
Laser Safety Policy

UNC Greensboro

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Table of Contents

1.	Policy	1
2.	Laser Classification	1
3.	Roles & Responsibilities.....	2
	Authorized Laser User	2
	Laser Operator.....	2
	Service Personnel.....	2
	Laser Safety Officer (LSO).....	2
4.	Training	3
5.	Requirements for Class 3B and Class 4 Lasers.....	3
	5.1 Registration & Inventory	4
	5.2 Hazard Assessment.....	4
	5.3 Laser Operation.....	4
	Written Procedures.....	4
	Beam Alignment.....	4
	Best Practices	5
	5.4 Beam Control	5
	Key Control	5
	Emergency Stop Switch	5
	5.5 Laser Facilities	5
	Entryway Controls.....	5
	Signs & Labeling.....	6
	Facility Protective Equipment.....	7
	5.6 Personal Protective Equipment (PPE)	7
6.	Accidental Exposure	7
	Appendix A: Laser Registration Form	8

1. Policy

All use of lasers at UNCG must comply with the American National Standards Institute (ANSI) Z163.1 “The Safe Use of Lasers”. All Class 3B and Class 4 lasers and laser systems, certain Class 3R lasers, and Class 1 laser systems that have higher power embedded lasers that will be serviced in place must comply with the UNCG Laser Safety Policy. To ensure safe and compliant operation, any acquisition or fabrication of a laser **must be reported to the Laser Safety Officer (LSO)** in the Environmental Health & Safety Department.

All lasers, laser systems and laser products purchased, transferred, donated, loaned or leased for use at UNCG must comply with the requirements of the Federal Laser Product Performance Standard (FLPPS), 21 CFR Subchapter J, Parts 1040.10 and 1040.11 as well as the reporting and labeling requirements with respect to certification of laser products. Such devices must have an easily visible certification label that states that the product complies with the FLPPS.

The UNCG Laser Safety Program is designed to prevent accidental exposures of laboratory personnel, staff, students, visitors, and emergency responders to hazardous levels of laser radiation. Additionally, the program is designed to avoid harm from collateral hazards, such as electrical shock, fire, and chemical exposures from the use or chemicals or vaporized targets.

2. Laser Classification

Lasers are classified according to increasing output power and energy, which correspond with increasing risk of injury if accidentally exposed to the beam or, in some cases, scattered laser radiation. There are two classification systems in use, as shown in Table 1. The U.S. Food and Drug Administration (FDA) classification system is applied to laser products introduced into commerce in the U.S. The FDA also allows laser product manufacturers to use the classification system published by the International Electrotechnical Commission (IEC). In general, the IEC classification system has been adopted by the Accredited Standard Committee Z136, which writes the U.S. consensus standards on laser safety.

Class 1

Considered safe under all conditions and exempt from most control measures. Example: some laser printers.

Class 2

Considered safe due to the blink reflex limiting eye exposure < 0.25 seconds. Can be hazardous if the blink reflex is intentionally suppressed or if viewed through optical magnifiers (microscopes or telescopes). Example: Laser pointers.

Class 3R

Power levels of 1 to 5 mW, which can exceed the maximum permissible exposure (MPE), but with a low risk of injury if viewed only momentarily with the unaided eye. Severe injury can occur if viewed with magnifying instruments. Example: He-Ne lasers, some solid state laser pointers.

Class 3B

Will cause severe eye damage if viewed directly or by specular reflection. Example: Continuous lasers with power levels limited to 500 mW for any exposure of 0.25 seconds or longer; pulsed visible lasers not emitting more than 30 mJ per pulse; pulsed IR or UV lasers not emitting more than 125 mJ during any period less than 0.25 seconds.

Class 4

Will cause severe eye damage from direct or specular exposure and possibly from diffuse reflections off paper or other matte finishes. Can also start fires and cause skin damage. Example: Lasers exceeding 3b limits.

3. Roles & Responsibilities

Authorized Laser User - An individual responsible for the acquisition, use, and maintenance of a laser at UNCG. Responsibilities include:

- Notify the LSO prior to acquisition, fabrication, or transfer of a laser/laser system, using the Laser Registration Form in Appendix A;
- Develop written procedures for class 3b and 4 lasers and ensure implementation of procedures and safety controls by all operators;
- Limit operational access to Class 3B or 4 lasers to trained operators;
- Maintain a list of operators and training documentation;
- Immediately notify the EH&S Department of any laser accidents or suspected injuries.

Laser Operator – Any individual that uses a Class 3B or 4 laser must be trained on the specific laser/laser system prior to use and adhere to all relevant policies and procedures.

Service Personnel - Service personnel must provide documentation that they are authorized by their company to service a Class 3B or 4 laser or laser system or a Class 1 laser system with an embedded Class 3B or Class 4 laser that will be energized during service where, the direct or scattered radiation is accessible. All service personnel must use safe work practices and comply with specific provisions of UNCG with respect to contractor safety requirements.

Laser Safety Officer (LSO) – The LSO is a member of the Environmental Health & Safety Department, responsible for the administration of the UNCG laser safety program. The LSO responsibilities include:

- Maintain records of all Class 3b and 4 lasers;

- Provide assistance in evaluating and controlling hazards;
- Perform periodic reviews of laser use;
- Provide guidance on appropriate protective eyewear;
- Conduct annual review of the Laser Safety Program.

4. Training

Training is required for all users of Class 3B and Class 4 lasers or laser systems. The Authorized Laser User is responsible for ensuring that training is provided to all laser users who have potential exposure to laser radiation. Training must be completed prior to laser use activities presenting potential for laser radiation exposure. Laser safety training information shall be reviewed annually thereafter. Laser safety training may be task-specific, as follows:

General Laser Safety Training – Must address: the potential beam exposure hazards; non-beam hazards; the general and specific measures necessary to control the hazards; and how to respond to suspected injuries or incidents.

- Laser and laser system classifications
- Type and class of laser(s) present
- Bioeffects of laser radiation on the eye and skin
- Significance of specular and diffuse reflections
- Personal protective equipment (appropriate Optical Density of protective eyewear)
- Non-Beam Hazards (Electrical, Fire, Chemical)
- Methods to limit laser radiation exposure and non-beam hazards
- Reporting suspected exposures to eyes or skin
- Emergency and incident response procedures

Operator Training - Laser operators must receive training on the contents and location of the written operating procedures for each Class 3B or 4 laser or laser system they will operate.

- Responsibilities of management and workers
- Fundamentals of Laser Operation
- Location and contents of written operating procedures

5. Requirements for Class 3B and Class 4 Lasers

The requirements to operate Class 3B and Class 4 lasers include laser registration, user training, hazard assessment inventory, establishment of suitable entryway controls, signage, written standard procedures, written alignment procedures, and the use of suitable facility personal protective equipment.

5.1 Registration & Inventory

The Laser Registration Form in Appendix A should be used for initial reporting of new lasers to the LSO. The Authorized Laser User must maintain a list of all Class 3B and Class 4 lasers. Changes to the laser inventory must be communicated to the LSO when a laser or laser system is received, stored, transferred, sold, donated, discarded, or moved to another or room.

5.2 Hazard Assessment

A hazard assessment shall be performed for all new installations or modifications of Class 3 or Class 4 lasers, including relocation of existing laser systems. The hazard assessment shall consider: laser properties (power, wavelength, divergence, etc.); objects in the beam path (optics, targets, etc.); existing controls and enclosures; application and use procedures. Results of the hazard assessment shall include; the maximum permissible skin and eye exposure (MPE); Nominal Hazard Zone (NHZ); Optical Density (OD) of required Laser Protective Eyewear; Non-beam hazards (electrical, fire, chemical, etc.).

5.3 Laser Operation

Written Procedures

Written standard operating procedures (SOP) and alignment procedures are required for the use of Class 3B and Class 4 lasers and laser systems. The SOP must include information on the operation, maintenance and service of the laser or laser system and how these activities may result in the potential for overexposure, as well as the potential hazards of overexposure and specific control measures in use to control exposures.

The alignment procedure may be incorporated into the SOP. Alternately, if the alignment task is described in sufficient detail in the user's manual, this may satisfy the requirement for a written alignment procedure. The alignment procedure must include information on the necessary LEP and the use of devices used for indirect viewing (e.g., scopes, cards or films used to view the location of the beam).

Non-beam hazards (fire, electrical, chemical) must also be addressed in written procedures for each laser area.

Beam Alignment

Beam alignment is the most hazardous task performed with lasers, beam alignment activities must be performed by individuals who have the highest level of knowledge about the system and who understand and apply safe work practices and utilize indirect viewing devices that will minimize the potential for overexposure.

Best Practices

General Use

- Never look directly into any laser beam or place your eyes near the beam path, even if wearing protective eyewear.
- Never aim a laser at a person or reflective surface.
- Keep beam paths below or above standing or sitting eye level.
- Enclose beam paths to the greatest degree possible.
- Eliminate all reflective material from vicinity of beam path.

Alignment

- Review alignment procedures prior to beginning the alignment process.
- Wear protective eyewear at all times during alignment procedure.
- Use a low power visible lasers if possible.
- Remove or cover any reflective objects from the area, including watches and jewelry.
- Ensure that curtains are securely closed with no gaps.
- Use beam blocks behind targets if the beam might miss the target during alignment procedures.
- Check for stray reflections before proceeding to the next step of the alignment process.
- Make sure all beams and reflections are terminated before high-power operations begin.

5.4 Beam Control

Key Control

Class 3B and Class 4 lasers should require a key or coded access (such as a computer code) to activate the laser or laser system.

Emergency Stop Switch

For emergency conditions, there shall be a clearly marked “Emergency Stop” switch or other appropriately marked device to deactivate the laser or reduce the output to levels below the applicable MPE.

5.5 Laser Facilities

Entryway Controls

Entryway controls suitable to Class 3B and Class 4 lasers include insuring that laser beams are not directed towards doors and utilizing entryway solid doors. Entryway controls required for

Class 4 lasers include the use of safety interlock switches at the entryway. The interlock switches may be defeatable or non-defeatable. If defeatable interlock switches are used, the bypass mechanism must insure that unauthorized individuals cannot enter into a potentially hazardous exposure condition. This could be insured by the use of a key switch, cipher lock, or badge-reader access. The entryway may also be configured without safety interlock switches. If this method is used, then the entry must include a light lock so that individuals are not at risk of exposure when entering or exiting the laser-use area. The entryway must have a visible indication that the laser is energized, such as a red light bulb or a lighted warning sign.

All Class 4 area or entryway safety controls shall be designed to allow both rapid egress by laser personnel at all times and admittance to the laser controlled area under emergency conditions.

Signs & Labeling

An appropriate sign must be displayed at the entrance to each Laser Controlled Area, an area where it is possible for exposure to occur to Class 3 or Class 4 levels of laser radiation. Laser Controlled Area entryway signs shall contain the following information, per ANSI Z136.1:

- Safety Alert Symbol (Exclamation Point)
- Laser Hazard Safety Symbol
- Signal Word
 - Class 3R: “Caution”
 - Class 3B – Class 4: “Warning”
 - High Power (>1 kWatt) Class 4: “Danger”
- Highest Class of Laser Present
- Applicable precautionary statements
 - “Restricted Area, Authorized Personnel Only”
 - “Do Not Enter When Light is Illuminated”
 - “Laser Eye Protection Required”
 - The Optical Density of Laser Eye Protection to be worn within the area
- The name and contact information for the LSO

All laser equipment shall have appropriate warning labels, per ANSI Z136.1, affixed to a conspicuous place on the laser housing or control panel. Such labels should be placed in both locations if the housing and control panel are separated by more than 2 meters. Equipment labels shall include:

- The Class of the laser or laser system;
- The emitted Wavelength, Pulse Duration (if appropriate), and Maximum Output Power;
- An appropriate precautionary statement based on the laser Class;
 - For Class 2 lasers, “Laser Radiation – Do Not Stare into Beam”
 - For Class 2M lasers, “Laser Radiation – Do not Stare into Beam or View Directly with Optical Instruments”

- For Class 3R and Class 3B lasers, “Laser Radiation – Avoid Direct Eye Exposure to Beam”
- For Class 4 lasers, “Laser Radiation – Avoid Eye Exposure to Direct or Scattered Radiation; Avoid Skin Exposure to Direct Radiation”

Facility Protective Equipment

This includes window covers, barrier curtains, matte-black foil, light baffles, beam dumps, and similar devices. The user must insure that the protective equipment is suitable for the power or energy of the beam. This means that the most likely exposure scenario of the material will not result in fire or the release of potentially hazardous airborne chemical agents. Also, the user must insure that a reasonably-foreseeable, single-fault failure of the protective equipment will not result in an overexposure.

5.6 Personal Protective Equipment (PPE)

Laser eye protection (LEP) must be used with Class 3B and Class 4 lasers and laser systems. The Authorized User must ensure that a hazard evaluation has been performed, including the determination of the exposure limit and the necessary optical density (OD) of protective eyewear. The LEP must be marked with the OD at the wavelength or wavelengths that the laser emits.

Specific PPE for direct exposure of the skin to laser radiation is not available. Hence, engineering controls and work practices are the primary measures of controlling the potential for overexposure of the skin. Where there is the potential for exposure to scattered ultraviolet radiation, the user must cover the skin to minimize the potential for exposure if engineering controls are impractical or inadequate. This includes the use of long sleeves with fabrics that are tightly woven or are known to have excellent UV protective characteristics (e.g., UV protection factors > 50).

6. Accidental Exposure

Individuals with known or perceived accidental exposure to Class 3B or Class 4 levels of laser radiation must immediately seek medical assistance. Students, faculty and staff shall report to the Gove Student Health Center for evaluation and treatment.

For **Emergency Medical Services** or **Fire Department**, call **UNCG Police** at **336-334-4444**.

All laser incidents and suspected exposures must be reported to the LSO/EH&S Department as soon as feasible, at 336-334-4357.

Appendix A: Laser Registration Form

Laser Registration Form

UNC Greensboro

CONTACT INFORMATION

Responsible Individual:

e-mail:

Department:

Phone:

LASER DATA

Description of each laser, including make/model/serial#/self-constructed, laser medium, laser classification, maximum power output, wavelength, mode of operation (pulsed, CW, repetitively pulsed, etc.), aperture diameter, and beam characteristics (divergence, pulse length, repetition rate, as applicable):

Purpose/application of beam(s):

Safety Precautions (interlocks, enclosures, eyewear, etc.):

Submit completed form to Eric Zack (e_zack@uncg.edu), EH&S Department.