laser class during normal operation of the system: Class Normal:

Laser class during alignment procedures (if applicable): Class Align:

Laser Procedure (SOP) Title:

TRANSFER INFORMATION:

Anticipated date of relocation: (mm/dd/yyyy)

From (current location): To (new location):

Name:

Phone #:

Email:

Damaged/inoperable

Name:

Phone #:

Email:

DISPOSAL INFORMATION:

Hazardous Materials within laser system:

List Components of laser system:

