University of Regina

LASER SAFETY PROGRAM

Rev 1.7 July 19 2023

Health and Safety

Human Resources Department

LASER SAFETY PROGRAM

This Laser Safety Program has been created in accordance with the Saskatchewan Ministry of Labour Relations and Workplace Safety's *Occupational Health and Safety Act* and *Regulations* and the American National Standard Institute's *ANSI Z136.1 – Safe Use of Lasers* and *ANSI Z136.8 – Safe Use of Lasers in Research, Development, or Testing.*

Contents

Laser Safety Program

1. Purpose and Policy

The University of Regina is committed to providing a safe and healthy working, learning, and living environment for all members of the University community. To meet this commitment the Laser Safety Program is intended to provide a written framework of ensuring safety for all personnel working with or around laser hazards of Class 3B or 4 lasers, or those Class 1 laser systems with embedded high-power lasers if higher emission levels are accessible during maintenance or service. The program provides guidance that applies to the entire life cycle of a laser or laser system: procurement, installation, operation, maintenance, service and decommissioning. The University of Regina *Radiation Safety Policy* (GOV-100-020) and *Health and Safety Policy* (GOV- 100-005) provides the guidance and authority to this Program and forms part of the Health and Safety Management System.

2. Background

2.1. Nature of Laser Beam and Non-Beam Hazards

Lasers produce concentrated light as visible, or invisible, laser beams. Light considered within the scope of interest is within the spectrum of 180 nanometres (nm) to 1 millimetre (mm) in wavelength (UV, visible, infrared light). Laser light typically causes damage to exposed tissue, such as eyes or skin by focusing high amounts of energy onto a small area. Laser injury can occur from photochemical, thermal, or photomechanical effects, depending on the wavelength of light and duration of exposure. Lasers and laser operation can also present numerous non-beam hazards such as electrical, fire, hazardous gas production (laser generated air contaminants), chemical (from lasing media or associated samples or analytes), or biological (from associated samples or analytes). For more information on the safe use of lasers, the biological effects of laser light exposure, and non-beam hazards, see ANSI Z136.1 – Safe Use of Lasers.

2.2 Definitions, Acronyms, and Abbreviations

AEL (Accessible Emission Limit) is the maximum emission level permitted within a particular laser hazard.

Continuous Wave (CW) is a laser operated with a continuous output longer than or equal to 0.25 s.

Laser (Light Amplification by Stimulated Emission of Radiation) is any device which produces a coherent directional beam of light (radiation) which can be emitted in a single pulse, repetitive pulses, or continuously.

Laser Classification is an indication of the beam hazard level of a laser or laser system during normal operation.

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

Laser User is a person who is authorized to work with or having the potential for exposure to radiation exceeding the MPE.

Laser Protective Eyewear (LPE) is protective eyewear specifically designed for protection against radiation from Class 3B and 4 laser or laser systems, which is required within the NHZ of a laser hazard.

Laser Safety Officer (LSO) is one who has the authority and responsibility to monitor and enforce the control of laser hazards and effect the knowledgeable evaluation and control of laser hazards.

Maximum Permissible Exposure (MPE) is 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) is the space within which the level of the direct, reflected, or scattered radiation may exceed the applicable MPE.

Optical Density (OD) is the factor of transmittance attenuation at a particular wavelength specified within Laser Protective Eyewear.

Power (Φ) is the rate at which energy is emitted, transferred, or received (watt, 1 W = 1 Js^{-1}).

Principal Investigator (PI) is the holder of an independent grant administered by a university and the lead researcher for the grant project, which in the sciences usually involves activities, such as a laboratory study or a clinical trial. The phrase is also often used as a synonym for head of the laboratory, academic staff member/faculty member, or research group leader.

Protective Housing is an enclosure that surrounds the laser or laser system and prevents access to laser radiation above the MPE.

Pulsed Laser is a laser that delivers its energy in the form of a single pulse or train of pulses with single pulse durations of less than 0.25 s.

Retinal hazard region is visible and near-infrared wavelengths (400 – 1400 nm) of light that pose a high risk to the tissues or areas of the retina.

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

2.3. Designation of Laser Safety Officer

University of Regina Laser Safety Officer:
Ryan King (Ryan.King@uregina.ca) – Health and Safety – Human Resources – 306-337-3245

3. Responsibilities

3.1. President's Advisory Committee on Radiation Safety (PACRS)

The President's Advisory Committee on Radiation Safety (PACRS) is responsible for the approval, oversight, and administration of the University's *Radiation Safety Policy* and associated programs, including the Laser Safety Program, to ensure the safe use of and to minimize exposure to potentially hazardous radiation and radioactive materials at the University of Regina. This includes the authority to establish and oversee a Laser Safety Committee mandated to formulate and implement practices,

policies, regulations and procedures governing the use of lasers and laser systems. For more information on PACRS, see the Radiation Safety Policy and Program.

3.2. Laser Safety Committee

Terms of Reference

The laser safety committee is delegated by PACRS to formulate and implement University of Regina policies and procedures governing the use of lasers and laser systems to ensure safe use at the University of Regina in accordance with the University's Radiation Safety Policy. Policies, procedures and decisions made by the laser safety committee or the LSO are subject to review and amendment by PACRS.

Constitution of LSC

The LSC consists of the following members:

a. The Chair of the Laser Safety Committee
b. The Laser Safety Officer

Duties of the Laser Safety Committee

The LSC is subject to the direction of the PACRS, acts on behalf of, and is responsible for:

- Formulating and implementing University of Regina policies, and procedures governing the use of lasers and laser systems to ensure the safe use of radiation at the University of Regina in accordance with the University's Radiation Safety Policy;
- Evaluating the qualifications of those who apply to work with high powered lasers and issue written authorization to those who qualify;
- Review the registration of lasers, their use by qualified personnel, and adherence of their use to the program;
- Suspending or stopping any laser activities where in the opinion of the LSC the Laser Principal Investigator has failed to comply with program requirements or where the suspension is otherwise in the best interests of the University. When a activities are suspended, the LSC shall advise the Principle Investigator that it may appeal the suspension to PACRS;
- Reporting its activities to PACRS at such times and to such extent as PACRS directs;
- Reviewing requests to commission new laser control facilities;
- Responding to laser safety situations, which require immediate action.

3.3. Laser Safety Officer (LSO)

The Laser Safety Officer (LSO), reporting to the Manager, Health and Safety, is appointed by the President of the University of Regina with the authority and responsibility to evaluate and control laser hazards, to implement control measures, and to monitor and enforce compliance with required standards and regulations. Wherever duties or responsibilities of the LSO are specified, the LSO either performs the task or ensures it is completed by qualified individual(s). The LSO establishes and maintains adequate policies, procedures, incident records and programs for the control of laser hazards.

Key responsibilities:

- Classification or verification of classification of laser or laser systems.
- Hazard evaluation of laser work.
- Ensuring prescribed controls are in effect.
- Recommend or approve PPE, inspection and periodic audit of PPE.
- Approve wording on signs and labels, ensure information is current for laser activity.
- Approve laser installations and equipment prior to use.
- Responsible for the periodic examination of the features of laser equipment and systems to ensure safe operations and usage.
- Ensure adequate training is provided to authorized persons.
- Effect medical examinations when necessary, ensure they are scheduled and performed and shall maintain records.
- Perform incident investigation and initiate appropriate action.
- Stop any activities involving lasers when deemed appropriate.

3.4. Laser Principal Investigator

A laser principal investigator is a supervisor of individuals who are working with or having potential for exposure to radiation exceeding the MPE.

The principal investigator shall:

- have knowledge of laser safety requirements for lasers under their authority;
- have knowledge of, and performance in, completing and implementing risk assessments applicable to activities under their supervision;
- issue appropriate instructions and training materials on laser hazards and their controls to all laser users for lasers under their control;
- not permit the operation of a laser unless there is adequate control of laser hazards to employees, visitors, or members of the public;
- submit a list of users to be authorized for use and records of training as requested by the LSO;
- immediately report and act upon becoming aware of a suspected incident, incident, or near miss;
- assist in obtaining appropriate medical attention for any laser user involved in a laser incident, if necessary;
- not permit operation or modification of a Class 3B or 4 lasers under their authority without approval of the LSO;
- register and submit plans for Class 3B and 4 laser installations or modifications to the LSO for review before energizing lasers or laser systems of these classes;
- ensure availability and implementation of applicable SOPs to laser workers as required;
- fully inform all who may be exposed to radiation from lasers or devices containing lasers.

3.5. Laser User

A laser user shall:

- not energize or work with or near a laser unless authorized to do so;
- comply with safety rules and procedures prescribed by the principal investigator and LSO;
- immediately inform the principal investigator of suspected incident, incident, or near miss;

- be formally trained to carry out procedures for which a laser or laser system is to be used and be able to demonstrate knowledge of the equipment, biological effects associated with its use, and necessary safety procedures.

3.6. Procurement Agents

Individuals designated to review and approve laser and laser system purchases shall contact the LSO prior to purchase of any laser or device containing lasers to implement the laser safety program.

3.7. Maintenance/Installation/Vendor personnel

Individuals installing interlocks or other control measures, installing, altering, or otherwise servicing Class 3B or 4 lasers or laser systems, or laser systems where Class 3B or 4 conditions exist during installation, altering or maintenance, shall contact the LSO prior to energizing any such laser to implement the laser safety program.

4. Hazard Class Summary

Class 1 Lasers or Laser Systems

Considered incapable of producing damaging laser exposure during operation and are, therefore exempt from control measures or other forms of surveillance. A common example of a class 1 laser system is one that contains an embedded higher-class laser but during normal operation does not present a laser radiation hazard to the user. The embedded laser can be contained by housing, optical fibers, or beam tubes to enclose the beam path and termination.

Class 2 Lasers or Laser Systems

Low power laser systems in the visible spectrum (400 nm to 700 nm), and where eye protection is normally afforded by aversion response, for example blinking, or movement. The AEL of class 2 lasers does not exceed 1 mW.

Class 3 Lasers or Laser Systems

Medium power lasers that may be hazardous to the eye under direct and specular reflection viewing conditions, but the diffuse reflection is usually not a hazard and it is not a hazard to the skin. Class 3R lasers have an AEL of 5 mW for visible lasers, and 5 times the AEL of class 1 for invisible lasers. Class 3B laser or laser systems with CW emission have an AEL between 5 mW and 500 mW.

Class 4 Lasers or Laser Systems

High power lasers that are a hazard to the eye or skin from direct beam, and sometimes from diffuse reflection. Class 4 lasers and can also present a fire hazard. A class 4 laser system may produce laser generated air contaminants or hazardous plasma radiation. Class 4 lasers have an accessible emission greater than 500 mW in continuous wave, or a visible pulse greater than 30 mJ.

5. Non-Beam Hazards

Non-beam hazards are all hazards arising from the presence of a laser system excluding exposure to direct or scattered laser radiation. This may include the presence of sample or equipment hazards, like chemical, biological, or electrical; produced hazards such as ionizing radiation, fire, plasma, or laser generated air contaminants.

6. Program

6.1. Laser Registration

All class 3B and 4 lasers are to be registered with the LSO before they are put into operation. See appendix for laser safety registration form. Un-registered class 3B or 4 lasers, or those class 1 laser systems with embedded high-power lasers if higher emission levels are accessible during maintenance or service are not to be energized without approval of the LSO.

6.2. Training

Safety education and training shall be provided to laser users that are potentially exposed to laser radiation exceeding the MPE. Education and training shall also be completed by principal investigators of laser users.

LSO

The University of Regina shall provide for the LSO training on the potential hazards, controls, and any other information pertinent to laser safety and applicable standards outlined in Table 6.2.1, or shall provide to the LSO consultative services on these topics. The LSO shall complete refresher training regularly.

Laser Principal Investigators and Laser Users

All users of class 3B or 4 lasers or laser systems shall have knowledge of and demonstrated competency in laser safety subjects, potential hazards, controls, and safe work practices pertinent to the highest level of potential laser radiation exposure. Training must include laser safety awareness as well as site specific training outlined in Table 6.2.1. Training shall also include applicable non-beam hazards, such as cryogenics, electrical, chemical or biological safety. All training shall be documented and made available to the LSO upon request.

Refresher Training

Laser Principal Investigators and Laser Users

The frequency and capacity of refresher training shall be case specific and determined by the evaluation of the laser hazards present and the qualifications of the user. For example, users operating lasers with high frequency may not be required to receive full and extensive refresher training on fundamentals of laser operation, but will complete refresher training on biological effects, emergency procedures, and site-specific SOPs. A user not routinely operating lasers will be required to receive refresher training on hazard identification, controls, and fundamentals.

Table 6.2.1 Training Requirements

LSO		Laser safety standards
		Laser safety control measures (engineering, administrative, procedural, PPE)
		Essential laser characteristics (operation, applications, manufacturers requirements)
		Safety methods and procedures (alignment, barriers, warning signs, labels, authorized users, audits, laser worker training, incident record keeping)
PI/User	Training Program	Fundamentals of laser operation (principles of lasers)
		Biological effects of laser radiation on the eyes and skin
		Laser Protective Equipment
		Laser signs and labels
		Review of applicable standards
		Emergency procedures in case of an incident (also site-specific)
	Site Specific Training (may be included in SOP)	Standard Operating Procedure (SOP)
		Capabilities of equipment and attachments
		Purpose, use, and limitations of controls and safeguards
		How to make a daily visual inspection of all safety devices
		Emergency procedures in case of an incident
		Demonstration of operating equipment through functions necessary to perform task
Maintenance Staff		Scope of approved maintenance procedures
		Safety control measures as appropriate for accessed laser hazard during maintenance
		Identification of service procedures requiring authorized original equipment manufacturer, technicians
Visitor		Safety protocols and PPE required, must be accompanied by authorized personnel

6.3. Control Measures

6.3.1. Hazard Analysis

A hazard analysis must define a laser control area with the appropriate controls according to laser classification. Based on the hazard analysis, a laser control area may necessitate constructed or altered specifications to a location's layout, lighting, ventilation, security, electrical systems (may include emergency stop buttons or powered inter-lock devices), or signage (including powered visual or auditory warning devices). Be acutely aware of, and prepared to meet these conditions before planning a laser purchase or installation. If the hazard analysis, required control measures, or information to determine these topics are not provided/determinable, the LSO may request the Department/Faculty consult external resources/experts to meet these requirements at their expense.

Hazard analysis is generally completed in a step-by-step process by:

1. Determining and evaluating the Nominal Hazard Zone (NHZ) of all possible beam paths, including from fixed and unfixed mounts.
2. Determining beam hazards resulting from specular reflections, such as from reflective surfaces (fixtures, mirrors, optics), then diffuse reflections.
3. Determining access to the NHZ for all personnel during operation.
4. Review of any collecting optics.
5. Determine non-beam hazards.

6.3.2. Laser Control Area (LCA) and Nominal Hazard Zone (NHZ)

The LCA is commonly a laboratory, or shared laboratory containing accessible emissions of class 3B or class 4 lasers.

Class 3B or class 4 LCAs shall:

- be controlled by the Dean such that lasers and laser systems are operated only by trained and authorized users;
- have appropriate signage conspicuously displayed in locations where they best serve to warn approaching or entering personnel. Signage must convey appropriate controls designed to prevent unintentional exposure above MPE;
    - Examples of wording that could be included on signage: knock before entering, invisible/visible laser radiation, laser eye protection required, do not enter when light/sign is illuminated/posted, protective eyewear required, restricted area, authorized personnel only
    - Some of these may be covered by the general lab signage
- be operated with a well-defined beam path/location;
- have required eye protection immediately accessible.

Additionally, class 3B LCAs should and class 4 LCAs shall also:

- be under direct supervision of an individual trained in laser safety;
- have any hazardous beams sufficiently terminated;

- have reflective materials (other than mirrors and other optics part of the beam operation) removed near the beam path;
- secure the beam path at a level above or below the eye level of a standing or sitting person/user;
- have means to secure/lock-out the laser (such as plug-in lock, or securing the master key-switch);
- an area warning device (visual or auditory) to warn all personnel that a laser is energized, or about to be energized;
- an emergency stop, or other clearly marked device to deactivate the laser or reduce output below MPE;
- an entryway control (one of, in priority order):
    - non-defeatable entryway/controls or interlocks (such as a door latch, sensored floor mat, electrical switch)
    - defeatable entryway/area controls - if above interferes with required operation, or if radiation at entry cannot exceed MPE;
    - procedural entryway/area controls – may be implemented where interlocks are not possible or feasible, all authorized personnel are trained and provided appropriate PPE, and radiation is blocked/prevented from reaching entryway.

Hazard determination begins with defining a static and controlled beam path. With an adequately planned and controlled beam path the NHZ identifies the area where ocular or skin hazards can exceed the MPE from intra-beam viewing, specular reflections, and diffuse reflections. The NHZ of an enclosed beam may be determined to be confined to the enclosure. Additional requirements for a NHZ to prevent unintentional exposure above the MPE:

- If the NHZ exceeds the dimensions of the laser control area, internal or external windows within the NHZ of a class 3B or class 4 laser shall be protected such that the transmitted radiation is less than the MPE.
- A blocking barrier, such as a laser curtain or filter should be used to prevent laser radiation of the NHZ from leaving the LCA if the laser is visible from the LCA entryway.

6.3.3. Temporary LCAs / Maintenance and Service

Temporary LCAs are locations where the classification or hazards of a laser or laser system are temporarily increased, such as during installation, alignment, or maintenance. The most common use of a temporary LCA is for class I laser systems that must have protective housings removed or interlocks overridden by a designated service personnel. As the facility will most likely not have permanent controls required of a Class 3B or Class 4 LCA, temporary controls must be implemented. In these circumstances the area shall have, upon approval of the LSO:

- signage notifying of a Temporary Laser Control Area to warn of potential hazards;
- only individuals trained in the conditions of the LCA and possible hazards may be authorized entry;

- appropriate PPE must be used during the assigned maintenance/operation;
- if any alterations are made to the laser's set-up or conditions, the hazard class of the laser and the controls within the LCA must be reviewed.

6.3.4. Engineering Controls

Engineering controls, including those incorporated into the laser or laser system's installation shall be given primary consideration in limiting access to laser radiation. If engineering controls are impractical or inadequate, administrative and procedural controls, as well as PPE shall be used.

When evaluating the purchase/installation/operation of a laser the supervisor/purchaser of a laser or laser system shall (whenever feasible) apply the following engineering controls:

- implement the minimum power of laser radiation required for its application
- completely or to whatever extent possible enclose a hazardous open beam path
- maintain a beam height at a level other than that of eye level of a standing or seated person

Additional Engineering Controls:

- Protective housings
- Interlock devices
- Master key switches
- View portals/windows, filters or barriers
- Beam enclosures, such as beam tubes or fibers

For more information on engineering controls and the requirements by laser class, contact the LSO and/or consult ANSI Z136.1.

6.3.5. Administrative Controls

Administrative controls are policies and procedures for safe operation. Administrative controls are secondary to engineering controls, as they are inherently defeatable.

The following administrative controls are required for Class 3B and Class 4 lasers:

- **shall** be operated under direct supervision and control of an experienced and trained user;
- **shall** have direct control of the authorization of users, ensure their training, and prevent unauthorized use;
- all users **shall** be provided both education and training;
- **shall not** be permitted to be modified, unless evaluated by the LSO and hazard analysis completed;
- **shall** require an approved written standard operating, maintenance, and service procedures (unless under 15 mW);
- **shall not** be operated without a protective housing, unless evaluated by the LSO and a hazard analysis is completed;
- **shall** not be decommissioned or sold without notification to the LSO

- **shall** have laser eyewear protection indicated by the manufacturer to have sufficient optical density (OD) for the given wavelength of the laser hazard. This eyewear shall be inspected once per year. Training and use of the eyewear must be strictly adhered to by all users whom can be exposed above the MPE;
- **shall** supervise and control master key switches to prevent unauthorized use. Master switch **shall** be removed from the device while not in use.
- Open beam path **shall** include controls to prevent unintentional reflection, such as procedure for preventing intra-beam viewing/reflections.

6.3.6. Collecting Optics

All collecting optics (lenses, microscopes, etc.) integrated into, or operated with a laser system shall integrate appropriate controls, such as interlocks, filters, or attenuators to maintain transmitted radiation below the MPE. Defeatable control measures on collecting optics must be explicitly labelled and the appropriate use included in site specific training.

6.4. Medical Surveillance

The primary reason for requiring a medical examination in a laser safety program is to ensure that an injury is diagnosed and treated, and laser safety issues are identified and remedied to preclude subsequent occurrences.

6.4.1. Examination following a suspected or actual laser-induced eye injury:

When a suspected injury or adverse biological effect from a laser exposure occurs, the exposed individual(s) shall receive a medical examination as soon as possible, usually within 48 hours. For optical injuries within the retinal hazard region, examinations shall be performed by an ophthalmologist.

Any suspected or actual laser-induced skin injury should receive medical care as required and the incident reported.

6.4.2. Baseline eye examinations

Any person who may be exposed to laser radiation above the MPE is recommended to have a baseline eye examination. This exam is for diagnostic purposes in case of incident/injury, as well as identifying users that might be at special risk of an accidental injury. Certain medical conditions or photosensitizing medications may cause increased risk for chronic exposure. Visual or colour acuity/discrimination is also relevant, as a user may not be able to recognize a laser hazard or exposure of a discriminated wavelength. These conditions must be incorporated into the hazard assessment and control measures.

6.5. Laser Inventory

The LSO shall keep records of the inventory and location of all Class 3B and 4 lasers, as well as Class 1 laser devices with embedded Class 3B and 4 Lasers if access to higher emission levels are possible during maintenance or service.

6.6. Program Reporting/Auditing

The LSO shall produce a laser safety report for PACRS annually to assess and determine the extent of compliance with and completeness and effectiveness of the laser safety program.

PACRS may determine the contents of the laser safety report.

6.7. Incidents

An incident is an event that results in or may result in the failure of laser system controls, injury or exposure to persons, or damage to property. Suspected or real intra-beam exposure to laser radiation, or diffuse exposure above the MPE, non-beam hazard incidents (fire, burning a beam-block, protective eyewear), the loss, theft or unauthorized use of a laser or laser systems are examples of incidents. All accidents or incidents involving lasers must be reported promptly to the Laser Safety Officer. The incident will be investigated by the LSO to find the root cause and evaluate current controls. The LSO may suspend use of lasers involved in incidents until the investigation is complete. Incidents and the results of the impending investigation into causes and controls shall be reported in the laser safety report to PACRS for the purposes of identifying and remedying any deficiencies in the compliance or completeness of the laser safety program.

In some instances, the LSO may be required to immediately report the incident to the Saskatchewan Ministry of Labour Relations and Workplace Safety (Radiation Safety Unit).

6.7.1. Incident Reporting Procedure

1. All incidents involving lasers or laser systems must be reported to the LSO, or in their absence Health and Safety.
2. The LSO, or in their absence a knowledgeable party designated by the PACRS Chair, will investigate all incidents involving lasers or laser systems.
3. The LSO will produce a written investigation report which will be forwarded to PACRS.

6.8. Emergency Response

It is the responsibility of all principal investigators to develop Emergency Procedures for responding to emergencies involving laser or laser system exposure for each of their labs. It is also their responsibility to ensure that all persons working in those labs are familiar with these procedures and know what to do in case of emergency.

Emergency procedures should include (but are not limited to):

- laboratory specific procedures based on the present hazards;
- how to safely de-energize or use emergency stop to deactivate a laser or reduce emissions below MPE, or use other applicable interlocks;
- how to safely contain, mitigate, or evacuate during an incident involving non-beam hazards;
- relevant information for a post exposure medical examination, beyond acute symptoms, such as exposure wavelength and emission characteristics/context (difference between an intra-beam strike, specular or diffuse reflection exposure, exposure duration);
- for optical injuries within the retinal hazard region, examinations shall be performed by an ophthalmologist.

6.8.1. Emergency Contact Information

24 Hour Emergency (Fire, Police, Medical):	911
24 Hour Saskatchewan HealthLine:	811
Campus Security:	306-585-4999

Laser Safety Officer (LSO):	306-337-3184/ 306-421-6846
Health and Safety, Human Resources:	306-337-2370 /306-585-4776
PACRS Chair:	Contact Campus Security for contact #
Hazardous Material Response Team:	306-585-4999

6.8.2. Medical Emergency

1. Phone 911 – Direct them to the scene of the occurrence.
2. Call Campus Security: 306-585-4999
3. Give First Aid, if you are qualified to do so, or get help from Campus Security.
4. Stay with victim.

Laser Standard Operating Procedure Example

Title: _____

Location: _____

Procedure Approval

Principal Investigator (PI) Name	Signature	Date
Laser Safety Officer (LSO) Name	Signature	Date

I. Purpose

This Standard Operating Procedure (SOP) outlines requirements to be considered by an authorized user for the work outlined below.

Nature of Laser Work: (Brief explanation of activity)

II. Personnel

A. Authorized User – The laser equipment may be operated only by authorized users who are fully cognizant of all safety issues involved in the operation of this equipment. These personnel are to ensure that the laser is only operated in the manner consistent with this document. To become an authorized user, one must:

1. Complete Laser Safety Awareness Training.
2. Read and fully understand the SOP.
3. Receive on-the-job training for this system and demonstrate competency in using the laser.
4. Sign the authorized user sheet to affirm that the above steps have been completed.

   Steps 1-4 only apply to individuals who have a potential for laser radiation exposure.

B. Unauthorized Personnel – Visitors or other staff who do not have any potential for laser exposure and do not manipulate the laser system may not enter during laser operation unless accompanied by an authorized user. All visitors must be briefed on proper safety protocol and must wear laser safety goggles located on the premises.

III. Hazards

The work in this area presents many personnel hazards. Indicate which hazards are present:

Biohazard	
Radiation	
Chemical	
Electrical	
Compressed Gases	
Cryogens	
Electrical	
Hazardous Materials	
Laser (Class 3B or IV)	
Other:	

IV. Hazard Controls

Indicate control measures for hazards indicated above.

A. Lasers – General Laser Safety Guidance

1. Only authorized users will operate lasers.
2. The laboratory doors will be closed, and a sign posted when the laser is operated.
3. During alignment, the laboratory doors will be closed, and a sign posted stating "Laser alignment in progress. Do not enter. Eye protection required.".
4. Unauthorized personnel will be only allowed entry to the laboratory during laser operation with the supervision of an authorized user under the terms specified in section II.B.
5. Laser protective eyewear for sufficient protection against accessible wavelengths are available. Laser protective eyewear must always be worn when the laser is in operation.
6. Specular and diffuse reflections will be controlled using apertures, beam housings and enclosures, and optics. All of these control methods must be in place during normal operation.
7. Laser alignment must be performed only by following the steps outlined in the alignment procedure supplement or alignment section.
8. Perform physical surveys to determine if there are stray beams, specular or diffuse, emanating from each laser and its optics and block such reflections as well communicate the findings to others in the lab.
9. If the beam path must be changed significantly by relocating the laser or optics,

all users must be notified of the change, as well as when the laser beam can exit the laser.

10. The same precautions that are taken for safe operation of the laser must also be followed when adjusting any of the optics in use with the apparatus.
11. Remove jewelry and reflective objects from yourself (ID badges, access cards).
12. Communicate your intentions to others always present, for example, before opening and closing shutters, removing beam blocks, or actions that might put others unintentionally at risk.
13. Use low power beams for alignment, when possible.
14. Consider the use of remote viewing methods.
15. All optics are to be securely fastened to the table.

B. Laser Specific Controls – Document any set-up of controls.
   1. Master key switch – to be removed when not in use.
   2. Beam curtain.
   3. Collecting optic filter must be in place when viewing through lens.
   4. Laser eyewear must be worn when laser is energized.
   5. Signage to be posted when beam is energized to communicate active laser.

C. Laser Alignment – Techniques for laser alignment listed below will be used to help prevent accidents during alignment of any laser system.
   1. Perform alignments with a colleague.
   2. Review alignment procedures.
   3. Identify equipment and materials necessary to perform alignment.
   4. Remove all unnecessary equipment, tools, and combustible materials to minimize the possibility of stray reflections and non-beam accidents.
   5. Persons conducting the alignment must be authorized by the principal investigator (PI).
   6. Use of non-reflective tools should be considered.
   7. Access to the room or area is limited to authorized personnel only.
   8. System specific alignment procedures (list).

D. Non-Beam Hazards, Electrical – List hazard controls
   1. Enclosures for protection against the high voltages of the laser power supply or laser head may only be removed after the power supply has been unplugged from the outlets and after following the safety procedures outlined in the safety and operations manual provided by the manufacturer.
   2. Only qualified personnel may perform all internal maintenance to the laser. More than one user must be present when performing said maintenance.
   3. Every portion of the electrical system, including the printed circuit cards, should be assumed to be at dangerous voltage levels.

E. Chemical – List hazard controls. Verify the SDS for each chemical is available.

F. Other – List hazard controls

IV. Emergency Procedures

Authorized laser users will be familiar with the location of emergency equipment and exits, and emergency procedures for fires, natural disasters, and evacuations. Emergency shut-off for lasers is located (user to fill in).

A. Suspected Laser Injury – Accidental laser beam exposure is a serious incident. In the case of suspected laser injury, operations must cease, master keys shall be removed, and the set-up shall remain unchanged to allow for analysis of the cause of the accident.

1. Those subject to a suspected or real laser eye injury should seek a medical evaluation within 24 hours.
2. Notify any staff in the area, as well as the PI, who must inform the Laser Safety Officer. The incident must be reported to Health, Safety within 24 hours.

B. Ensure that the laser system is shut off.

C. Provide for the safety of the personnel, such as first aid and evacuations, as needed.

1. In case of emergency call 911.
2. Then call Campus Security at 306-585-4999.

Authorized Users

I have read and understand the standard operating procedures & completed on-the-job training consistent with my activities.

Name (print)	Signature	Date	PI Initial

Site Specific Training Procedure and Documentation Example Form

Scope

This procedure applies to all laser users.

Competency Requirement

All laser users are required to take a basic laser safety course(s). While this course is important to the general understanding of hazards, it is site-specific training that will prevent most laboratory injuries.

For example, laser alignment and beam manipulation has proven to be the activity related to most laser accidents in the research setting. It presents the greatest opportunity for unplanned and unintentional reflections onto the eye or skin. In recognition of this, only individuals with the skills and system hazard awareness can perform “beam on” laser manipulation and alignment work.

The individuals listed on a completed Site Specific Training Procedure and Documentation Form, or equivalent, have demonstrated core laser safety skills for their work site. Equivalent forms must include trainer and trainee names and signatures.

Training Agenda Topics

Instruct trainee on the work process and safety steps.

Demonstrate hands-on skills to trainee.

Trainee performs the activity to demonstrate competency.

Trainee provides feedback.

Topics

- Blocking stray reflections
- Communication with others
- Selection of proper safety eyewear
- Demonstrating beam detection methods
- Checking condition of eyewear
- Thoroughly checking for stray reflections
- Familiarization with equipment safety features
- Understanding controls for different intensity levels
- Alerting others prior to turning on laser and of open beams
- Reading SOP and becoming familiar with required engineering, administrative, and procedural controls

Site Specific Training Documentation Form

Site Specific Trainee Information				
Name	ID #	Work Location Building/Room(s)	Signature	Date

Site Specific Trainer Information

By signing below, the Site Specific Trainer affirms that the trainees listed in the "Site Specific Trainee Information" table have successfully completed the requirements of this course and are competent to perform laser work.

Trainer Name (printed) Trainer Signature Date

Laser Registration Form

Forward completed copy to LSO

Laser Information:

Departmental Contact Person _____

Telephone Number _____

Email _____

Faculty _____

Department/Unit _____

Location of Laser (Building and Room #) _____

Manufacturer and Model _____

Serial Number _____

Hazard Class (IIIB or IV) _____

Type (lasing media) _____

Wavelength(s) (nm) _____

Single pulse, multi-pulse, or CW _____

Output Power (W) _____

For pulse lasers: _____

Pulse Energy _____

Pulse Length/Period _____

Repetition Rate _____

Safety Related Information:

Open beam, partially open beam, or enclosed beam?	
Describe laser application.	
Does the laser require regularly scheduled maintenance or alignment? If yes, describe.	
Is the manufacturer's operating procedure available?	
Is the manufacturer's laser datasheet available?	